

Environment and Integrated Pest Management Seminar



January 11-14, 1993

Chamcar Daung Agricultural Institute,
Phnom Penh, Cambodia

with the Ministry of Agriculture, Food and Agriculture Organization,
International Development Research Center, International Rice Research Institute

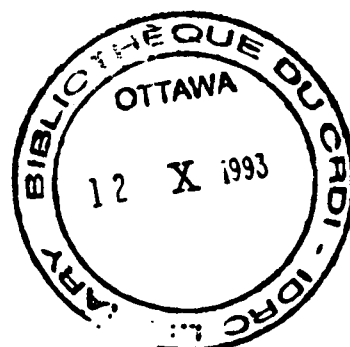
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This volume reflects opinions given during the seminar but not "officially" those of the organisations.

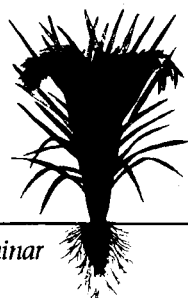
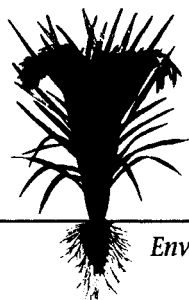


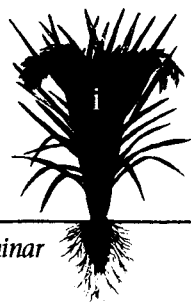
Table of Contents

List of Acronyms	i
Foreword	ii
Opening Speech by the Minister of Agriculture	iii
Introduction	1
Structure of the Seminar	1
Presentation of Papers	3
Cambodia and the Environment	3
Integrated Pest Management and the Environment	4
Workshop on Environment and Integrated Pest Management	9
Objectives of the Workshop	9
Results of the Workshop	9
Closing Remarks by Vice-Minister of Agriculture	13
Map	14
Annex	15
Membership of National Environment Committee	15
List of Seminar Participants	16
Seminar Agenda	17



List of Acronyms

ACR	Australian Catholic Relief
AIDAB	Australian International Development Assistance Bureau
AWB	Asian Wetland Bureau
CWS	Church World Service
FAO	Food and Agriculture Organization
IDRC	International Development Research Centre
IIBC	International Institute for Biological Control
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
JVC	Japan International Volunteer Centre
PADEK	Partnership for Development in Kampuchea
UNDP	United Nations Development Programme
WVI	World Vision International



Foreword

The UN Conference on Environment and Development (UNCED) at Rio de Janeiro refocused the attention of national governments both North and South, and of donor agencies, on the difficult choices which must be made if economic development is to be sustainable, and on the human and financial resources which must be made available if those choices are to be made wisely and appropriate programs put into effect.

As Cambodia rejoins the international community and the international market place, it is faced with intense pressure to generate revenue from the rapid exploitation of its natural resources and from the establishment of industry. Yet it is clear that if the aspirations of this and future generations for a reasonable material standard of living are to be met, then economic development planning and programs must include management of environmental values.

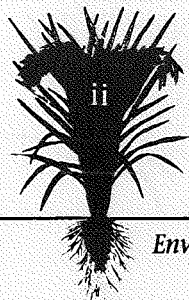
The seminar reported in this volume contributes to the dialogue on environment and sustainable development among Cambodian officials and the international community, through bilateral, multilateral and NGO representatives. This dialogue has already resulted in the initiation by the Ministry of Agriculture (with assistance from IDRC, IRRI/AIDAB, and FAO) of research and policy formulation work in the area of Integrated Pest Management, designed to apply experience from elsewhere to the Cambodian agricultural environment. Other major work on environmental issues will begin soon, supported by UNDP and other donors.

Peace in Cambodia will make development possible. If the possibility of an equitable and sustainable pattern of development is to be realized, then research, policy formulation, and planning must begin now. We welcome the opportunity to join with Cambodian and other international institutions in undertaking and supporting this vital effort.

*Peter Kenmore, Regional Coordinator
FAO Integrated Pest Management Programme*

*Andrew McNaughton, Sr. Regional Program Officer
Environment and Natural Resources Management
International Development Research Centre*

*Harry Nesbitt, Agronomist/Project Manager
Cambodia-IRRI Rice Project*



Opening Speech

Mr. Chairman
Distinguished Colleagues
Members of the International Community
Ladies and Gentlemen

It is with great pleasure that I welcome you to Chamcar Daung College. I would like to thank you most sincerely for taking part in this seminar on the "Environment and Integrated Pest Management".

The purpose of this seminar is deliberate and determines, to the extent possible, policies that promote agricultural development that at the same time ensure the sustainable management of our natural resources and protect our environment. We now recognize that economic development is linked to the point of being dependent on the environment; if we fail to maintain a high quality of the environment we will compromise our efforts to develop economically.

Cambodia is a developing country that is quite distinct from other countries in the region. Emerging from exceptional circumstances well over a decade ago, the people of Cambodia have made enormous efforts to rebuild the national economy, based largely on agriculture. At present, the living conditions for many people are still difficult and food security is not assured. This precarious situation is being further threatened by a high rate of population growth of 2.8% per year. It is inescapable, therefore, that we increase our agricultural output and productivity to meet the growing demand. This will mean developing a rational approach in using agricultural inputs such as fertilizers and pesticides.

But we must take heed of the experiences of other countries who have suffered a rapid degradation of their environment in their push for economic development. We must also be mindful of the fact that it is the local communities who are the users and managers of the natural resources, and ultimately it is they who have the greatest stake in wise stewardship of these resources.

Aware that new institutional mechanisms are required to integrate different approaches into policy development, the government established in 1992 an inter-ministerial National Environment Committee.

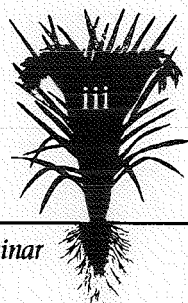
Represented at this seminar are members of the National Environment Committee, officials of the Ministry of Agriculture from all provinces, bilateral and multilateral agencies, and non-governmental organizations. I see this seminar as a starting point to an ongoing dialogue on environmental issues. I also look forward to the continuing cooperation between the Government of Cambodia and your organizations to assist us in protecting our environment.

I would like to express my gratitude to IDRC, IRRI, AIDAB and FAO for their generous contributions towards the staging of this seminar.

I also thank those who will be presenting papers over the next few days, and to the all participants. It will be your collective contribution that will allow us to manage complicated environmental issues that are of concern to us all. And I would like to reiterate the willingness of this government to work with the various organizations to assure the quality of the Cambodian environment.

I now declare that this seminar on the "Environment and Integrated Pest Management" officially open and I wish you the greatest success in your deliberations.

—Mr. Nguon Nhel, Minister of Agriculture



Introduction

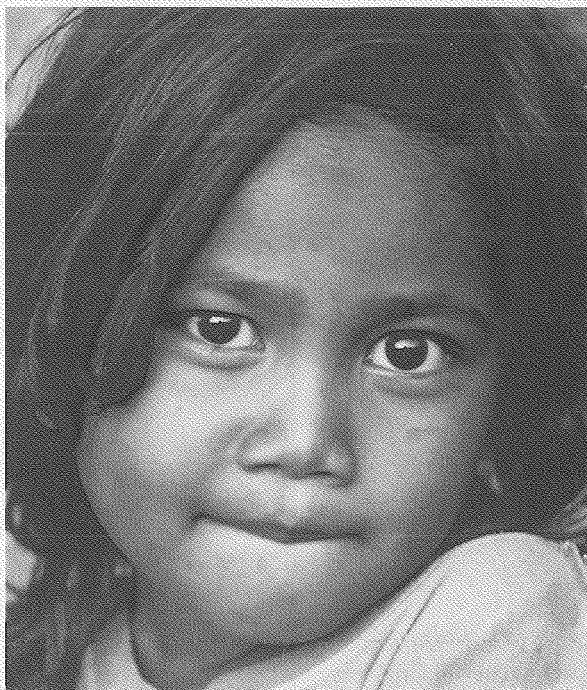
Rationale for a Seminar on IPM & the Environment

A country in a state of political unrest is generally not predisposed to considering environmental issues as one of its priorities. Three months before the United Nations-monitored general elections, Cambodia cannot be said to be at peace with itself and there is still much uncertainty in the future of the country. Yet it is becoming increasingly apparent is that the Cambodia's economic future is very much tied to its natural resource base.

Cambodia's economic development has gained momentum rapidly since the government opened its economy to foreign investment. The presence of UNTAC has further promoted investor confidence. As a result of the increased economic activity there has already been an appreciable deterioration in the quality of the environment. The country does not yet face a major environmental crisis; however, uncontrolled and inappropriate investment, a rapidly growing population, and a mounting demand for natural resources, threaten to have an appreciable environmental impact in the future. In the forest sector, Cambodia's principal source of foreign exchange, the United Nations Transitional Authority in Cambodia (UNTAC) considered the situations serious enough to impose a ban on the export of logs from the country, done in part with an eye on the long term ecological consequences of the deforestation.

The government is eager to take advantage of the lessons learned in other countries in the region and to avoid the excesses that have foreclosed some development options of their neighbours. However, as the National Report to the United Nations Conference on Environment and Development (UNCED) at Rio de Janeiro noted, Cambodia has few financial or human resources to manage even the most basic natural resource management issues. Nevertheless, the government recognizes that it needs to develop appropriate resource management policies.

One event, the announced intention of the government to accept a shipment of pesticides, raised concerns in a number of quarters in the development community and, in the end, brought about the government's decision to hold this seminar. The Ministry of Agriculture wished to explore the issues and the options surrounding the use of pesticides in agricultural production by organizing this seminar and



Caring now for the environment of future generations.

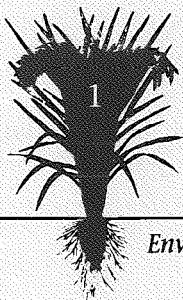
soliciting the advice of those institutions with experience in pesticide use. At the same time, the government decided to put the specific issue of pesticides use within a broader context of environment and natural resource management in Cambodia. In that sense, integrated pest management was seen as contributing to the seminar a concrete illustration of sustainable development, a technique that is as concerned with sustained production as it is with environmental protection. It also served to exemplify the sometimes complex process of environmental management as well as to highlight the fact that difficult choices must be made between available options.

Structure of the Seminar

The seminar was designed to provide information to those who make decisions within the government on the exploitation and management of the country's natural resources. To a large measure, this means two groups of people. The first is the senior policy makers within the ministries represented on the National Environment Committee (see Annex 1 List of Representatives on NEC). The second is senior officials, primarily within the Ministry of Agriculture, who have the mandate for the management and protection of agriculture, fisheries, forestry, wetlands and wildlife.

Representation at the seminar was broad based from within the Ministry of Agriculture (see Annex 2 List of Seminar Participants). Officials of other ministries attended the seminar although it was recognized that future meetings to deliberate environmental policy and strategy would ideally have greater representation from economic, planning and sectoral ministries. While the international development non-governmental organizations were well represented, there are at present no local or national environment or development NGOs in Cambodia.

The seminar was divided into three parts (see Annex 3 Seminar Agenda): a survey of general environmental issues, a more detailed presentation of Integrated Pest Management, and a workshop where the seminar participants split into smaller work groups.



Presentation of Papers

The papers presented at the seminar provided an overview of a number of environmental and resource management issues seen to be important to Cambodia's economic development. In general they were intended to highlight the development experiences of other countries, describing how environmental problems can and do undermine the goals of development, and the conditions under which environmental policies can compliment economic growth. Integrated Pest Management is presented as an illustration of this principle as well as being particularly relevant within the Cambodian context.

Cambodia and the Environment

"Forestry: Policy Options for Development"

—**Mr. Koum Saron, General Manager, KASOTIM, Cambodia**

While the rate of deforestation in South-East Asia is the highest in the world, most of the cutting has occurred only very recently. Various explanations for the rapid deforestation in the region are provided based on case studies of neighbouring countries. Most are related to government policies both in and outside the forest sector, including timber pricing and concession policies, timber processing subsidies, and competing land use and land tenure policies. In Cambodia the deforestation relates more to meeting the growing demand for commercial timber from surrounding countries. The decision by UNTAC to close the bor-

of Cambodia's forest resources; however, the Department of Forestry estimates that from 1965 to the present time, at least one and a half million hectares of dense forest, two million hectares of open forest and 300,000 hectares of flooded forest have been destroyed. There is a critical need to rebuild the forestry institutions.

"Wetland Conservation and Fisheries Management in Cambodia"

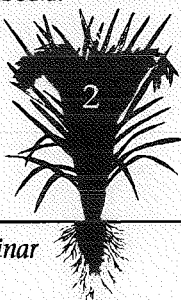
—**Mr. S. Selvanathan, Assistant Director, Asian Wetland Bureau, Malaysia**

Over 30 percent of Cambodia is considered wetland, which represents five percent of the total wetland area in Asia. The wetlands are of critical importance to economic life of Cambodia, being the basis of its agricultural and fisheries' systems. The wetlands are also a mechanism for flood control, coastal protection and water supply as well as providing economic value from its plant resources. In addition, the value of the wetlands to nature conservation in the region is enormous; a recent survey concluded the vast swamp forests and natural flood plain grasslands of the Tonle Sap Basin now constitute not only some of the most extensive examples of these habitat types in Southeast Asia but probably the finest examples on the entire Asian mainland. Other studies have shown that Cambodian wetlands are moderately to severely threatened by reclamation for development, construction of dams and barrages, conversion to aquaculture ponds, diversion of water supplies, degradation of watersheds,



Wetlands are of critical importance to the life of Cambodia.

ders would provide a short reprieve during which time the government should develop more sustainable policies and forest management systems. Due to the lack of data collection, it is difficult to reliably estimate the extent



pollution, wood cutting, hunting and flood control measures. Constraints to sustainable wetland management include lack of up-to-date information, shortage of institutional capacity, and inadequate legislation.



Preserving the Angkor archaeological site in its natural surroundings offers a unique challenge for Cambodians.

"Biodiversity: Its Importance and Conservation"

— **Dr. Bov Bang Eav, Professor of Forestry, University of Colorado, USA**

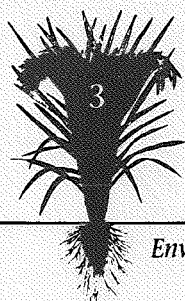
The economic and social value of maintaining the existing array of biodiversity is not adequately taken into account in development planning. The economic arguments for biodiversity range from the value of timber harvesting, to the many species of rice and fish on which the Cambodian diet is based, to the multitude of traditional medicines available, to the potential for nature tourism as a major source of foreign exchange. The indirect benefits of the ecological services provided by biodiversity are more difficult to quantify but cleaning the air, modifying climatic extremes, degrading wastes, recycling nutrients, and regulating hydrological functions are of indisputable value as essential life-support systems. The main cause for the continuing and alarming loss of biodiversity is habitat destruction from clearing and burning forests, draining and filling wetlands, destroying coastal areas for development, and converting natural ecosystems for agriculture, industry and human settlement. As with many other environmental problems, the root cause of the problem lies with current economic and social policies. These include the lack of appropriate economic and natural resource accounting, and policies related to population growth, land use, migration, forestry, fisheries, and agriculture that are often poorly conceived and inconsistent with each other. Because the list of actions to be taken to conserve the country's biodiversity is long, priorities must be established by way of a national policy framework for biological con-

servation. On the basis of experience of neighbouring countries, one of the most effective ways of conserving biodiversity is through creating a system of national parks, wild life sanctuaries and other kinds of protected areas that must provide recognizable benefits both to governments and local communities if they are to be sustainably managed.

"Cultural Heritage and Protected Areas Management"

— **Mr. R. Englehardt, Representative, UNESCO, Cambodia**

Using Cambodia's most famous cultural monument, Angkor Wat as an example, it was stressed that there are a number of opportunities exist where policies related to economic development and revenue generation through nature or eco-tourism coincide with the objectives of environmental protection. Cambodia has great potential to create a profitable industry with its cultural and historic sites linked to unique ecological features such as Angkor and the Tonle Sap area, or Preah Vihear and the forest mountains and northwestern part of the country. However, the sustainability of this income from eco-tourism depends directly a maintaining a high environmental quality of the sites and their surroundings. The site of Angkor from the Kulen Mountains down to the shores of the Tonle Sap was inscribed in December, 1992, by the World Heritage Committee on the List of World Heritage in Danger. The Committee also initiated the process of examining the adjacent Tonle Sap wetlands areas for consideration for inscription on the World Heritage List of Natural Sites.



"Financing the Environment" — **Mr. Robert Piper, Programme Officer, UNDP, Cambodia**

The paper examined general approaches to financing environmental protection that need to be incorporated into environmental and resource management policy frameworks. A recurrent theme of the seminar was reinforced by noting the need to formulate and implement appropriate development policies that emphasize avoidance of environmental degradation, given that it is more cost efficient to avoid environmental degradation than to mitigate its effect in the future. Thus environmental cost avoidance should be a key strategy in efficient resource development and conservation. Pay-backs in investments in better resource management skills and better environmental technology can be high.

The private sector can be important in those areas where economic development and environmental protection are complimentary as in nature tourism. Considerable attention was given to the fact that the protection of critical ecosystems is no longer a national concern but a global one. International funding has been established to identify and address global environmental problems. In this regard, two sources of funding were mentioned. The first is the Global Environmental Facility (GEF) which is designed to address international environmental issues in three areas: the reduction of emissions of greenhouse gases, the prevention of pollution into international waters, and the protection and maintenance of biodiversity. The second is a Capacity 21, linked to the agreement adopted at the United Nations Conference on Environment and Development in Rio de Janeiro in June 1992. It is designed primarily to build the national capacity for sustainable development in the areas of policy formulation, institution building and training human resources. Finally, the UNDP will fund in the near future a four-member interdisciplinary environmental advisory team to provide a variety of advisory, training, and environmental information services. It is designed as an emergency measure to provide advice on a range of issues relating to sustainable development and conservation during the transition period.

Integrated Pest Management and the Environment

"IPM: A Policy Perspective" — **Dr. Peter Kenmore, IPM Team Leader, FAO, Philippines**

The experience of farmer training throughout Asia during the last 10 years has shown that pesticides are not necessary in rice to increase yields from one ton/ha to four ton/ha yield levels. In fact, experience has shown that increased insecticide usage results in greater threats from brown planthopper outbreaks. This experience is backed by research through national institutions in South East Asia and IRRI that has shown that pesticides destroy naturally occurring predators, parasites and pathogens that keep pest populations at low densities. This is especially true for organophosphorous and pyrethroid pesticides. Furthermore, data is becoming

available that shows that other rice pests besides brown planthoppers do not cause yield loss at levels found in the field. Leaffolders and stemborers in particular are key insecticide spray targets that, according to yield loss studies, do not cause major yield losses.

However, with the worldwide contraction of the pesticide market, pesticide corporations will be seeking new markets. Cambodia is one such market that is newly opening and is particularly vulnerable. It is likely that some markets in particular will come under increased pressure to reduce pesticides as world free-trade agreements, such as GATT, impede high subsidies that allow very high use of pesticides (e.g., Japan with 2.5% of the world rice production uses 60% of pesticides applied to rice world-wide, largely from national corporations). As these artificially high-use markets change, there will be continuous pressure for importation and use of pesticides on rice. Policies, such as those implemented in Indonesia under Presidential Instruction 3/86, must be in place to protect farmers and national food security from the threat of pesticide misuse.

Pesticides Side Effects

Pest Resistance and Resurgence

- Stimulation of pest reproduction can induce resurgence
- Resistance: between 1967 and 1979 the carbamate resistance of BPH increased 10-fold in Japan

Environmental Pollution

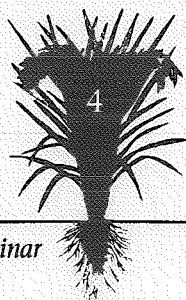
Destruction of non target organisms potential insects, fish, birds and mammals are victims of pesticide poisoning. Two-hundred fifty milliliters of Folidol (parathion Methyl) is theoretically sufficient to kill 8 tons of fish. As Mevinphos it is classified as extremely hazardous (Class Ia).

Health hazards resulted from misuse in 1988. WHO estimated that 25 million occupational pesticides poisonings occur annually worldwide.

Reduced benefits because of the increasing cost of production.

"Long Term Pesticide Exposure: a study of Philippine farmer health" — **Video presentation prepared by Dr. Prabhu Pingali, Ms. Leslie Rose and Dr. Robert Raab, IRRI, Philippines**

Policy makers, research scientists and the general public have often viewed pesticides as an essential input into modern rice production. While anecdotal evidence on the negative effects of pesticides on human health and the environment has existed for several decades, little has been done in terms of systematically quantifying these effects. This video, aimed at policy makers and scientists, presents the results of a unique study in which medical doctors, economists and biological scientists teamed up to assess the impact of prolonged pesticide use on farmer health.



Detailed medical examinations of pesticide users and non-users in the Philippines found that users exhibited symptoms of long-term exposure to hazardous chemicals. Eye, skin, pulmonary neurologic, and renal problems were significantly associated with long-term exposure to pesticides. Many of the chemicals available to the Philippines are banned or highly restricted in the US and Europe. Moreover, these chemicals are handled and applied with minimal safety precautions.

Health impairments are directly related to the types of chemicals applied and the frequency of application. Farmers exposed to pesticides incur higher overall health costs relative to non-users, both in terms of treatment costs and in the opportunity cost of lost time. On average farmers lost forty days of income due to pesticide related health ailments. The value of crop lost to pests tends to be lower than the value of the health impairment caused by pesticides.

To policy makers, this video suggests several technological and policy options for reducing pesticide related health hazards. It challenges the common perception that pesticides are necessary for maintaining high production levels. Technologies, such as Integrated Pest Management, that reduce the need for pesticides are described. Improved regulatory mechanisms, such as banning the more hazardous chemicals, are discussed.

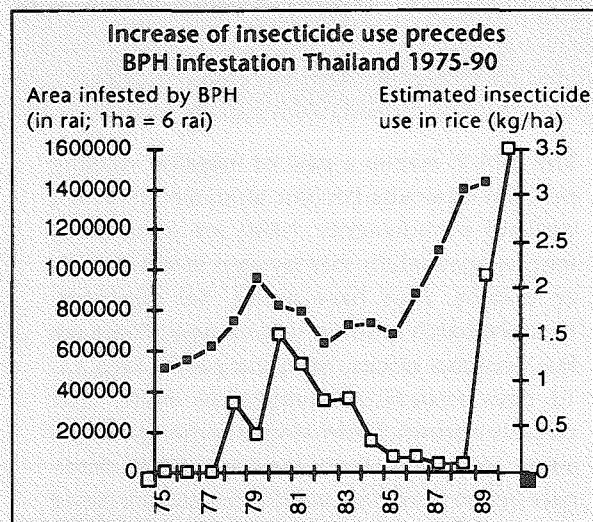
"The Impact of Pesticides on Rice Brown Planthopper"

—Dr. Kazushige Sogawa, Kyushu Nat'l. Agricultural Experiment Station, Japan

The field observations and experiments during the period from 1983 to 1987 in Indonesia, revealed that injudicious and excessive use of broad spectrum organophosphate insecticides in the paddy fields encouraged resurgence of the brown planthopper (BPH) and led to the prevalence of varietal resistance-breaking biotypes, which threatened the newly attained rice self-sufficiency in the country. The BPH resurgence was realized when the highly reproductive potential of the BPH was liberated from the natural regulatory mechanism of the ecosystem. Under intensive treatments of insecticides, natural enemies were virtually eradicated, while the BPH survived in the egg stage, because of no ovicidal action of the insecticides and of their shorter residual period as compared to the egg period. Thus, the explosive recovery of the BPH population was possible from the egg survivors under the reduced pressure of natural enemies. In order to avoid such BPH resurgence crisis that threatens sustainable rice production in the developing countries in tropical Asia, the maximum conservation of natural enemies and minimal reliance to insecticides should be more workable IPM approach. In this connection, it was noted that BPH could be a sensitive barometer of IPM implementation in tropical rice agriculture.

However, differential reliance to insecticides for controlling the insect pests of rice between temperate and tropical paddy ecosystems was pointed out. For example, in Japan where the rice is an exotic crop and the BPH is an overseas migratory pest, the bio-control functions of

indigenous natural enemies are not always sufficient in order to cope with the massive immigrant BPHs, and chemical control measures have often been vital. An insect growth regulator, Bupofezin, which is highly selective to homopterous insect pests and fully compatible to natural enemies has successfully been introduced for controlling the BPH without resurgence and resistance problems posed to the indigenous insect pests. It would be an example of viable IPM options suitable to the temperate paddy ecosystem.

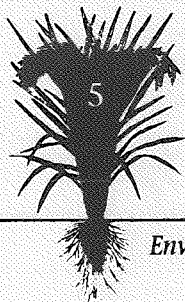


"Pest Management for Sustainable Rice Production"

—Dr. K.L. Heong, Entomologist, IRRI, Philippines

The green revolution, with emphasis on external inputs and intensification, has resulted in dramatic growth of pesticide and fertilizer use in many Third World countries. Besides being primary environmental pollutants, insecticides cause secondary pest problems. In rice, the brown planthopper (BPH) problem is often a direct consequence of insecticide use. This pest species is well adapted to cope with environmental disruptions and insecticide sprays tend to favor its survival.

Farm surveys conducted in the Philippines, Vietnam, Thailand and China have shown that rice farmers apply more insecticides to control early season leafhoppers than any other pest. Farmers tend to overestimate crop losses, partly because the damage symptoms are highly visible. However, actual loss due to these pests is extremely low. Such aversion to risks is deeply entrenched among many farmers and is partly due to the abundance of sale promotion campaigns, the association of pesticide use with modernism, and the promotion of pesticide use by government agencies. By using the farmer participatory research (FPR) approach, many farmers in the Philippines and Vietnam have been persuaded to avoid early season spraying. About 80% of the farmers who avoided early season spraying reported either increased yields or no yield differences. Yields of the remaining 20% were not significantly lower than fields with the spray. Early season spraying, besides being unnecessary, can potentially damage the natural control balance in rice fields. The insecticide often applied at this



stage are methyl parathion and monocrotophos, which are broad spectrum, killing non-target species such as natural enemies and scavenger species, which are food for natural enemies. In addition, these compounds classified by WHO as being highly hazardous, can be dangerous to users without appropriate protective clothing.

Rice Brown Plant Hopper (BPH) (*Nilaparvata lugens*)

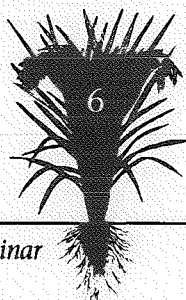
The BPH is mainly a pest of irrigated wetland rice, but it can also become abundant in rainfed wetland environments. Fields are invaded by long-winged adults that lay eggs in leaf sheaths or midribs. Eggs have broad, flat egg caps. Nymphs hatch in seven to nine days. There are five nymphal instars. Nymphal period lasts 13-15 days. First-instar nymphs are white, later stages are brown. Short-winged and long-winged adults are produced. Short-winged adults dominate before flowering, and the females are found among the tillers at the extreme base of the hills. As the crop ages, long-winged forms capable of migrating are produced.

Nymphs and adults suck the plant sap from the base of plants where they stay day and night. The BPH may remove enough sap or block its flow to cause the tillers to dry and turn brown, producing hopperburn during later growth stages, severe infested plants yellow and die. BPH transmit grassy stunt, ragged stunt, and wilted stunt virus diseases.

BPH outbreaks are associated with development of irrigation systems to allow year-round rice cropping, excessive fertilizer usage results in higher planthopper populations, and the use of insecticides that kill natural enemies, but not the BPH eggs.

Biological control of the BPH is possible through the many parasites, predators and pathogens that attack all stages of the BPH and effectively control this pest under most situations.

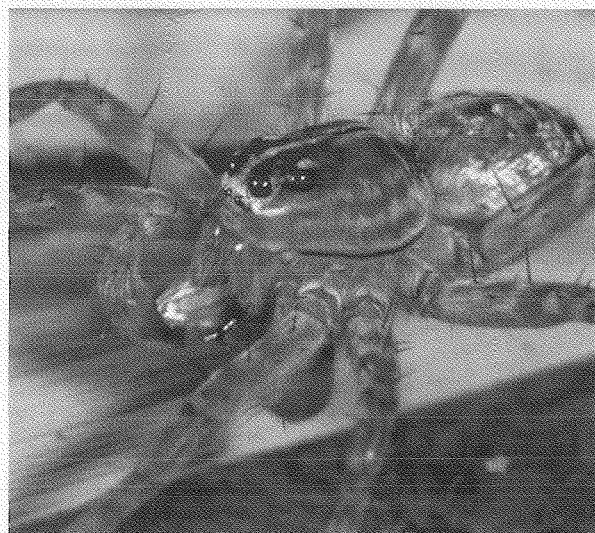
Natural control can be further enhanced by increasing habitat diversity in the rice ecosystem. Habitats associated with rice production often serve as refugia, alternate food sources, and breeding sites for predator species. Appropriate balance in habitat mix can make rice ecosystems more resilient to eliminate disruptions like droughts and floods. Strategies to maximize the natural control and minimize undesirable effects are basic concepts of Integrated Pest Management (IPM) that can make rice production more sustainable.



"Biological Control: Understanding and Conserving Parasites and Predators."

—Dr. Peter Ooi, Entomologist, IIBC, Malaysia

In Malaysia, rice stem borers (*Chilo polychrysus* and *Scirpophaga incertulas*) were considered as serious pests of rice in peninsular Malaysia in the early 1970s. However, field surveys showed that the incidence of bored tillers were relatively low indicating that rice stem borers were not serious pests. A comparative study in Kriam, Perak, showed that the incidence of bored tillers was lower following double cropping. The lower incidence was attributed to the activities of natural enemies to survive. Observations in the Sekinchan, Selangor, where a brown planthopper outbreak was high in areas regularly treated with insecticides. The importance of natural enemies, particularly parasites, in the control of the yellow stem borer has been reported in India as well as the Philippines.



Hunting spider is one of the most important predators.

Another example of effective biological control in the rice ecosystem is reported for the brown planthopper (*Nilaparvata lugens*). Before 1977, this insect was not even considered a major pest of rice. Studies in the Tanjung Karang Irrigation Scheme, Selangor, showed that higher incidence of the brown planthopper was reported in areas where insecticides were commonly used. Detailed studies in insecticide free rice fields showed that predators were important in maintaining low pest population. Two important predators are the hunting spider, *Lycosa pseudoannulata* and the mirid egg predator, *Cyrtorhinus lividipennis*. The impact of predators was also shown to be important in the control of the white-backed planthopper (*Sogatella furcifera*) in Kedah.

Biological control of rice insect pests is easily disrupted by insecticides. Hence, it is important to educate farmers about the benefits of pest predators to minimize risks of causing pest outbreaks through the use of insecticides. Experiences in Indonesia have shown that farmers can be taught the value of parasites and predators in rice ecosystems and hence conserve these beneficial organisms.

IPM Implementation: The Experience of Indonesia

Five years after the Presidential Instruction No. 3/1986 regarding pesticide use and restriction, rice production was the highest in Indonesia's history, up 13% from the 1986 levels, and pesticide use has been decupled from production packages, falling 60% during the same period and saving US \$120 million a year in pesticide subsidies. The program is based on:

- Production of healthy crops through crop management
- Introduction of proper cropping systems
- Use of resistant cultivars against major pests. (IR72 and KRU are two GLH and BPH resistant varieties.)
- Educational Programs (1,000 Pest observers, 2,000 field extension workers and 100,000 farmers were to be trained over three years)
- Conservation of beneficial predators and parasites
- Weekly field observation to determine proper action
- Prohibition of broad-spectrum pesticides and total withdrawal of its subsidies

"A Researcher-Facilitated Farmer's Pest Management Experiment in the Philippines: Results, Pitfalls and Implications."

— *Dr. Sam Fujisaka, Social Scientist, IRRI, Philippines*

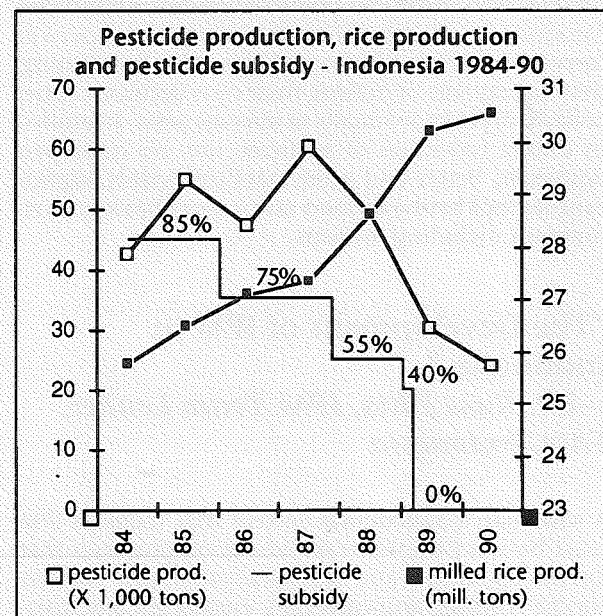
Irrigated rice farmers in Nueva Ecija, Philippines, sprayed insecticide three to four times in the wet and three times in the dry season for leafhoppers, hoppers, armyworms, and stemborers. They expected 25-35% yield loss per pest if not controlled. On the basis of evidence that rice plants compensate for early defoliation damage, 27 farmers experimented by not spraying insecticide for the first 40 days after transplanting on plots within their farms. Monitoring indicated that the natural enemy and insect pest levels were similar for treated and untreated fields. Mean rice yields were also the same for sprayed and unsprayed areas, with yield differences due to experimental design problems rather than insect pests. The goal of determining if farmers would change insecticide practices based on results of their own experiments was not met in this season due to experimental design problems. Experimental design is being improved on lessons learned.

"IPM Training: The Key to Acceptance."

— *Dr. Kevin Gallagher, IPM Training Officer, FAO, Philippines*

The key for farmer acceptance of IPM is field training which provides a management and conceptual framework. There are four management rules for IPM implementation, namely: 1) Grow a healthy crop; 2) Conserve natural enemies; 3) Observe the fields at least weekly; 4) Farmers must necessarily become IPM experts. Training focusses on the conceptual and practical skills necessary to implement these management rules. Agronomic practices are linked closely to crop recovery and compensation for biotic (e.g., pests) and abiotic (e.g., drought) damage. Field management and pesticide practices are closely linked to natural enemy and pest population dynamics. Field observation includes decision making on water, variety, fertilizers, diseases, rats, weeds, snails, birds, insect pests, and natural enemies. Observation methods are taught through an

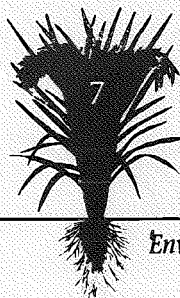
Agrosystem Analysis approach that provides an ecological learning experience for farmers and trainers each week during the training. Farmers do become expert at decision making through this training scheme, and do gain skills for continuous learning and research to improve their own IPM practices. It is important that policies support farmer training for IPM rather than for pesticides that destabilize rice ecosystems. Furthermore, these policies must have the explicit goal that farmers become expert decision makers in their own fields and that farmers have ownership of IPM programs in their communities.



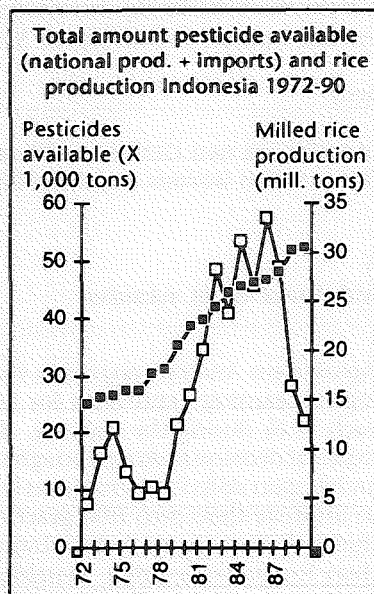
"Pest Control in Indonesia"

— *Dr. Ida Nyoman Oka, IPM Secretariat, Indonesia*

During the early years of the Food Intensification Program of Indonesia, increasing pest problems were controlled by using pesticides. The pesticides were applied for preventative purposes following the calendar system. However, despite massive use of pesticide on crops, it did not have a significant impact on reducing the pest population, and in some cases increased it. Pest resistance and resurgence, environmental pollution, as well as destruction of non-target organisms and health hazards to people resulted from inappropriate pesticide use.



The government gradually changed its policy of pest control from pesticide alone to a comprehensive one known as Integrated Pest Management (IPM). This is based on sound ecological principles: production of healthy crops through crop management, introduction of proper cropping systems (synchronized planting and crop rotation), use of resistant cultivars against major pests, periodic surveillance of the crop for pest abundance and their natural enemies (essential for making decisions on pesticide use). The policy also prohibited the use of broad spectrum pesticides and total withdrawal of its subsidies.

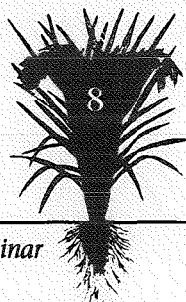


Massive IPM training for the field personnel and particularly the farmers started in 1989. The training method is an experimental-discovery-learning process for adults. It is designed to make farmers the experts in carrying out IPM in their own fields. After the training, they are capable of making their own decisions either collectively or individually to manage pests. It resulted in drastic reduction of pesticide use, no more pest outbreaks, better and more stabilized yields, significant savings by the farmers and a more healthy environment including humans.

"The Development of IPM in Indonesia."

—Dr. Russ Dilts, IPM Team Leader, FAO, Indonesia

A sustainable agricultural system that includes IPM must have an emphasis on education processes that focuses on farmers and ecological principles. Farmers are the creators, implementors, evaluators, and managers of agriculture in the field, and it is the farmers who must ultimately use ecological principles to develop a sustainable system. The Indonesian National IPM Training and Development Program has developed education and research models and is currently implementing them on a large scale. The processes include Farmer Field Schools during which the farmers build groups in order to approach decision making through agro-ecosystem analysis; Field Labs in which farmers define research problems and work together with researchers living in farm communities to solve problems; and Swadaya Field Schools in which farmers themselves continue from Farmer Field Schools to train other farmers in their own communities using local financing. In all these activities, farmers are developing themselves and working from an ecological understanding of ecosystems to solve local problems.



"Rice Pest Control in Thailand: Our Experience with IPM"

—Dr. Somkid Disthaporn, Plant Pathologist, Dept. of Agriculture, Thailand

Some major rice pests consist of insects, diseases and weed and their control measures in Thailand were generally described. The integrated program of rice pest control had been conducted since 1976. Even though the results of the IPM according to the opinion of farmers were considered to be reasonably successful, chemicals are still the first option and import levels have increased yearly. After the big outbreak of Brown Planthopper (BPH) during 1989-1991 in the central part of the country, the farm survey on pest management practices was studied to evaluate farmer knowledge, attitudes and practices related to BPH and rice ragged stunt virus disease control. The evaluation indicated that the attitude of farmers towards IPM was not clear and that it would likely take years for them to comprehend the concepts of IPM.

"IPM Experience and Capacity Building in Vietnam"

—Mme Vo Mai, Vice-Director, Ministry of Agriculture & Food Industry, Vietnam

With the support of FAO, IRRI, and other international organizations, Vietnam started an IPM program in 1989. Surveys of farmers' practice were conducted as background for an IPM workshop. The workshop was designed to convince policy makers, scientists, and others of the value of implementing an IPM strategy. IPM field demonstrations and farmer participatory exercises have been undertaken throughout the coun-



Khmer technicians test pest-resistant rice varieties.

try to show the farmers what IPM is and how to undertake it. IPM for rice has been implemented on about 10,000 ha with the following results:

- quantity of pesticide used fell by 60-65%;
- plant protection costs decreased by 25-48%;
- rice yields remained steady or increased;
- higher net return in IPM managed fields;
- 35 trainers, 483 technicians and 34,854 farmers were trained in rice IPM.

Workshop on Environment and IPM

Objective of the Workshop

The seminar participants were divided into five groups. Each group was made diverse and inter-disciplinary as possible; the Environmental Policy Group was composed of the most senior policy makers attending the seminar. The five groups were Forestry, Fisheries and Wetlands, Agriculture, Integrated Pest Management, and Environmental Policy.

The objectives of the workshop were straight forward:

- to expose senior resource managers to issues outside their particular field and to initiate a dialogue between sectoral disciplines;
- to initiate a dialogue across institutional boundaries within and between ministries;
- to list the perceived environmental and resource management problems and constraints;
- to outline possible solutions to those problems.

The groups were not asked to develop exhaustive lists of problems and solutions but to examine the ways in which environmental issues cut across the resource sectors. This approach acknowledged that the objective of the workshop was as much to start the dialogue on the environment more than it was to provide a status report on the Cambodian environment. The output of the workshop, therefore, should not be seen as a summary statement of the environmental issues in Cambodia, nor of the government's resource management policies to address those issues.

Each group adopted its own approach to examining the issues depending on the issues at hand and the facilitator's judgment in guiding the discussion.

Results of the Workshop

Forestry

Deforestation was the greatest concern identified; its causes were divided into three major groups:

Commercial logging and milling

- the political circumstances has made controlling illegal logging impossible;
- all political factions were cited but particular note was taken of the heavy logging activities and saw-mills operated by the Khmer Rouge;
- private interests were said to be responsible for logging and illegal milling in other parts of the country;
- Battambang, Kampong Speu and Koh Kong¹ were mentioned as problem areas.

Cutting of the Flooded Forest

- conversion of flooded forest to croplands;
- clearing flooded forest for seedling beds in Pursat;
- charcoal making by farmers around Kampong Thom, notably around traditional

tourist attractions;

- fire-wood harvesting for cooking, tobacco curing and brick firing.

Shifting Cultivation

- shifting cultivation was seen as of secondary importance but was still of concern in Koh Kong; upland rice shifting cultivation in Siem Riep was noted as a particular problem.

Insufficient technical training, lack of resource inventory and data collection were noted as constraints to the development of a functioning forest management system.



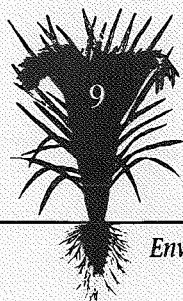
Heavy logging activities is one of the major threats to Cambodia's environment.

Recommendations

The recommendations provided by the group related primarily to government policy that should be promoted to:

- reduce the annual timber harvest based on an estimate of sustainable yield;
- encourage reforestation on degraded lands;
- promulgate and strictly enforce appropriate laws on the protection and regeneration of national forests;
- establish a system of national parks;
- encourage nature based tourism by restoring traditional tourist sites in Cambodia to their former state;
- promote the development and use of alternate fuel sources, e.g., rice hulls, to reduce internal fuel-wood consumption;
- promote cooperation with donor agencies for technical assistance and training.

¹ In this and other groups, when towns or provinces were named as having particular environmental problems, it usually reflected the experience of an individual district officer of the Ministry of Agriculture. This does not mean that similar circumstances are not found, or even widespread, in other parts of the country.



Fisheries and Wetlands

This group divided into three sub-groups Inland Fisheries, Marine Fisheries, and Wetlands for the identification of the environmental issues but sat together to develop joint solutions and recommendations.

Identified Issues

Inland Fisheries

- degradation of spawning grounds;
- higher demand from increasing population;
- poor understanding of the need to sustainably manage resources
- sedimentation;
- low capacity to enforce laws.

Marine Fisheries

- expanding shrimp culture industry without registration of enterprises or adequate technical knowledge;
- inadequate government policy and legislation;
- low capacity to enforce laws.

Wetlands

Overall wetland degradation due to:

- deforestation for firewood, alternative land use, dams, canals;
- extension of roads;
- encroachment by village settlements;
- shifting cultivation;
- poor understanding of wetland benefits.

Recommendations

The group felt that the rebuilding and development of the institutional framework for the management of fisheries and wetlands was the principal need.

Developing human resources and natural resources management skills were considered to be the cornerstones of building institutional capacity.

Natural Resource Management

- fish stocks should be subject to ongoing assessments, monitoring and evaluation;
- sustainable exploitation should be the basis of fisheries management
- legislation should be enacted to protect critical habitats and fish stocks;
- capacity to enforce the laws should be strengthened;
- provincial fishery offices should be under Department of Fisheries;
- greater international cooperation is required for technical assistance and funding;
- impact analysis is required on economic activities and development projects.

Human Resource Management

- managerial and technical skills should be developed;
- extension services should be provided to end users;
- training and education in appropriate use of resources, as well as integration of environment into school and college curricula.

Agriculture

The group discussed the general constraints to greater agricultural production in Cambodia. These included soil infertility, poor land use regulations, lack of irrigation, pest problems, poor technical training, lack of agricultural inputs, and an ineffective food/grain distribution system. In as much as these constraints were related to broader environmental issues, the group identified the following issues and recommendations:

Soil and Water

It was recognized that the soils in Cambodia are naturally poor. This has led to inappropriate agricultural practices on poor soil and eventual degradation of land resources. Some water problems are a result of depending on the rainfall pattern and a poor knowledge of water management.

Pests and IPM

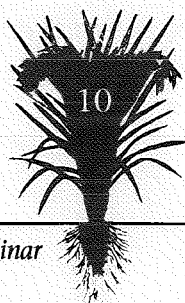
- the importation and distribution of highly toxic pesticides should be regulated;
- farmers should be trained in Integrated Pest Management techniques, including insect identification, basic ecology and should be extended to farmers through demonstration fields;
- complimentary risk avoidance strategies should be introduced along with IPM, such as crop diversification and cropping rotations;
- effectiveness of IPM in controlling pests, particularly rats, which have been difficult to control in certain areas, must be demonstrated in order to gain farmer confidence;
- international assistance will be required for the effective implementation of IPM;
- appropriate legislation may be required to protect native species of plants and animals to reduce pest occurrence; ecological imbalance resulting from widespread deforestation may be a contributing factor.



Rice transplantation in Kandal Province.

Technical Training and Equipment

- training and education on sustainable agriculture must reach all levels, i.e. from the policy makers to the farmers;
- teach farmers how to use organic sources of nutrients and practice sustainable nutrient management.



Integrated Pest Management

Many facets of Integrated Pest Management had been discussed during the presentations on the previous day. This included the identification of the agricultural issues and problems that have led to the adoption of IPM as a control strategy in other countries. For this reason, the group looked more at how IPM could be integrated in the Cambodian agricultural system. The group discussed this in terms of policy responses and training needs.

Pests in Cambodia

Insects:	Brown Plant Hopper (BPH) Gall Midge Green Leaf Hopper (GLF) Stemborer Heaf Folder Caseworm
Weeds:	
Grass:	Digitaria Cyperus Echinochloa
Broadleaf:	Monochloria
Rats	
Birds	
Diseases:	Brown Spot Blast Sheath Rot Sheath Blight Tungro

Policy Responses

- The government should strictly control the importation of pesticides;
- Appropriate legislation should be passed regarding the importation, distribution, and use of pesticides;
- Human health must be considered in the management of pesticides. The government should have access to an information base on pesticides, including their toxicity, pathways and health effects. The government should also establish a data base on pesticide poisonings within the country;
- The choice of pesticides for application should be not be indiscriminate, i.e. pesticides should be as target specific as possible and less;
- Continued and greater cooperation is needed between the Ministry of Agriculture and international organizations that can provide the training and assist in the implementation of IPM;
- Mechanisms of self-financing from within the agriculture sector for the widespread diffusion of IPM should be explored.

Training

Training is essential if IPM is to be successfully integrated into agriculture in Cambodia. This includes training for:

- policy makers and senior managers to pro-

vided appropriate institutional structures and policies that support IPM;

- agronomists and researchers for technical training and research methodology;
- extension officers for the successful and widespread diffusion of IPM;
- farmers who will provide the direct application of Integrated Pest Management.

Environmental Policy

The Environmental Policy group developed a framework for organizing and examining the environmental issues without trying to duplicate the exercise of the other groups.

Within constrained time limits and dealing with a broad array of subjects, the group discussed priorities, the range of possible interventions, and institutional arrangements, as well as the apparent contradictions and trade-offs inherent in some of the proposed solutions. In addition to the categories for forestry, fisheries, and agriculture, the group added social-economic development, urban-industrial issues, and ecology-land resources. The following are the main issues raised by the group:



Forestry

- the rate of deforestation was recognized clearly to be too high;
- the constraining factors to controlling the deforestation were seen as the ongoing political situation and the critical need for foreign exchange;
- the UNTAC ban on log exports was seen as the only realistic control in the present political climate;
- forest cutting would be necessary in the future but the balance between meeting domestic needs and supplying the foreign markets would need to be redressed.



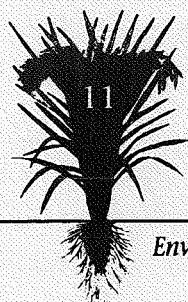
Agriculture

- the constraints on agricultural production related to deteriorating environment were considered to be:
- inadequate and improperly designed irrigation systems;
- shifting cultivation;
- improper management and use of agricultural inputs including agricultural equipment and pesticides;
- lack of farmer familiarity with pesticide application.



Fisheries

- the increase in foreign investment is creating too large a fishing fleet, i.e. an over-capacity to catch and process fish;
- there is a need to control the type of industrial projects and where they are situated so as to avoid pollution of inland and marine waters;
- the destruction of the flooded forest and the resulting siltation of the Tonle Sap is of great concern.





Farmers' training represents the cornerstone of Integrated Pest Management.

Social Dimensions of Environment and Development

The following was considered to be an influence on the ability of the country to develop economically while maintaining environmental integrity:

- war;
- poverty;
- rate of population growth;
- level of education and current attitudes and practices of general population concerning the environment and proper resource management;
- lack of community development and absence of institutional relations with government;
- lack of expertise and financial resources to address the above.



Urban-industrial Issues

- mounting levels of urban and industrial waste is of concern in the absence of environmental standards, a regulatory framework, or a waste management plan;
- there is the need to encourage the growth of the industrial sector while managing it with an appropriate regulatory and control systems which are not currently in place;
- industrial zoning regulations are essential to avoid unnecessary risk.



Ecology-Land Resources

- the rapid soil erosion and its impact in all sectors, as well as the increasing degradation of the soils was considered a major issue that was having immediate impact on general economic development;
- the lack of information on potential impact of climate change was noted;
- the absence of a system for land use planning

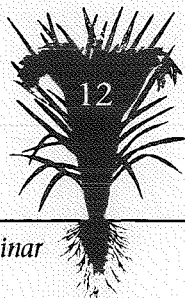
for the management of resources and the avoidance of future use conflicts;

- there is no methodology or technique for screening environmental impacts of projects or foreign investment;

Recommendations

Building the basis for sustainable development is not possible until peace and stability returns to Cambodia; a National Environmental Strategy must be part of the economic planning. This strategy should outline:

- a strong environmental policy framework that links the sustainable management and conservation of natural resources along with economic policies that govern their production and use;
- a body of legislation that provides for environmental control and regulation;
- a strategy for enhanced regional and international cooperation on technical and financial assistance;
- the implementation of a environmental impact assessment procedures for screening development projects;
- national institutions that deal with the environment need to be created and supported where possible. Of particular note, is the need to strengthen the mandate and responsibilities of National Environment Committee. National environment institutions, in turn, need to be linked with sub-national and local institutions for effective resource management of resources;
- human resource development and information dissemination is crucial to the exercise of capacity building;
- the participation of the people and communities in resource management and environmental protection is essential to the success of any management strategy;
- significant areas of Cambodia should be protected as soon as possible through the establishment of national parks, or an appropriate protected areas management system.



Closing Remarks

I would like to congratulate all the participants of this seminar on the notable results achieved during the past few days. Your energy and skills have contributed to the a greater understanding of some of the difficult problems that now face Cambodia.

I support the views of Mr. Mok Mareth on the importance of continuing to turn our attention to environmental issues and I particularly support the proposal to evaluate the need for a program of Integrated Pest Management in the near future. Let me give you, however, what I see as some of the more important points that emerged during the seminar and some of the directions that we may wish to consider taking, both in the short and longer term.

First, the effects of war and political instability do not readily lead to sustainable development and the elimination of poverty. We all look forward to the day when collectively we can address these difficult issues and resolve the problems that face us as a nation. In the meantime, this government will continue to build the foundations for effective natural resource management and environmental protection at the national level.

Second, one of the main messages of the seminar needs to be stated once again—that environmental protection must accompany the economic development of this country. The experience of other countries shows that government economic and development policies are often responsible for environmental degradation. We must strive to avoid repeating these mistakes in our efforts to rebuild our national economy by identifying and promoting those policies that support economic development at the same time as protecting the environment.

Third, if our population continues to grow at its present rate, we will always be trying to catch up to provide food security, health and social services, and generally ensure an adequate standard of living for our people. Additional population puts great strain on our natural, financial and human resources. If this issue is not confronted, it will be responsible for the continuing degradation of our environment.

Fourth, we clearly need to develop new mechanisms to deal with environmental concerns. This includes the development of a new body of environmental legislation that is appropriate to Cambodian circumstances and reflects the broad-based nature of environmental issues. We will need to create new institutions and strengthen of existing ones that can cut across traditional sectoral lines in order to address environmental initiatives. In this regard the National Environment Committee can play a crucial role in providing an inter-ministerial forum for the development of a national environmental policy framework.

Fifth, Cambodia's agriculture sector must become more efficient and productive. Under certain conditions in other countries in the region, Integrated Pest Management has been shown to increase productivity while protecting the environment. I would like to invite the sponsors of this seminar to continue their collaboration by assisting us to examine the development of a suitable IPM program for Cambodia.

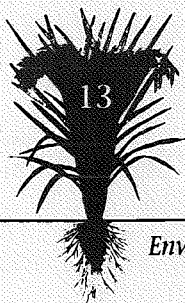
Finally, the points that I have just mentioned need to be addressed in a practical manner. We will need to develop new approaches and ideas that are convincing, pragmatic and suit the needs of Cambodia. Again I appeal to the international community to assist us in following up on these matters. This seminar is a good beginning in establishing a national dialogue on the environment and we should ensure that it continues.

I would like to close this seminar by thanking all those who have come from afar to attend and participate in this seminar. Experts from Vietnam, Thailand, Indonesia, Malaysia, Philippines, Japan, Canada, Australia, New Zealand and the United States have generously contributed their time and skills. The success of this seminar is due largely to your efforts and I take this opportunity to invite you back to Cambodia to continue what we started here.

I am especially grateful to IDRC, IRRI and FAO who have worked with us at the Ministry of Agriculture in staging this seminar. I look forward to extending this collaboration in the future.

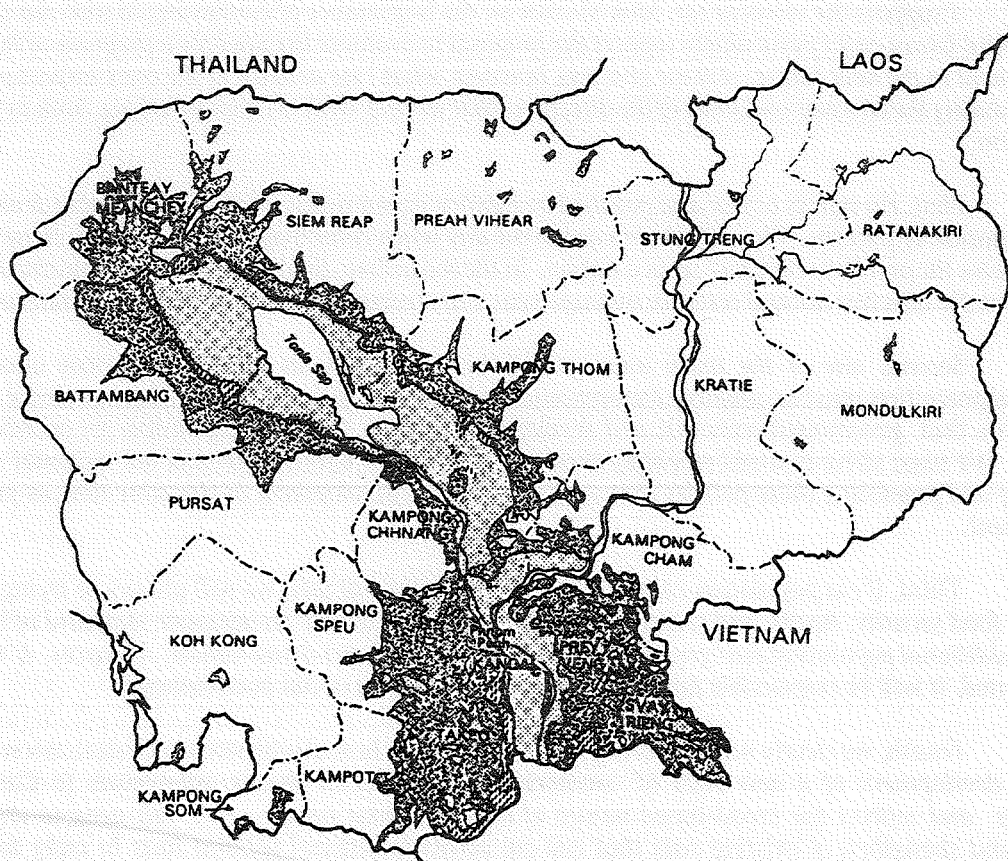
My last thanks goes to Vice-Minister Samreth Pech, President of the seminar's Organizing Committee, and to all the committee members.

Thank you.



—Mr. Chhea Song
Senior Vice-Minister of Agriculture

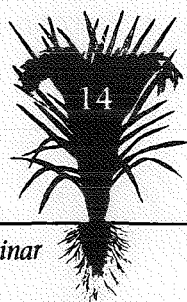
Major Rice Producing Areas in Cambodia 1993



Map Key:
Shaded areas depict ricefields.

Area and yield of rice types in Cambodia, 1990

	Harvested area (ha)	Production (tons)
Wet season	1,425,803	1,910,576
Dry season	130,076	351,205
total	1,555,879	2,261,781




Annex

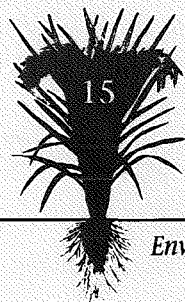
Membership of National Environment Committee

Mr. Mok Mareth Chairman	Vice Minister	Ministry of Agriculture
Mr. Ho Vichet Vice-Chairman	Vice-Director	Technical Dept., Ministry of Industry
Mr. Oun Porn	Vice-Director	Disease Prevention & Control, Ministry of Health
Mr. Koy Van	Vice-Director	Ministry of Transportation
Mr. Pech Keo	Director-General	Ministry of Culture
Mr. Chong Bun Horn	Vice-Director	Construction Dept., Ministry of Planning
Mr. Chan Tong Yves	Director	Planning and Statistics, Ministry of Agriculture
Mr. Chea Peng Chheang	Vice-Director	Fishery Department, Ministry of Agriculture
Mr. Kum Saron	Forestry Department	Ministry of Agriculture



Organizing Committee

		Mr. Samreth Pech	Chairman		
		Mr. Sin Niny	Vice-Chairman		
Mr. Kong Thay Bunthan	Member			Mr. Ith Nody	Member
Mr. Chan Sarun	Member			Mr. Ly Kim Han	Member
Mr. Chan Tong Yves	Member			Mr. Pech Tuch	Secretary
Mr. Leng Sophal	Secretary				



National Participants

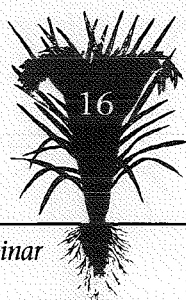
Nguon Nhel, Minister, Agriculture
 Chhea Song, Senior Vice-Minister, Agriculture
 Mok Mareth, Vice-Minister, Agriculture
 Somreth Pech, Vice-Minister, Agriculture
 Sin Niny, Director General, Agriculture
 Chhan Sophan, Director, Chamcar Daung
 Chan Nareth, Vice-Director, Chamcar Daung
 Noun Sin, Director, Personnel Dept
 Sym Hang, Vice-Director, Personnel Dept
 Ly Kim Han, Director, Fishery Dept
 Chea Peng Chheang, Vice-Dir., Fishery Dept
 Siv Gnan, Vice-Director, Veterinary
 Ith Nody, Director, Agronomy Dept
 Try Meng, Vice-Director, Agronomy Dept
 Leang Sam Hat, Director, Ag. Machinery Dept
 Or Soeun, Vice-Director, Forestry Dept
 Uk Sokhorn, Vice-Director, Forestry Dept
 Chhim Somean, Chief Office, Forestry Dept
 Chay Savong, Director, Veterinary Dept
 Chea Kong, Director, Planning
 My Bun Doeun, Doctor, M.O.H.
 Um Sam An, Doctor, M.O.H.
 Seng Narong, Director Ag., KP/SNC
 Pech Kim Yong, Staff Ag., KP/SNC
 Mol Phat, Staff Ag., KP/SNC
 Keang Leang, Personnel, M.O.P.
 Ros Chhav, Personnel, M.O.P.
 Kim Po, Director, Women Association
 Leng Sokun, Vice-Chief Office, M.O.F.
 Thay Sun Hieng, Director, Prek Leap
 Pen Vuthy, Staff, Prek Leap
 Mrs. Nob Vanthy, Staff, Agronomy
 Lim Phai, Assistance, PADEK
 Ms. Mok Soleang, Staff, Agronomy
 Ms. Kim Rany, Staff, Agronomy
 Ms. Lim Theavy, Staff, Agronomy
 Pech Thuch, Chief Office, M.O.A.
 Pen Vuth, Chief Office, Agronomy
 Chin Chor Rum, Staff, Agronomy
 Ros Chhay, Staff, Agronomy
 Chea Sareth, Chief Office, M.O.A.
 Kong Thay Bunthan, Vice-Director, Planning
 Chan Tong Yves, Vice-Director, Planning & Sta
 Leng Sophal, Vice-Chief Office, Planning & Sta
 Ros Sovan, Staff, Planning & Sta
 Kong Toro, Director of AG. Dept., Kratie
 Preab Sotheara, Cadre of Forestry Office, Kratie
 Sbn Sang, Cadre of Agronomy Office, Kratie
 Som Kim Lorn, Chief of Fishery, Kratie
 Chap Saroeun, Director of AG. Dept., Pursat
 Som Sem, Chief Office of Agronomy, Pursat
 Mong Seng, Chief Office of Fishery, Pursat
 Mom Eang, Chief Office of Fishery, Pursat
 Vong Phanny, Director of Ag. Dept., Kondal
 Touch Tai Theng, Chief Off. of Ag., Kondal

Som Phoeung, Chief Office of Fishery, Kondal
 Hang Try, Vice Director of AG., Takeo
 Sun Sophal, Cadre Forestry of Office, Takeo
 Soun Sum, Chief Office of Forestry, Takeo
 Keo Neam, Vice Director of AG., Kompot
 Plork Thai, Chief Office of Forestry, Kompot
 Song Lorn, Chief Office of Fishery, Kompot
 Nun Chhorn, Chief Off. of Agronomy, Kompot
 Em Phear Sor, Director of AG. Dept., Kg. Thom
 Van Danny, Chief Office of Fishery, Kg. Thom
 Chhim Chorn, Ch. Off. of Planning, Kg. Thom
 Nhem Cheil, Vice-Chief Off. Admin., Kg. Thom
 Nop Mongdy, Chief Office of Ag., Kg. Thom
 Van Chhon, Vice-Director of Ag., Kg. Cham
 Heng Pinny, Kg. Cham
 Nhoug Sophat, Cadre of Forestry Office, Kg. Cham
 Bun Chheng Hak, V-Chief Of. of Fishery, Kg. Cham
 Chhon Bunna, Cadre of Agro. Office, Kg. Cham
 Khon Vuth Dyna, Dir. of Agro. Dept., Sihanoukville
 Sor Sasna, Agronomy, Sihanoukville
 Pho Savang, Fishery, Sihanoukville
 Ker Chea, Forestry, Sihanoukville
 Nop Mongdy, Director of Ag. Dept, Koh Kong
 Dom Sarin, Chief Office of Planning, Koh Kong
 Nai Ol, Vice-Chief Office of Fish, Koh Kong
 So Bun Dait, Vice-Chief Office of Forest, Koh Kong
 Touch Yoeun, Vice-Chief of Ag., Kg. Chhnang
 Keo Thay, Chief Office of Fishery, Kg. Chhnang
 Bin Sareth, Director of Ag. Dept., Kg. Speu
 Leng Thary, Vice-Chief Office of Ag., Kg. Speu
 Pot Cheanal, Vice-Chief Office of Forestry, Kg. Speu
 Yem Kan, Vice-Director of Ag., Preah Vihear
 Touy Yin Hor, Administration Office, Preah Vihear
 Ros Sor, Vice-Director of Ag., Siemreap
 Boy Kan Sokarith, Forestry Office, Siemreap
 Sear Bunhok, Agronomy Office, Siemreap
 So Sarorm, Vice-Chief Office of Forestry, Siemreap
 Sorn Kim Sear, Fishery Office, Siemreap
 Thouch Thear, Chief Office of Forestry, Stung Treng
 Som Phalla, Staff, Office of Fishery, Stung Treng
 Thach Ratana, Director of Ag. Dept., Svay Rieng
 Chan Tak, Svay Rieng
 Toun Bun Than, Director of Agriculture, Prey Veng
 Kong Vitanak, Cadre Fishery of Office, Prey Veng
 Phal Mony, Vice-Chief of Fores. Off., Prey Veng
 Sam Sarun, Vice-Chief of Agro. Off., Prey Veng
 Sang Chhoeut, Vice-Chief of Agro. Off., Battambang
 Keat Mong, Vice-Chief of Fishery Off., Battambang
 Phin Phannan, Vice-Chief of Forestry, Battambang
 Hem Cheun, Banteay Meanchey
 San Kim Sour, Staff of Ag. Office, Banteay Meanchey
 Phit Phong Nong, Ch. Of. of For., Banteay Meanchey
 Pin Ngoun Leng, Chief Office of Ag., Phnom Penh
 Iv Phirun, Phnom Penh

International Participants

Dr. Harry Nesbitt, Director, IRRI
 Dr. Andrew McNaughton, Senior Program Off., IDRC
 Dr. Selvanathan, Assist. Dir., Asian Wetland Bureau
 Mr. Marjon Fredrix, Implementation IPM, FAO-IPM
 Mr. Mark Hickey, Ag. Extension Network, ACR
 Ms. Ann Hickey, Ag. Extension Network, ACR
 Mr. David Loring, Agronomist, CWS
 Mr. Russ Dilts, Team Leader, FAO-IPM
 Dr. Sean Bun Chin, Consultant, IDRC
 Dr. Lim Chhorn, Consultant, IDRC
 Dr. Bov Bang Eav, Consultant, IDRC
 Mr. I.N. Oka, IPM Chemistry Group, Indonesia

Ms. Tat Eng Lay, Technical Coordinator, WWI
 Mr. Hiroshi Taniyama, Representative, JVC
 Mr. Gregory Woodsworth, Env. Planner, IDRC
 Mr. Somkiol Disthaporn, Plant Pathologist, DOA BKK
 Ms. Kong Bounna, Asst. Project Officer, JVC
 Mr. Kevin Gallagher, IPM Training, FAO-IPM
 Mr. Agnes C. Roler, Asst. Professor, IRRI-UPLB
 Ms. Vo Mai, The motorologist, Vietnam
 Mr. K.L. Heono, Etomologist, IRRI Philippine
 Mr. Xavier Ortega, Agronomist, Padek
 Mr. Peter Ooi, Eutornologist, IIBC
 Ms. Hirono Azyrna, Officer, JVC



Environment and IPM Seminar Program

Sunday, 10 January

Arrival of participants

Monday, 11 January

08.00 Registration, CDAI

OPENING SESSION

Chairman: Mr. Samreth Pech

08.30 Welcome Address.

Mr. Nguon Nhel, Minister for Agriculture

08.50 Economic development and environmental management: Keeping the options open.

Mr. Chhea Song, Sr. Vice Minister for Agriculture

09.10 The role of UNTAC in safeguarding Cambodia's resource base. Ms. C. Aifsen, Rehabilitation, UNTAC

09.30 Coffee Break

CAMBODIAN RESOURCES Chairperson:

Mr. Mok Mareth

10.30 Forestry: Policy options for development.

11.30 Lunch

14.30 Conservation of wetlands and fisheries management.

Mr. S. Selvanathan

15.10 Biodiversity: Its importance and conservation.

Mr. S.B. Chin

15.40 Coffee Break

MANAGEMENT OF RESOURCES

Chairman: Mr. Chan Tong Yves

16.00 Financing the environment.

Mr. R. Piper

16.30 Cultural heritage and protected areas management.

Mr. R. Englehardt

Tuesday, 12 January

INTEGRATED PEST MANAGEMENT AND THE ENVIRONMENT

Chairman: Dr. Peter Ooi

08.00 IPM: a policy perspective

Dr. P. Kenmore

08.30 Pesticides and farmer health in the Philippines.

Dr. P. Pingali

09.00 The impact of pesticides on rice brownhopper.

Dr. K. Sogawa

09.30 IPM for sustainable rice production.

Dr. K. L. Heong

10.00 Coffee Break/Discussion

IPM: FARMERS AND TRAINERS PERSPECTIVE

Chairman: Dr. Peter Kenmore

10.30 Biological Control: understanding and conserving parasites and predators.

Dr. P. Ooi

10.50 Farmers acceptance of pest control techniques.

Dr. S. Fujisaka

11.10 IPM-training, the key to acceptance.

Dr. K. Gallagher

11.30 Discussion

12.00 Lunch

IPM: EXPERIENCES IN OTHER COUNTRIES

Chairman: Dr. K. L. Heong

14.30 Pest control in Indonesia: lessons to be learnt from our experiences.

Dr. I.N. Oka

15.15 The development of IPM in Indonesia.

Dr. D. R. Dilts

15.35 Coffee

16.00 Pest control in Thailand: our experiences with IPM.

Dr. S. Disthaporn

16.20 Pest control in Vietnam: our experiences with IPM.

Mme. Vo Mai

16.40 Discussion

Wednesday, 13 January

08.00 Explanation of Work Group Process: Workshop Objectives, Group Assignment Mr. Chan Tong Yves

08.20 General Discussion in Groups

10.00 Coffee Break

10.30 Specific Work Groups

Group 1 Environmental Policy

Group 2 Agriculture

Group 3 Integrated Pest Management

Group 4 Forestry and Watershed management

Group 5 Fisheries and Wetland management

12.00 Lunch

14.30 Continuation of Work Groups: identification of problems, issues, concerns; identification of solutions, conclusions; recommendations; preparation of presentation to plenary

17.00 End of Day

18.30 Seminar Dinner

Thursday, 14 January

Plenary Session

Chairman: Mr. Samreth Pech

08.00 Presentation by Group 2

08.15 Presentation by Group 3

08.30 Presentation by Group 4

08.45 Presentation by Group 5

09.00 Presentation by Group 1

09.20 Synthesis and Discussion

10.30 Break

11.15 Summary Statement of Workshop

12.15 Closing Remarks

12.30 End of Seminar

Mr. Mok Mareth, Vice Minister

Mr. Chhea Song, Senior Vice Minister

