

Economic Assessment of a Change in Pesticide Regulatory Policy in the Philippines

D Templeton and N Jamora, International Rice Research Institute

In response to growing health concerns, the Philippine government instigated a suite of pesticide regulatory policies and implementing guidelines and launched Integrated Pest Management as a National Program to promote a safer and ecologically-sound approach to pest control. The main aim of this study is to measure the economic benefits of the 1992 to 1996 pesticide policy package. Specifically, the study examines those factors that influenced the government's decision to change the policies on pesticides and pest control practices and attributes these benefits to the key players, with a focus on relevant International Rice Research Institute's (IRRI) policy-orientated research.

1 Introduction

In the Philippines, the widespread use of pesticides in rice production expanded rapidly during the 1970s and into the 1980s. This was largely due to concerns that crop losses from pest infestation would negate the benefits from planting modern rice varieties. Even the release of early pest-resistant varieties did little to alleviate those concerns. However, by the 1980s, it was clear that indiscriminate use of pesticides can cause an ecological imbalance which can exacerbate, rather than alleviate, a pest problem. Moreover, at the same time, a body of research was providing evidence of substantial environmental and health costs from the excessive use of pesticides – particularly insecticides.

While policies banning the use of some hazardous chemicals were enacted by the Fertilizer and Pesticide Authority (FPA) of the Philippines in the early 1980s and in 1989, research continued to show that the effect of pesticide on human health was substantial. In response to the growing health concerns, the Ramos Administration (1992 to 1996) undertook a multi-pronged approach to the judicious use of pesticides. As such, the FPA instigated a suite of pesticide regulatory policies and implementing guidelines aimed at banning or restricting the use of commonly-used but highly toxic insecticides in rice production and encouraging safer pesticide management practices¹. Further, the Department of Agriculture (DA) launched Integrated Pest Management (IPM) as a national program to encourage a more ecologically-sound approach to pest control.

The main aim of this study is to measure the economic benefits of the 1992 to 1996 pesticide policy package. Specifically, the study examines those factors that brought about or influenced the government's decision to change the policies on pesticides and pest control practices and, where possible and justified, to attribute the policy-induced benefits to the key players, with a focus on relevant research undertaken by the International Rice Research Institute (IRRI).

While establishing a link between research and policy change may theoretically appear to be fairly straightforward and logical, in practice it is a difficult task. This is because, in general, there are a large number of factors that can influence the policy-formulation process. For example, rarely is a research study on any particular researchable issue unique, nor is that issue the only one likely to influence policy makers on any given topic. In the case at hand, IRRI was neither the only nor the first organization to undertake research on the ill effects of pesticide use in the Philippines. The results from research undertaken by the Philippine medical

¹ Here after collectively referred to as the '1992 to 1996 pesticide policy package'.

profession and academia were in the public domain by the mid 1980s. Research had also been undertaken on pest-resistant rice cultivars and IPM, providing farmers with less toxic alternatives to pest control since the 1970s.

Changes in a country's political environment can also directly impact on a policy maker's ability to enact policy. The significant shift in the Philippine agricultural agenda from one that strongly encouraged the widespread use of agricultural chemicals (Marcos regime 1965 to 1986) to one that explicitly considered the harmful effects of pesticides on the environment and human health (Ramos era 1992 to 1998) provided policy makers with a strong political platform upon which policies that promote the safe and judicious use of pesticides could be pursued.

International codes of conduct, regulations and alliances can also influence domestic policy making, particularly when the domestic country actively participates in the international arena. For example, in the case of the Philippines, staff and advisors of the FPA participated in international conferences organized by the Food and Agriculture Organization (FAO) and World Health Organization (WHO) of the United Nations (UN) on the harmful effects of injudicious use of toxic agricultural chemicals. The Philippines also made a commitment to Agenda 21 of the UN Conference on Environment and Development, which was crafted in Rio de Janeiro in 1992.

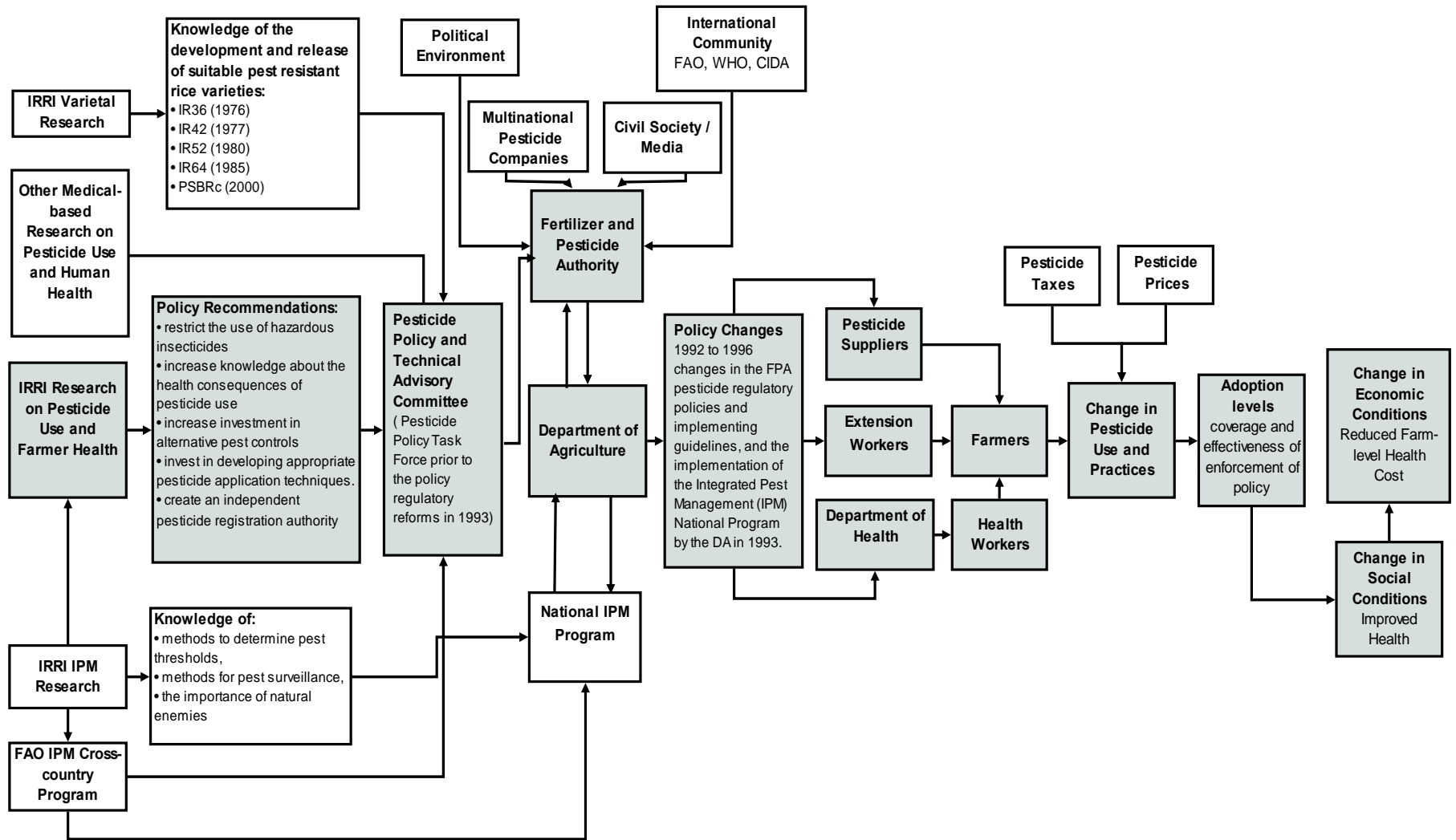
The private sector can also influence governments to shape policy in their favor. In the Philippines, the pesticide industry is primarily made up of large multi-national companies, importing around 95% of pesticides available on the Philippine market. The industry has always had strong links with the FPA because all pesticides have to be registered with the FPA before they can be imported, manufactured, distributed, sold, and used in the Philippines. These links could be used to discourage policy makers to impose pesticide regulatory policies that could be in direct conflict with the financial interests of the pesticide industry.

The media and civil society groups can also trigger policy discussions by bringing issues to public attention and keeping them there. This was particularly evident in the Philippines when the media and anti-pesticide advocates, such as the Pesticide Action Network (PAN), publicly supported the government's decision to ban the use of a number of highly toxic insecticides in rice production, despite strong opposition to the bans from the pesticide industry.

Finally, there are likely to be factors, which may be either unrelated or indirectly related to the policy change in question, that need to be considered when attributing the value of changes in farmer practices to that policy change. Other factors that may have induced a change in pesticide use and management practices in the Philippines include changes in pesticide taxes and prices.

All the above factors are depicted schematically in the impact pathway presented in Figure 1.1. In this figure, the pathway from IRRI's research on pesticide use and farmers' health to the change in health costs (depicted by the solid gray shaded boxes) is central. This does not mean to imply that the link between IRRI's research and the policy change is unequivocal nor is IRRI's research central or essential to the policy change. Rather, it is depicted this way because it is central to the research question at hand, which is -- 'Did IRRI's research influence the policy change and, if so, how much of the potential benefits from the policy-induced changes in farmers' pesticide practices can be attributed to that research?'

Figure 1.1: Impact Pathway for PORIA of Changes in Philippine Pesticide Policy



Another important point is that, in this analysis, the measured benefits are limited to the measurable changes in farmers' health costs. Changes in rice production due to a change in the type or quantity of insecticides used, other than those due to a farmer's illness-induced reduction in productivity which are already subsumed into the health cost estimate, are not considered in the analysis for two main reasons. First, the more judicious use of insecticides has been found to have an insignificant effect on rice yields. Second, the efficacy of all pesticides to control targeted pests is ascertained before these chemicals can be registered with the FPA. In addition, the potential changes in environmental conditions are not considered because measuring environmental impacts are beyond the scope of this analysis.

In line with the impact pathway, the format of this paper is as follows. In Section 2, the factors that could have influenced the 1992 to 1996 pesticide policy package are summarized. An overview of Philippine pesticide policies is given in Section 3. In Section 4, the changes in the pesticide use and management practices in the Philippines over the period 1966 to 2007 are examined. The economic benefits of the changes in pesticide use and management practices, measured in terms of changes in health costs are quantified in Section 5. In Section 6 the factors that influenced the 1992 to 1996 pesticide policy package are examined and an estimate of the percentage of benefits that can be allocated to IRRI's research on pesticide use and farmers' health is given. Section 7 provides the benefit-cost assessment, while the conclusions are presented in Section 8.

2 An Overview of Factors that could Influence Philippine Pesticide Policy

As stated above, a policy maker's decision process is influenced by a number of factors. In the case of the change in pesticide and pest control policies for the rice growing industry in the Philippines, it is considered that the main influential factors are research (on pest-resistant rice varieties, the health implications of pesticide use and IPM), the change in the Philippine government's broader agricultural and environmental policies, international pesticide codes of conduct and regulations, the demands of multinational pesticide companies and the concerns of civil society and the media. Each of these is discussed in turn.

2.1 Research

Varietal Development

The introduction of new high yielding varieties (HYV) of rice started with the release of an IRRI rice variety called IR8 in 1966. The early HYVs, such as IR8, were susceptible to major rice diseases such as blast, bacterial blight, tungro and grassy stunt and to insect pests such as the three strains of Brown Plant Hopper (BPH), stem borer and gall midge (Khush and Virk 2005). Moreover, because the realization of their yield potential was dependent on the use of other inputs, the release of high yielding rice varieties was packaged with crop management recommendations including the intensive use of water, labor, fertilizer and pesticides. With regard to the agricultural chemicals, the management component of the technology package was simplistic, recommending a calendar rather than a needs-based approach to fertilizer and pesticide application.

By the mid 1970's, IRRI focused its multidisciplinary endeavors beyond yield potential to incorporating disease and pest resistance into improved germplasm. This led to the development and widespread adoption of pest and disease resistant varieties such as IR26, released in 1973, and IR36 released three years later. IR36 proved to be particularly popular replacing IR26, the dominant variety at that time. A major factor contributing to the success of

IR36 was that it was resistant to the newly emerged biotype of BPH, which overcame the resistance of IR26. IR36 quickly accounted for 65% of the rice production in the Philippines. In 1977, IR42 was released. At the time of their release, both IR36 and IR42, which originated from the same crosses, were resistant to blast, bacterial blight, tungro, grassy stunt, Green Leaf Hopper (GLH), two BPH biotypes, stem borer and gall midge. In addition, both varieties were tolerant to mineral toxicities and deficiencies in soils, providing another reason for their popularity (Khush and Virk 2005).

The genetic resistance to tungro in both IR36 and IR42 had deteriorated by 1984. In December of that year, there were concerns that tungro infestation, particularly in Southern Mindanao may affect the country's food production program (Bulletin Today, 11 December 1984). As a result of the increased risk of tungro-induced crop losses, the Philippine Crop Insurance Corporation (PCIC) 'delisted' varieties that had become susceptible to tungro making it a condition that only farmers growing tungro resistant varieties, such as IR52 (1980), IR58 (1983) and IR60 (1983), would be eligible for crop insurance (Valley Times 22(19) p 9; Times Journal, 12 April 1985).

In 1985, IR64 was released. It soon became the most widely-used rice variety in the Philippines, replacing IR36. This was largely because IR64 is high yielding, highly resistant to BPH and green leafhopper, moderately resistant to striped stem borer, and has good eating quality enabling it to command a high price. As a result of these attributes, IR64 didn't only become the most popular variety in the Philippines but also the most widely grown rice variety around the world (Khush and Virk 2005).

After the release of IR64, there was an increase in the proportion of breeding lines with good cooking characteristics. Nevertheless, IR64 remained the most popular variety in the Philippines until 2002 when PSBRc 82 (released by the Philippine government in 2000) became the most widely grown variety.

Research on the Adverse Effects of Pesticide Use on Human Health

Since the publication of Rachel Carson's book 'Silent Spring' in 1962, revealing the adverse effects of pesticides, a considerable amount of research on the ill effects of pesticides on human health and the environment has been undertaken. For example, Davies, Freed and Whitemore (1982) and Smith, Carpenter and Faulstich (1988) found that long-term exposure to on-farm pesticide use can cause numerous health impairments such as cardiopulmonary disorders, neurological and hematological symptoms, and dermal diseases. In the Philippines, medical research was undertaken by the National Poison Control and Information Service (NPCIS) center at the University the Philippines – Philippine General Hospital (UP-PGH) (Castañeda and Maramba 1980; 1986). Environmental and food residue effects were also being studied (Magallona 1977; 1989). Gonzales and Chua (1984) reported incidents of Organophosphate (OP) poisoning among farmers in Cebu. These reports were confirmed and extended by Casanova, Pedrajas and Querubin (1984), who found poisoning among formulation plant workers. Casanova, Pedrajas and Querubin (1984) also concluded that medical personnel in hospitals and plants were not familiar with the diagnosis and treatment of poisoning, indicating that the problem could be much higher than the number of confirmed cases, and the consequences of pesticide exposure could be worse. In addition, they found that basic protective clothing was seldom worn by rice farmers; a finding that was later supported by Castañeda and Maramba (1986). Population-based estimates of the impact of pesticides on human health were first available in 1987 from retrospective analysis of mortality records (Loevinsohn 1987). These were extended to other areas of the country by Bantilan, Rola and Corcolon (1989), the results of which suggested that the Philippines was facing a major pesticide-related public health problem. Pesticide policy research, funded by International

Development Research Centre (IDRC), the FAO and United States Agency for International Development (USAID), was also undertaken by Dr Rola at the University of the Philippines, Los Baños (Rola 1989; 1994). Analysis of hospital records showed that the risk of occupational poisoning was greatest among age, sex, and occupational categories most exposed.

In addition, IRRI undertook policy-orientated research into the private health costs and environmental effects of pesticide use in rice farming in the Philippines (Table 2.1). This resulted in the production of numerous publicly available papers (e.g., Pingali, Palis and Rodriguez 1989; Marquez Pingali, Palis, Rodriguez and Ramos 1990; Pingali and Marquez 1990; Pingali and Palis 1990; Antle and Pingali 1991; Pingali, Marquez and Palis 1992; Rola 1986, 1989). While some of this body of research was not published in journals until 1994 (e.g., Antle and Pingali 1994; Pingali, Marquez and Palis 1994) and books until 1993 (Rola and Pingali 1993) and 1995 (Pingali and Rogers 1995), these studies gained exposure at workshops and conferences in the Philippines and internationally, including the Progress Reports Meeting of the Environmental Costs of Chemical Input Use in Southeast Asian Rice Production, 31 October 1989, IRRI, Los Baños, Laguna, Philippines, the Workshop on Environmental and Health Impacts of Pesticide Use in Rice Culture, 28-30 March 1990, IRRI, Los Baños, Philippines, the annual meeting of the Association for the Advancement of Science, New Orleans, Louisiana, USA, Feb 22-25, 1990, the International Association of Agricultural Economists, Conference 22-29 August 1991, Tokyo and the Workshop on Measuring the Health and Environmental Effects of Pesticides, 30 March-3 April 1992, Bellagio, Italy. The primary output of this research is knowledge that the negative private health cost of using insecticides in rice production is large and overwhelms any potential economic gains.

The main policy recommendation to come out of the IRRI policy-orientated research on pesticide use was to restrict the use of hazardous insecticides by imposing and implementing bans on those insecticides that pose acute or chronic health effects and/or adversely affect the environment or, if banning is not feasible, to apply a selective pricing policy, taxing the more hazardous pesticides at higher rates than the less toxic pesticides. Additional recommendations include:

- Channel public and private resources into developing alternative pest control measures to complement or substitute for insecticides.
- Set and enforce MRLs for food, feed and water.
- Implement training programs for agrochemical dealers, agricultural technicians, rural medical officers, pesticide applicators and farmers on the nature and consequences of pesticide use.
- Implement mass media campaigns on safety practices in pesticide use.
- Invest in developing appropriate pesticide application techniques.
- Create an independent pesticide registration authority that has the regulatory authority and power to register and regulate pesticides.

In response to the considerable revisions in the international regulation of pesticides and to the growing body of evidence that pesticides were hazardous to human health and the environment, changes were made to pesticide regulations in the Philippines. A detailed overview of these changes is presented in Section 3.

Table 2.1: IRRI Policy-Orientated Research Projects on Pesticide Use and Philippine Farmer Health, Productivity and the Environment.

Project title:	Environmental Cost of Agricultural Chemical Use in Southeast Asian Rice Production (01/01/89 to 31/12/91)
Donor	Rockefeller Foundation (RF)
Budget¹	US\$101,700 (plus matching funds from collaborators)
Project leader:	PL Pingali
Collaborator/s:	Montana S.U., UPLB, Kasetsart Univ., Malaysia, Indonesia
Project title:	WRI/IRRI special project on “Economics of Sustainable Agriculture for Lowland Irrigated Rice Production in the Philippines” (01/06/90 to 30/06/92)
Donor	World Resources Institute (WRI)
Budget¹	US\$23,000
Project leader	PL Pingali
Collaborator/s	Dr. Paul Faeth (WRI); Dr. Tirso Paris (UPLB)
Project title:	Research into the Private Health Costs Due to Pesticide Use in Rice Farming (01/12/91 to 10/11/92)
Donor	Overseas Development Administration (ODA)/Associate Professional Officers Scheme (APOS)
Budget¹	£14,734
Project leader	PL Pingali
Collaborator	H Warburton (Collaborative Research Fellow from UK)

Source: IRRI Project Database. ¹Does not include IRRI in-kind costs

Research in IPM and the Philippine IPM Program

While the concept of IPM was first introduced to the Philippines in the early 1970s through IPM workshops sponsored by the Hawaii-based East-West Food Institute, it was not an official program until 1978. In that year, the FAO initiated and funded an IPM research program in the Philippines under the FAO Program for Community IPM in Asia (Matteson 2000). Complimentary research was also being undertaken by IRRI on determining pest thresholds, methods for pest surveillance, and the importance of natural enemies and varietal resistance to different pests and diseases (Rola and Widawsky 1998). In addition, IRRI research showed that in six out of the nine study sites throughout Asia, the marginal benefit from prophylactic insecticide use was less than the marginal cost (Herdt 1979).

In the early 1980s, IRRI economists studied the economics of insect control in the Philippines. The results of their research showed that insecticide use, particularly at the levels that they were being applied, is generally not economic in rice cultivation (Herdt *et al.* 1984) and that the yield-enhancing effects of pesticides are very small (Litsinger 1984). IRRI research also showed that insecticides induce resurgence of the BPH, a pest that had risen to prominence with the Green Revolution because the agro-chemicals being used were destroying its predators and parasites (Kenmore 1980). Perhaps ‘one of the worst examples of this phenomenon occurred on the Indonesian island of Java in the 1980s when excessive pesticide use disseminated the insect population that preyed on BHP. The planthoppers’ short breeding cycle then allowed it to breed

unchecked by predators' (Dawe 2006, p 85). Litsinger (1987) traced epidemics of BPH and green leafhopper and their associated viral diseases to chemical use and crop intensification while Magallona (1989) found that insecticides in rice ecosystems caused the eradication of a range of beneficial organisms and resistance in the pests. Moreover, Smith, Litsinger, Bandong, Lumaban and de la Cruz (1989) and Rola and Pingali (1993) established that relying on natural biological control and abstaining from using insecticide is the most profitable choice under normal circumstances.

With the over use of insecticides leading to insecticide resistance in pests, and the growing evidence of negative impacts of the use of pesticides particularly on farmers' health (Maramba 1985; Rola 1989; Pingali and Marquez 1990; Pingali and Palis 1990), the urgency to complement resistant varieties with IPM to economically minimize production risks and protect the environment increased. As a result, the Philippine Rice Research Institute (PhilRice) also became active in IPM research, extension and training (Rola and Pingali 1993, p 65). IRRI also conducted IPM seminars throughout the Philippines. In addition, three pest information publications, namely, *Field Problems of Tropical Rice*, *Helpful Insects, Spiders, Pathogens: Friends of the Rice Farmers*, and *Natural Enemies of Insect Pests of Rice*, were published in 29 non-English editions and made publicly available through IRRI, the FAO Integrated Pest Control Program (IPC) and the DA.

The evolution of the field implementation of IPM philosophy was very much shaped by the FAO Inter-Country IPC Program in Rice in South and Southeast Asia (Teng 1990). The first phase focused on developing and testing the technical aspects of IPM concepts in the 7 participating countries – Bangladesh, India, Indonesia, Malaysia, Philippines, Sri Lanka and Thailand. The program was then directed towards enhancing farmer adoption (Palis 2002). Hence, IPM activities moved from being primarily research-based in 1977 to primarily extension-based by 1987. As a consequence, 'training and visit' extension systems were operational in the Philippines by 1988. As can be seen from Table 2.2, the IPM program resulted in a considerable number of trainers, subject specialists, extension agents and farmers being trained in IPM in rice production from 1984 to 1991. For the eight-year period training costs totaled US\$1.8 million (Sumangil, Daniel and Davide 1991).

Table 2.2: IPM Training in the Philippines: 1984 to 1991

Category	1984-1989	1990-1991	Total
National trainers	98	0	98
Subject matter specialists	1,474	0	1,474
Extension agents	10,887	373	11,260
Farmers	166,672	22,714	189,386
Total	179,131	23,087	202,218

Source: Sumangil, Daniel and Davide 1991

Despite the considerable investment in IPM by IRRI, the FAO IPC Program, PhilRice and the DA, insecticide use in Central Luzon continued to trend upwards from 1986 to 1990 (Figure 4.1) and adoption of IPM was low (Palis 2002). A number of reasons for the low adoption of IPM recommendations in the 1980s have been suggested. They include:

- The centrally-driven recommendations were not specific enough for local ecological variation and often 'collapsed' under the commercial marketing pressure of chemical

companies in an environment where the extension agents feared they would be culpable for crop failure (Kenmore 1996).

- The ETL-based IPM technology was complex requiring significant training to ensure effective implementation, particularly when the simultaneous presence of an array of pests needed to be considered (Sanchez 1989; Palis *et al* 1990).
- Farmers are risk averse and perceive not spraying will cause yield loss and, hence, financial loss (Escalada and Heong 1993). Even farmers who recognized the pest resistant attributes of IR64 still targeted the very pests that IR64 is resistant to (Palis 1998).

Beyond the farm-level impact of IPM, the IPM program was successful in inducing policy changes to strengthen the sanctions of IPM as a means for crop protection. The IPM National Program was initiated by the DA (though the leadership of Dr Jesus S. Binamira, National IPM Program Officer) under the Presidential Memorandum No 126 issued by President Ramos in 1993 (Loevinsohn and Rola 1998). As stated above, while IPM had been declared national policy for crop protection in 1989, uptake at the farm-level was limited (Palis 1998). Nevertheless, the 1993 IPM Program, commonly known as KASAKALIKASAN, built on the earlier IPM research and training activities and lessons learned (Matulac 1993; Stuart 1993). The FAO (through the Inter-Country IPC Program) continuing to play a very important role. In advocacy, the FAO used IRRI research results, among others, to convince Secretary Sebastian to lend full support to KASAKALIKASAN². As such, the five-year IPM training program was in line with the government's commitment to Agenda 21 of the UN Conference on Environment and Development.

Unlike the earlier IPM programs, KASAKALIKASAN delivered an ecologically-based rather than pest-based approach to pest control. The underlying basis of the enhanced IPM was biological control. The four principles were: 'a) grow a healthy crop through the use of resistant varieties, better seed selection processes, and efficient nutrient, water, and weed management; b) conserve natural enemies – beneficial predators and parasites; c) observe the field weekly to determine management actions necessary to produce a profitable crop; and d) farmers become IPM experts and trainers' (Palis 2002).

In addition to the changed basis of pest control, the method of delivery was also changed. Rather than the top-down, lecture-based approach of the earlier IPM programs, season-long IPM Farmer Field Schools (FFS) were developed to a non-formal learning-by-doing approach to IPM extension. In 1991, FAO IPC in Rice in South and Southeast Asia initiated IPM-FFS in the Philippines in the province of Antique through the Antique Integrated Area Development Program (Palis, 2002). In the 1992 wet season, PhilRice, DA, FAO, and IRRI ventured into a collaborative village-level action research referred to as "Barangay Integrated Pest Management Program" (BIPM). The BIPM training, which lasted 16 consecutive Fridays from January to April 1993, was conducted in a FFS put up in Barangay Matingkis, Muñoz, Nueva Ecija. Participants

² While the focus of this paper is on pest control in rice production, it should be noted that IPM Farmer Field Schools (FFS) training among vegetable growers, with the FAO providing technical assistance, was the forerunner of KASAKALIKASAN. KASAKALIKASAN was implemented immediately after the 'cyanide scare' in the Cordillera vegetable industry in 1992, where some vegetable farmers mixed cyanide with the insecticides available at the time, in an attempt to control the diamond back moth -- a course of action which backfired and nearly ruined the vegetable industry. Most of the banned pesticides were found in cabbages.

in the IPM research were trained by fellow farmers from the neighboring Barangay of Bantug who were trained on IPM by PhilRice, IRRI, and FAO during the 1992 dry season. The FAO provided strong technical support in the training process and in developing the FFS curriculum and provided funds for the first season-long rice specialist training course conducted in 1993 in Bayombong, Nueva Vizcaya. (RP becoming IPM country, Manila Bulletin, December 31, 1995) The learning centered on the farmers' experiences and took place in the field. As such, the farmers were given the know-how to choose the most appropriate option for their particular circumstance.

The initial funds (PhP100 million) of the IPM Program (KASAKALIKASAN) (not just the rice component) was sourced from the Japanese KR2 grant. Counterpart funds were provided by local governments, primarily to support the FFS. In the later years, the DA, through the Banner Food Programs, provided funding.

The implementation of KASAKALIKASAN (1993) took cognizance of the decentralization of the agricultural extension system (around 1992). IPM advocacy took a major role, especially in convincing LGU officials to provide counterpart funding for the FFS and to allow extension or agricultural technicians to serve as IPM FFS trainers. The IPM Program required counterpart funding of at least 15% of the cost of FFS. As such, the initial focus of the IPM Program was to establish local government capacity to implement FFS through Training of Trainers activities for LGU extension agents. A municipal-based IPM Training Team is composed of two IPM trained agricultural technician (facilitator) who conducts two FFS every cropping season (Binamira, pers. comm. September 2007).

To obtain an indication of the success of the IPM program, respondents in the 2007 dry season survey, undertaken in Laguna, Nueva Ecija and Quezon, were asked about IPM. Around 18%, 66% and 26% of respondents in Laguna, Nueva Ecija and Quezon said that they had attended IPM training. Of those, over 90% said that their attitude toward pests had changed with 78%, 97% and 85% of the Laguna, Nueva Ecija and Quezon trainees said that they practice IPM. However, while these figures indicate that the KASAKALIKASAN program has been successful in terms of the proportion of farmers who have attended the training (particularly in Nueva Ecija) and the number of trainees that say they have changed practices because of IPM, further research is required to quantify what those changes were and the benefits of the program at the farm and national levels.

2.2 Political Environment

Ferdinand Marcos was the President of the Philippines from 1966 to 1986. The overriding objective for the agricultural sector during the Marcos era (1966-86) was self-sufficiency in rice (Loevinsohn and Rola 1998). It was the responsibility of the National Food and Agriculture Council (NFAC) to implement the food sufficiency program (Rola 1989). At that time, agro-chemicals were seen as essential for the intensification of traditional smallholder agriculture. In 1973, wide and intensive use of agro-chemicals among small farmers was promoted by the Philippine government under a scheme called Masagana 99³. Agro-chemical programs included the timely availability of inputs, a fertilizer subsidy, credit, and farm management supervision. Purchase of fertilizers and pesticides was mandatory and tied to the credit scheme. These credit schemes came under the food programs and, hence, were the responsibility of the NFAC. At the beginning of each growing season, the NFAC provided a list

³ The program was called Masagana 99 because the aim was to produce 99 cavans (or 4950 kg) per hectare. Masagana means bountiful.

of recommended pesticides and practices based on efficacy and user safety. The recommendations also included application rates and approved government prices (Rola 1986).

President Marcos also issued the Presidential Decree 1144 establishing the Fertilizer and Pesticide Authority (FPA) in 1977. While the FPA has the dual mandate of (a) assuring the Philippine agricultural sector of adequate supply of agricultural chemicals at reasonable prices and (b) protecting public health and the environment from adverse consequences inherent in the use of hazardous chemicals, with a target of self-sufficiency in rice, attention was focused on the first mandate.

In 1986, Corazon Aquino became the President of the Philippines. The Aquino era (1986-1992) was one of economic stagnation. With limited resources for agriculture, the objective of agricultural policy was maximization of farmers' income. In principle, cost-saving approaches like IPM were attractive. As a result, President Aquino proclaimed IPM as the official cost-reducing technology for pest control in 1986 and an IPM Advisory Group (IPM-AG) was established. Under the guidance of the IPM-AG, the DA, with assistance from the FAO IPC Program, pursued the objective of making IPM the center of pest control in the Philippines. In 1989, signaling a significant change in crop protection ideology by the government, President Aquino endorsed IPM as the national crop protection policy.

In May 1991, Secretary of Agriculture Senen C. Bacani established the Pesticide Policy Task Force (PPTF) to address the growing and conflicting concerns of government regulators, the pesticide industry, farmer groups and public advocacy groups over the productivity, health, and environmental consequences of pesticide use in the Philippines. The mandate of the PPTF was to provide the Secretary of Agriculture with policy recommendations on pesticide use. It was chaired by Dr Bruce Tolentino, the Undersecretary for Policy and Planning.

President Ramos came to office in June 1992. Under the Ramos administration (1992 to 1998), human and environmental health issues came to the fore. President Ramos appointed Roberto C. Sebastian as Secretary of Agriculture and Frank C. Cornejo as the Administrator of the FPA. Secretary Sebastian and Administrator Cornejo strongly advocated the need to ensure human and environmental health and safety in agricultural production through the judicious use of agrochemicals. This resulted in the 1992 to 1996 pesticide policy package that is of interest in this study, such as the banning or restriction of numerous hazardous insecticides that were commonly used by farmers and the promotion of safe and effective use of pesticides through educational activities and product stewardship by the industry and government.

2.3 International Community

In addition to actively participating in international conferences organized by the FAO and WHO on the harmful effects of toxic agricultural chemicals, the Philippines is party to a number of major international guidelines pertaining to the production, distribution and use of agrochemicals. For example, the FPA follows the WHO international hazard classification of pesticides, which is based on the acute harmful effects of pesticide formulations. Also, as a member of the FAO, the Philippines endorsed the International Code of Conduct on the Distribution and Use of Pesticides adopted by the Twenty-fifth Session of the FAO Conference in 1985⁴. The Code of Conduct serves as a voluntary standard and point of reference for sound pesticide management practices for all organizations involved in pesticide regulation, manufacture and trade. Then in 1992, because of the Ramos government's strong

⁴ The FAO Code of Conduct was published in 1985 and updated in 1989 and then substantially revised in 2002 to reflect changes in management practices and international conventions relating to pesticide use.

environmental agenda, the Philippines became a signatory to the Agenda 21 of the UN Conference on Environment and Development, which provided a framework for Philippines sustainable development programs (Rola 2007 pers. comm.). In addition, just prior to the 1993 to 1996 pesticide policy changes, the FPA set up strong alliances with Canadian counterparts who had just completed a comprehensive review of pesticide laws and policies (Rola; Cornejo 2007 pers. comm.). In August 1991, the Canadian International Development Agency (CIDA) funded a study called the 'Environment and Resource Management Project (ERMP)', based at the University of the Philippines Los Baños (UPLB). One of its objectives was to use the results of project activities to support the Government of the Philippines' environment sector plans and programs, and policy development (Rola pers. comm. 9 July 2007). Mr Versteeg, a Canadian pesticide policy advisor, was also contracted to provide recommendation to the Pesticide Policy Task Force (PPTF), and, hence, the Philippine Government on pesticide policy (Versteeg 1992). Administrator Cornejo (the Administrator of the FPA at the time) also spent some time in Canada looking at Canadian pesticide regulatory policies. Mr Versteeg became an ally and advisor and strongly influenced Administrator Cornejo (Cornejo 2007 pers. comm.).

2.4 Multinational Pesticide Companies

As the Philippines does not have a pesticide manufacturing industry, except for Agchem Manufacturing Company that produces herbicides, imports account for around 95% of domestic sales. During the Marcos Era, the Agricultural Pesticide Institute of the Philippines (APIP), a trade organization representing 24 chemical companies, primarily large multi-nationals, oversaw the 'adequate supply' of pesticides through the importation of registered chemicals as either technical materials (for domestic formulation) or formulated product (Rola 1986). In line with the Government promotion of the use of pesticides through Masagana 99 which commenced in 1973, pesticide companies also actively promoted the use of their agro-chemicals through company-sponsored farmer field days and extension activities. Prior to the 1992 to 1996 pesticide policy package, endeavors by the pesticide industry to educate farmers on safe and effective application, storage and disposal practices were limited (Administrator Cornejo⁵, pers. comm., 26 July 2007).

As pesticides have to be registered with the FPA before they can be imported, manufactured, distributed sold and used in the Philippines, pesticide regulatory policies can directly affect the operation of the multi-nationals. As such, it can be in the interest of the companies to oppose those policies that ban or restrict the sale of commonly used pesticides. This happened in the early 1990s when Hoechst challenged the FPA decision to ban Endosulfan 35 EC (see Section 3). On the other hand, the pesticide industry also either explicitly or implicitly supported the 1992 to 1996 pesticide policy changes through increased stewardship endeavors designed to educate farmers on safe and effective application, storage and disposal practices, and by undertaking research into the development of new environment-friendly compounds that are toxic to pests at low doses.

⁵ Administrator Cornejo worked in the pesticide industry for 30 years prior to becoming the Executive Director of FPA from 1992 to 1996.

2.5 Civil Society and Media

The media and civil society groups can also trigger policy discussions by bringing issues to public attention and keeping them there, or they can provide support to changes in government policy. With regard to the 1992 to 1996 policy changes, the strong stance by the FPA, not to be swayed by chemical industries, attracted considerable media attention, as well as support from civil society groups. The Federation of Free Farmers, for instance, commended Secretary Sebastian for 'seeking to protect the health and safety of millions of farmers and provincial folk' (The Philippines Times Journal, 23 December 1993). Other government departments also supported the policy changes. For example, the Environment Secretary Angel Alcala stated, 'I strongly commend the FPA for taking a strong hand against the sale and use of the pesticides (Brestan 60 EC supplied by Hoechst) to protect not only the people's health but also the environment' (Philippine Daily Inquirer, 26 December 1993).

3 Changes in Pesticide Regulatory Policy and Guidelines

Having examined the factors that could influence policy change, the next step is to examine the policy changes that took place. Here, the discussion is limited to policy changes that directly affect the registration, importation, formulation, distribution, and sale of pesticides in the Philippines. As presented below, while these changes were initiated in the early 1980s, the majority of the effort took place during the early to mid 1990s.

In 1981 and 1983, the FPA banned 17 pesticides for use in the Philippines because of the emerging evidence of adverse health and environmental effects. These included Paris Green, the Organochlorines such as DDT (Dichloro-Diphenyl-Trichloroethane in mosquito coils), 1,2-DIBROMO-3-CHLOROPROPANE (DBCP) and Endrin, the Organosphosphates such as Parathion Ethyl, and some Sodium compounds. The regulations were followed in many other countries and were not contested (Loevinsohn and Rola 1998). Almost seven years later, the FPA's list of banned and restricted pesticides was extended to 24 products including most of the so-called 'Dirty Dozen' (Pesticide Circular No 04; 1989) - a term popularized by an international non-government organisation (NGO) called the Pesticide Action Network (PAN). Banned pesticides can not be brought into and used in the Philippines under any circumstances, while restricted chemicals can be used only under specified conditions.

While restrictions were imposed on the use of Chlordane in construction, Endosulfan away from aquatic ecosystems, DDT for malarial control, Paraquat for institutional use, and Methyl Bromide and other fumigants for use by certified fumigators only, limited human and financial resources and weak institutional infrastructure, at that time, inhibited the full implementation, monitoring, enforcement, and improvement of pesticide laws and policies (Loevinsohn and Rola 1998). The difficulty and controversy surrounding the banning of Organotin and the restriction of Endosulfan from rice production provides a prime example.

Following the ban of Organotin in October 1990, the FPA issued an immediate suspension of the importation, sale, and use of Organotin compounds in agriculture – particularly for use in the control of golden snail in rice fields. The suspended compounds included Brestan 60 EC (supplied by Hoechst Philippines Incorporated), Aquatin 20 EC (supplied by Planter Products Incorporated) and Telustan 60 WP (supplied by the Shell Chemical Philippines Incorporated). To fully enforce this ban, the FPA cleared for sale relatively safe alternatives to Organotin. However, despite the availability of registered alternatives, farmers continued to use Endosulfan-based formulations. The health consequences of the misuse of Endosulfan became evident from a review of hospital cases at the Philippine General Hospital (PGH), which showed that by 1990, Organochlorine poisonings, primarily from Endosulfan, rose significantly with a

mortality rate of 29.7% (<http://www.chem.unep.ch/pops/indxhtmls/manexp7.html>). To try to curb the misuse of this highly toxic chemical, in December 1991, the FPA sent out a notice prohibiting the use of Endosulfan in the control of golden snail.

Following the recommendations of PTAC, the FPA banned Methyl Parathion, Azinphos, Azinphos Ethyl compounds, Monocrotophos and Endosulfan 35 EC in April 1992. As Endosulfan was one of Hoechst's leading chemicals, Hoechst challenged this decision in court on the grounds that the FPA did not follow 'due process' in implementing the ban. The ban was overturned by the court. The FPA Board of Directors then issued a second ban on 29 September 1993 ratifying 'Resolution No 1 (1993)' banning all Organotin compounds, Azinphos Ethyl compounds and all Methyl Parathion compounds for all uses in agriculture, and restricting Endosulfan to 5 EC or lower, and Monocrotophos for use only against beanfly control on legumes. The implementing guidelines issued on 15 November 1993 included: a change of labels on Endosulfan and monocrotophos formulations to conform with the product restrictions; a six month phase-out period; importation requirements; stock inventory requirements; directives on advertising promotional and peripheral materials; product and company coverage; penal provisions; and efficacy. However, the ban was again overturned in the courts as a result of further industry opposition and legal action. Nevertheless, the FPA continued to challenge the ruling and Resolution No 1 (1993) was finally implemented on 1 June 1994.

In addition to the direct bans or restrictions imposed on toxic pesticides, the FPA requested the Philippine banking system not to issue 'Letters of Credit' to any company for the importation of banned pesticides - a policy change that is in stark contrast to the days of Marcos and Masagana 99 when credit was tied to the use of agro-chemicals. Links with the Department of the Interior and Local Government (DILG) were also established to implement the new pesticide regulations. In addition, it became mandatory for Certified Pesticide Applicators (CPAs), to take refresher courses in best practice in pest control. All regional and provincial coordinators were ordered to retrieve and confiscate banned chemicals to forestall serious consequences which may arise as a result of "underground selling" of the banned formulations. The FPA also issued guidelines on the institutionalization of responsible care concept in handling crop protection products requiring all agricultural importer-distributors, formulators, area distributors and institutional users of pesticides to employ at least one Accredited Responsible Care Officers (ARCO). Finally, agro-chemical medical awareness campaigns and training courses, jointly conducted by the FPA, the academe, and the industry, were provided to rural medical officers and farmers. (Dr Lynn Panganiban pers. comm. 1 August 2007).

Despite these efforts, the control of the importation and use of illegal chemicals was difficult in the Philippines. Numerous newspapers reported the illegal importation of banned or restricted pesticides such as Brestan, Thiodan and Endosulfan, primarily from Malaysia (e.g., Nation Today 31 July 1994; Philippine Times Journal 4 August 1994 and 3 October 1994; Philippine Star 11 June 1995; Manila Times 26 June 2000.) Farmers continued to use the illegal chemicals, despite the known health risks and the availability of other chemical and non-chemical alternatives, because they were cheaper than the alternatives⁶. As a result, an inter-agency task force was formed to minimize illegal smuggling of pesticides. In addition, the FPA allowed the use of generic brand pesticides, which, in effect, decreased the cost of pesticides to the farmers, thus reducing the attraction of cheap, but illegal, pesticides (FPA Meeting 26 June 2007, pers. comm.).

In addition to the external changes, institutional changes within the FPA were also occurring. Prior to 1993, the Administrator drew technical advice from PTAC which was composed of

⁶ <http://www.chem.unep.ch/pops/indxhtmls/manexp7.html>

chemists, entomologist, weed scientists, a medical doctor, and other specialists in crop protection. After the policy regulatory reforms in 1993, the committee was reconstituted and became the Pesticide Policy and Technical Advisory Committee (PPTAC). The membership was expanded to include policy specialists, a farmer representative, media or civil society representatives and environmental scientists. The expanded mandate was to provide recommendations on the pursuit of the reformed policy pesticide handbook⁷. In January 1995, the Pesticide Policy Review Committee (PPRC) was established to revise and update pesticide policy and procedures documented in the 1985 FPA book on regulatory policies and the implementing guidelines and procedures. The 2nd edition was published in 2001. The overarching difference between the 1st and 2nd editions is the explicit strengthening of policies protecting public health and the environment. In addition, chapters on policy guidelines for biorational pesticides and product stewardship and responsible care were added.

4 Changes in Pesticide Use and Management Practices

It is clear from the preceding discussion that a concerted effort was made by Secretary Sebastian and Administrator Cornejo from 1992 to 1996 to implement bans or restrictions on insecticides that were considered to be hazardous to human health and the environment, and to follow through on those bans and restrictions by remaining firm when challenged by the industry and by issuing a raft of implementing guidelines. However, given the difficulties with enforcement, the question is whether or not the 1992 to 1996 policy package made a discernable difference at the farm level. The answer to this question is assessed by: (a) examining changes in the trends in the quantity of pesticides used over time (Section 4.1); (b) comparing survey data on the type of pesticides used (Section 4.2) and pesticide handling, and storage and disposal practice (Section 4.3) and (c) looking at whether or not the incidence of pesticide poisoning has fallen (Section 4.4).

4.1 Trends Insecticide Use and Application Rates

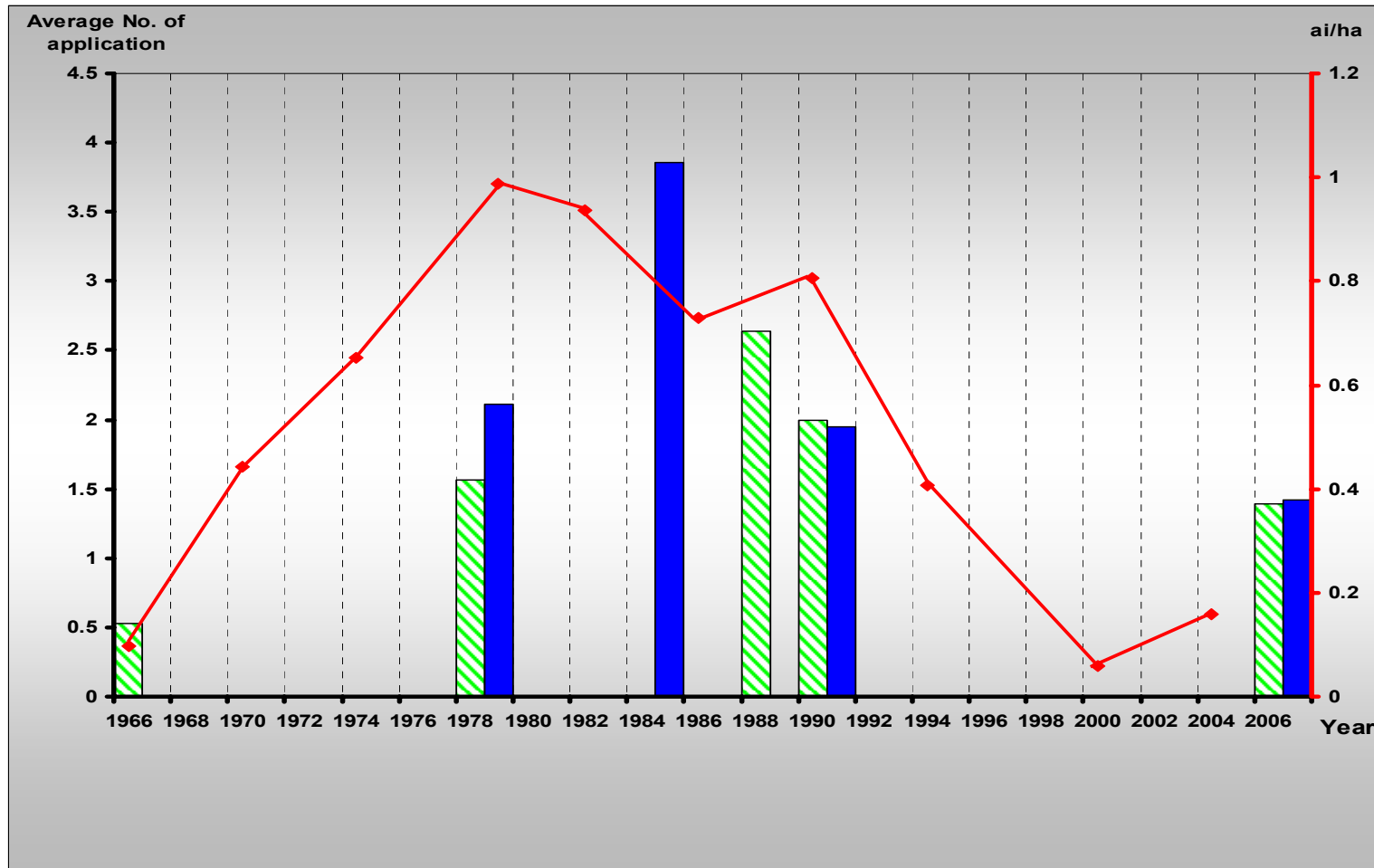
In 1966, IRRI surveyed rice farmers in Central Luzon to obtain economic and social household data. The household surveys were repeated roughly every four years and are collectively known as the 'Loop Survey'. As Central Luzon is the largest irrigated rice growing area in the Philippines, data on insecticide use from the Loop Survey provides an indication of the trend in the intensity of insecticide use in the Philippines from 1966 to 2004. The Loop Survey data on insecticide use, measured in terms of kilograms of active ingredient per hectare (ai/ha), is presented in Figure 4.1.

As can be seen, the trend in insecticide use can be divided into three distinct time periods, namely:

- 1966 to 1979: An era of rapid growth in the use of insecticides with a tenfold increase from 0.1 ai/ha to 1.0 ai/ha in 1979.
- 1980 to 1990: Fluctuating trend but overall gradual, albeit slight, decline to around 0.8 ai/ha in 1990.
- 1991 to 2004: A marked fall in insecticide use to 0.16 ai/ha by 2004, which is only 0.06 ai/ha above the pre Green Revolution levels.

⁷ After Administrator Frank C. Cornejo left the FPA, the PPTAC was no longer convened.

**Figure 4.1: Trends in Insecticide Use and Frequency of Application
Central Luzon (1966 to 2000), Laguna (1966 to 2000) and Nueva Ecija (1979 to 2006)**



Source: Warburton, Palis and Pingali 1995; IRRI 2004; Dawe 2006; IRRI 2007

While the most recent Loop Survey was conducted in 2004, more up-to-date insecticide data is available from the 2007 survey of farmers in Laguna and Quezon and Nueva Ecija. A comparison of the 2006/07 data with the comparative data collected in 1990/91 is presented in Table 4.1. This comparison shows that over the 16 years ending in 2007 farmers in Laguna have decreased insecticide use by 67% in the wet season and 56% in the dry season. Similarly, farmers in Nueva Ecija reduced insecticide use by 54% and 70% in the wet and dry seasons, respectively.

Table 4.1: Change in Insecticide Use in Laguna, Nueva Ecija and Quezon (1990/91 and 2006/07)

Province	1990/91		2006/2007		Difference	
	Wet	dry	wet	dry	wet	dry
	ai/ha	ai/ha	ai/ha	ai/ha	%	%
Laguna (Calabarzon)	0.43	0.48	0.14	0.21	-67	-56
Nueva Ecija (Central Luzon)	0.50	0.60	0.23	0.18	-54	-70
Quezon (Calabarzon)			0.01	0.01		
Weighted Average			0.15	0.16		

Source: Warburton, Palis and Pingali 1995; IRRRI 2007

Another indicator of insecticide use is frequency of applications. The survey data on the frequency of insecticide applications in Laguna and Nueva Ecija largely concurs with data on the quantity of insecticides being used by farmers in Central Luzon. In 1966, 89% of farmers in Laguna either didn't apply any insecticides or applied it only once during the cropping season. The average frequency of insecticide application was 0.53. By the late 1970s, only 3% of farmers in Laguna and no farmers in Nueva Ecija didn't apply insecticides (39%), with the average frequency of application increasing from 0.53 to 1.56. In Nueva Ecija, while no data is available for the 1960s, the average frequency of application was 2.07 in 1979 (Figure 4.1, Tables 4.2 and 4.3). However, contrary to the survey data from Central Luzon, which shows a fall in that the quantity of insecticides used from 1979 to the mid 1980s, the average number of insecticide applications was 3.85 in Nueva Ecija in 1985 and 2.64 in Laguna in 1988, both significantly higher than the levels reported in the late 1970s. Nevertheless, while data on the frequency of sprays is not available for the year 2000, recent survey data shows that by the beginning of the 1990s, the frequency of applications had declined to around 1.4 in both Laguna and Nueva Ecija.

**Table 4.2: Frequency of Insecticide Application in Laguna:
Wet Season 1966 to 2006**

No. of applications	1966		1978		1988		1990		2006	
	No.	%	No.	%	No.	%	No.	%	No.	%
0	18	53	1	3	2	6	2	7	10	20
1	14	41	18	53	8	24	11	38	22	43
2	1	3	11	32	9	27	9	31	12	24
3	1	3	3	9	4	12	2	7	4	8
4	0	0	1	3	5	15	3	10	2	4
5	0	0	0	0	1	3	1	3	1	2
≥6	0	0	0	0	4	12	1	3	0	0
Total	34	100	34	100	33	100	29	100	51	100
Average	0.53		1.56		2.64		2.00		1.39	

Source: Warburton, Palis and Pingali 1995; IRRI 2007

**Table 4.3: Frequency of Insecticide Application in Nueva Ecija:
Wet Season 1979 to 2007**

No. of applications	1979		1985		1991		2006	
	No.	%	No.	%	No.	%	No.	%
0	28	19	0	0	7	8	10	20
1	29	20	6	4	33	35	17	34
2	38	26	29	20	28	30	15	30
3	25	17	24	17	14	15	8	16
4	13	9	36	25	5	5	0	0
5	4	3	16	11	6	6	0	0
≥6	8	6	32	22	0	0	0	0
Total	145	100	143	100	93	100	50	100
Average	2.11		3.86		1.95		1.42	

Source: Rola and Pingali 1993; Warburton, Palis and Pingali 1995; IRRI 2007

4.2 Changes in Types of Pesticides Used

Prior to the 1992 to 1996 policy changes, the insecticides that rice farmers in the Philippines were primarily using include: (a) Organophosphates, namely Monocrotophos, Methyl Parathion and Azinphos Ethyl; (b) Carbamates, primarily Isoprocarb; (c) the Organochlorine, Endosulfan; and (d) the Pyrethroid, Cypermethrin (Table 4.4). These insecticides are all classified as WHO Hazard Class I and II.

As a result of the 1992 to 1996 policy change, all the organophosphates and endosulfan were banned from use in rice production because of their high toxicity. In their place, a number of safer and legally registered alternatives are available for use by rice farmers in the Philippines. While the media reported the continued importation and use of banned or restricted pesticides such as Brestan (which is an organotin), Thiodan and

Endosulfan 35 EC for a number of years after the ban (e.g., Nation Today 31 July 1994; Philippine Times Journal 4 August 1994 and 3 October 1994; Philippine Star 11 June 1995; Manila Times 26 June 2000), 93% of the respondents from the 2007 survey of rice farmers in Laguna, Nueva Ecija and Quezon stated that the banned chemicals are no longer available in the market place, and 90% stated that they no longer use the banned pesticides. Thirteen of the 15 positive responses for the use of banned pesticides [DDT (13) and Sodium Fluoroacetate (2)] came from Quezon where 65% of farm land is planted to non-rice crops, mainly coconuts, and the insecticide application rate is only a fraction of what it is in the other two provinces. There were 13 positive responses for DDT. This is a surprisingly high number given it was restricted for use in the control of Malaria until 1993 when the Department of Health banned it, recommending the use of pyrethroids instead. Only two farmers said they are using Sodium Fluoroacetate, but they may be confusing it with “1081 (Fluoroacetamide)”, a rodenticide which is common in Quezon. Table 4.5 shows the changes in use of different types of insecticides from 1991 to 2007 in Nueva Ecija. Evidently, there has been a significant increase in the number of farmers reporting the use of pyrethroids, and a reduction in the percent of farmers using organophosphates for the two periods.

Table 4.4: Types of Insecticides Applied by Season in Nueva Ecija in 1991 (% of farmers reporting)

WHO Class	Insecticide	1991	
		wet	dry
Organophosphates			
I	Monocrotophos ^a	33	36
I	Methyl Parathion ^b	5	5
I	Azinphos Ethyl ^b	2	1
Carbamates			
I	Carbofuran ^c	3	0
I	Methomyl ^c	0	1
II	Isoproc carb ²	20	33
II	BPMC + Clorpyrifos ²	7	14
Organochlorines			
II	Endosulfan 35 EC ^a	31	27
Pyrethroids			
II	Cypermethrin ⁴	14	16

Notes: a restricted use; b banned completely; c now listed as Cat II.

Source: Rola and Pingali 1993

Table 4.5: Types of Insecticides Applied by Season in Nueva Ecija: 1991 and 2007 (% of farmers reporting)

Generic Name	Dry Season		Wet season	
	1991	2007	1991	2006
Organophosphate	42	30	40	26
Carbamate	48	36	30	36
Pyrethroid	16	42	14	52

Source: Rola and Pingali 1993; IRRI 2007

Further, the wet season 2006 data shows that over 99% of the chemicals being used by the respondents were registered for use in rice production in the Philippines even though 29% of respondents said that they would still use the banned pesticides if they were available despite recognizing the health and safety issues. In sum, the survey results indicate that the FPA has largely been successful in ensuring that less toxic insecticides are being used. Of the registered alternatives, around 61% are classified as Category II, 28% as Category III and 11% as Category IV. As can be seen, Chlorpyrifos + BPMC is by far the most popular pesticide (40.2%) followed by Carbofuran (14.9%), MIPC (13.2%) and Isoprocarb (10.2%) (Table 4.6).

Table 4.6: Types of Insecticides Applied in Laguna, Nueva Ecija and Quezon: Wet Season 2006

Hazard Category	Active Ingredients	Total Quantity of Active Ingredient Used	Total Active Ingredient per Hectare	% of Total Active Ingredient per Hectare
		kg	No.	%
II	Chlorpyrifos + BPMC	10.71	0.0596	40.2
II	Carbofuran	3.96	0.0220	14.9
II	Lambdacyhalothrin	0.40	0.0022	1.5
II	Betacyfluthrin	0.38	0.0021	1.4
II	Phenthoate	0.25	0.0014	0.9
II	Carbaryl	0.25	0.0014	0.9
II	Phenthoate + BPMC	0.18	0.0010	0.7
II	Profenofos	0.13	0.0007	0.5
II	Chlorpyrifos	0.02	0.0001	0.1
III	MIPC	3.50	0.0195	13.2
III	Isoprocarb	2.71	0.0151	10.2
III	Cartap Hydrochloride	0.88	0.0049	3.3
III	Butachlor + 2,4-D IBE	0.22	0.0012	0.8
III	Betacypermethrin	0.09	0.0005	0.4
IV	Cypermethrin	1.55	0.0086	5.8
IV	Malathion	1.14	0.0063	4.3
IV	Ethofenprox	0.21	0.0011	0.8
IV	Deltamethrin	0.03	0.0002	0.1
Total		26.59	0.1480	100.0

Source: IRRI 2007

4.3 Changes in Pesticide Application, Storage and Management Practices

It has been stated that acute poisoning can be traced to unsafe pesticide application, storage and disposal practices (Rola and Pingali 1992, p 37). Unsafe pesticide practices have been documented in several farm-level studies (Pingali and Marquez 1990; Rola and Pingali 1992). The main findings of this research are that even if farmers were aware that pesticides are hazardous, they generally lacked knowledge about proper pesticide management, as awareness of exposure risks, particularly dermal exposure,

was limited⁹. Since these studies were undertaken, as part of the 1992 to 1996 pesticide policy package, the FPA encouraged the pesticide companies to focus more on product stewardship, such that their information campaigns and other extension activities would be more safety-based rather than just marketing exercises. Indeed, a major revision of Philippine pesticide policy was the addition of a new chapter devoted to 'product stewardship and responsible care' (FPA 2001 p 126 - 162). Discussions with pesticide industry leaders indicate that the pesticide industry takes its responsibility of product stewardship seriously with budget allocated for safety campaigns and monitoring (Drs Macatula and Roa pers. comm. 26 June 2007).

The vast majority of the 151 respondents in the 2007 survey acknowledged that pesticides were bad for their health (98%), caused water (91%), air (90%) and land pollution (64%) and lead to a decrease in the population of other animals (92%). They were also asked about their pesticide management practices with particular reference to preventive measures while spraying and after spraying and safe storage and disposal measures. About 69% of the farmer respondents prepare their own pesticide formulations, 63% actually spray the pesticides themselves, and about 44% of the farmers hire a laborer to do the spraying. Almost all of the male respondents determine how much and where to buy pesticides (Laguna = 86%, Nueva Ecija = 78%, Quezon = 84%). While women neither mix nor apply pesticides in Philippine rice farms, about a half of the female spouses (Laguna = 46%, Nueva Ecija = 52%, Quezon = 27%) are indirectly exposed to pesticides through washing pesticide-soaked clothes and about a quarter (Laguna = 26%, Nueva Ecija = 33%, Quezon = 24%) buy the pesticide chemicals (Table 4.7).

Table 4.7: Pesticide Activities Undertaken by Female Spouses: Dry Season 2006

Activity	Laguna	Nueva Ecija	Quezon
	%	%	%
Monitor field after spraying	5.7	13.0	2.2
Treat seeds with pesticides	0.0	0.0	0.0
Spray/apply pesticide	0.0	0.0	0.0
Mix pesticide	0.0	0.0	0.0
Handpick pests after pesticide application	8.6	4.3	2.2
Decide on how much to buy, where to buy	14.3	21.7	15.6
Buy pesticide	25.7	32.6	24.4
Carry pesticide to the field and back to storage area	2.9	0.0	8.9
Clean pesticide equipment and containers	0.0	0.0	4.4
Dispose pesticide containers	0.0	4.3	2.2
Wash pesticide-soaked clothes	45.7	52.2	26.7
Store pesticide and pesticide equipment	0.0	2.2	2.2
Apply pesticide around palay/rice storage area	0.0	0.0	0.0
Dispose unused or expired pesticides	2.9	4.3	0.0

⁹ <http://www.chem.unep.ch/pops/indxhtmls/manexp7.html>

Comparison of farm survey data collected prior to and after the 1992 to 1996 policy changes shows that not only are a significant percentage of farmers following recommended pesticide management and safety practices but that this percentage is considerably higher than it was in 1988/89 (Table 4.8). For example, in 1988/89 only 2% of farmers in Laguna and Nueva Ecija wore both long sleeves and long pants when spraying, compared with 85% in the same two provinces in 2006.

**Table 4.8: Protective Clothing
Laguna and Nueva Ecija
1988/89 and 2006**

Year / Province	No Protective Clothing ^a		Partial Protective Clothing		Long Sleeves and Long Pants	
	No.	%	No.	%	No.	%
Wet season 1988						
Laguna	2	6	30	94	0	0
Dry Season 1989						
Nueva Ecija	1	2	57	95	2	3
Total	3	3	87	95	2	2
Wet season 2006						
Laguna	2	4	5	10	44	86
Nueva Ecija	1	2	7	14	43	84
Total: Laguna & N. Ecija	3	3	12	12	87	85

Notes: a Short pants/long sleeves or t-shirt/long pants

Source: Warburton, Palis and Pingali 1995; IRRI 2007

Furthermore, farmers are far more diligent now when it comes to all the preventive/safety measures (Table 4.9). For example, while 61% of farmers avoided smoking while spraying, 63% avoided spraying into the wind, and 72% avoided spraying when it is hot in 1988/89, by 2007 over 90% of farmers practice these safety measures. While the number of farmers who wash their sprayers after use has not changed, there has been a marked change in the number of farmers who themselves wash immediately after using pesticides, from 6% to 86%. After washing the sprayer, significantly fewer farmers throw the washed water in the irrigation canal (36%), than in the past (83%). Recapping the pesticide bottles has largely always been practiced. Finally, while not as many farmers are re-cycling their bottles as they were in the past, it is still a (negative) activity practiced by more than half the farmers.

Overall, the data indicates that the farmers are very aware of the dangers posed by misuse of pesticides and long-term exposure. They are also more cognizant of, and actual practice, preventive measures. It can, therefore, be concluded that in addition to ensuring that farmers are using safer pesticides than they were in the past, the information on the safe use of pesticides appears to have not only reached the farmers but been translated into safer farm practices on the ground.

**Table 4.9: Pesticide Management and Safety Practices
Nueva Ecija 1991 and 2006**

Preventive / Safety Measures	Nueva Ecija	
	1991	2006
	%	%
Avoid smoking while spraying	61	92
Avoid spraying into the wind	63	94
Avoid spraying when very hot (before 8:30 am)	72	92
Eat or drink before spraying	9	78
Washes immediately after spraying	6	86
Wash sprayer after use	83	84
Wash-water not thrown in irrigation canal	17	64
Recap bottle after use	83	86
Do not re-cycle empty bottles	17	34

Source: Warburton, Palis and Pingali 1995; IRRI 2007

4.4 Changes in the Incidence of Pesticide Poisoning

In the Philippines, the NPMCC¹⁰, under the University of the Philippines-Manila, is responsible for monitoring pesticide poisoning cases. Data on the incidence rates of acute pesticide poisoning is presented in Table 4.10. While the data on the number of acute pesticide poisonings is not directly comparable, because the number of regions covered in each study varies¹¹, the incidence rates (that is the number of poisonings per 100,000 people) fell from 3.27 during 1982 to 1985 to 1.08 during the five years ending 1995.

**Table 4.10: Incidence Rates of Pesticide Poisoning
Philippines 1982 to 1995**

Source	Year	No. of pesticide poisoning	Incident rate (per 100,000)
Department of Health (12 regions)	1982-1985	1,704	3.27
NPCIS National Capital Region	1986-1990	221	2.6
NPCIS (Region XI)	1986-1990	166	4.08
Department of Health (6 regions)	1991-1995	336	1.08

Source: Panganiban (2002)

In addition to the data on the number of reported cases of pesticide poisoning, the types of pesticides which caused illness or death were also collected in two Philippine Department of Health (DOH) studies (1982-1985 and 1991-1995) and a joint study by

¹⁰ Formerly the National Poison Control and Information Service (NPCIS)

¹¹ The Philippines is divided into three major geographical areas, Luzon, Visayas, and Mindanao which are sub-divided into a total of seventeen regions.

WHO, the DOH and National Poison Control and Information Service (NPCIS) (2000-2001) (Table 4.11). Clearly, in the two earlier time periods (before the 1992-1996 policy changes were fully implemented), the majority of poisoning cases were caused by Organophosphates, with a fatality rate of around 16% in the 1982-1985 time period and 19% in the 1991-1995 time period. The second highest number of cases was due to Organochlorines with fatality rates of almost 50% during 1982-1985 and 33% during 1991-1995. During 1982-1985, the Carbamates caused 14% of poisoning cases while Pyrethroids were reported as the third highest cause of pesticide cases in 1991-1995. In contrast, Pyrethroids accounted for the highest number of acute poisoning in 2000 to 2001, followed by Organophosphates and Carbamates. The respective fatality rates were 2%, 10% and 6%, reflecting the relative toxicity of the compounds.

**Table 4.11: Type of Pesticide Poisoning
1982-85, 1991-95 and 2000-2001**

Pesticide	Department of Health (12 regions)		Department of Health (6 regions)		WHO; Department of Health and NPCIS (4 regions)	
	1982-1985		1991-1995		2000-2001	
	Cases	Deaths	Cases	Deaths	Cases	Deaths
Organophosphates	714	116	215	41	59	6
Organochlorines	326	161	49	16	9	2
Carbamates	238	10	9	2	31	2
Pyrethroids	20	0	27	1	89	2
Chlorophenoxy cpds	18	1	9	2	13	1
Rodenticides	21	0	10	1	7	0
Fungicides	2	0	1	0	10	1
Herbicides	22	2	9	0	3	0
Mixture	36	3	7	0	26	1
Others	39	3	0	0	12	2
No Information	268	36	0	0	68	1
Total	1,704	332	336	63	327	18

Source: Panganiban (2002; 2005)

When examining the above data in the context of the health affects of pesticide use in agricultural production, there are two points worth considering. First, the majority of cases of acute poisoning were intentional rather than due to occupational hazard. For example, of the 4,031 acute pesticide poisonings reported by government hospitals from 1980 to 1987, 603 cases resulted in death and the majority of these cases were suicidal (64%). A further 16% were classified as accidental and 14% occupational (Philippine Health Statistics 1990). In addition, the numbers of reported poisonings is likely to be an underestimate as not all cases of poisoning reach hospitals or rural health officers, and even when they do, they maybe incorrectly diagnosed (Casanova, Pedrajas and Querubin 1984; Palis 1998). Therefore, while hospital records provide an indication of the trend in pesticide poisoning and those pesticides that are responsible for acute poisoning in both rural and urban areas, detailed surveys of rice farming households provide additional and vital information on the prevalence of health impairments due to long-term pesticide exposure in agricultural production. For example, Rola (1989) reported that almost 50% of respondent farmers surveyed in 1987 in rainfed and

irrigated areas in Iloilo Province (Western Visayas) experienced illness while applying pesticides. In addition, of the 60 respondent farmers in Nueva Ecija surveyed in 1989, 69% experienced headaches or dizziness, 24% experienced vomiting, 16% became unconscious, while 22% experienced other symptoms such as weakness and stomach pains. Also, as discussed below, results of the analysis undertaken by Pingali, Marquez, Palis and Rola (1995) showed that eye, skin, respiratory, gastrointestinal and neurological problems are significantly associated with long-term pesticide exposure.

Since these surveys were undertaken, the FPA banned Monocrotophos, Methyl Parathion, Azinphos Ethyl and Endosulfan, which were the most widely-used insecticides and the major causes of insecticide poisoning. A comparison of the results from the 2007 survey of farmers with the 1989 Nueva Ecija and 1988 survey data show that the number of farmers reporting pesticide illness has fallen (see Table 4.12). This data indicates that the 1992-1996 pesticide policy changes have been successful in reducing the incidence of pesticide poisoning, supporting the survey results on changes in the type of pesticides used and the changes in pesticide practices.

Table 4.12: Percent of Poisoning Cases Reported by Surveyed Farmers Nueva Ecija (1989 and 2007), Laguna (1988 and 2007) and Quezon (2007)

Symptoms	Nueva Ecija		Laguna		Quezon
	1989	2007	1988	2007	2007
	%	%	%	%	%
Headache, dizziness	69	16	25	20	18
Vomiting	24	10	31	12	2
Other	38	25	53	28	34
Cases reported / no. of respondents	1.1	0.52	0.97	0.59	0.54

Source: Warburton, Palis and Pingali 1995; IRRI 2007

5 Estimating the Economic Benefits of the Changes in Pesticide Use and Management Practices

It is clear from the survey data presented above that, since the mid to late 1990s, there has been a reduction in the quantity of insecticides used by rice growers and an increase in the adoption of less toxic insecticides and safer pesticide management practices. Following Pingali, Marquez and Palis (1994) and Pingali, Marquez, Palis and Rola (1995), the economic value of these changes can be measured in terms of reduced health costs¹².

In this Section, the reduction in health costs are estimated first (Section 5.1). This estimate is then combined with the annual area grown to rice over a 30-year time period and a 'compliance rate', and then discounted by 5% to obtain an measure of the present value of the total benefit (in terms of private health costs avoided) due to the changes in insecticide use and management practices (Section 5.2). An estimate of how much of the total benefit is attributable to the policy change is given in Section 5.3.

¹² The reduction in the quantity of pesticides used could translate into a measurable benefit to farmers as a reduction in production costs. Further benefits could also arise from yield increases due to reduced losses from pest resurgence. However, measuring these production-based changes is outside the scope of the study.

5.1 Estimation of Farmers' Private Health Costs

Estimation Procedure and Health Cost Model

In the policy-orientated research undertaken by IRRI (Pingali, Marquez and Palis 1994; Pingali, Marquez, Palis and Rola 1995), economists and a medical doctor jointly assessed the effects of prolonged pesticide use on human health to identify the level of impairments and to quantify these impairments relative to the level of pesticide use. To undertake this analysis, two sample groups of farmers/farm workers with long-term exposure to pesticides were compared with a sample group of farmers with no history of pesticide exposure. The exposed group included 31 farmers and 25 pesticide applicators from Laguna and 42 farmers and 15 pesticide applicators from Nueva Ecija. The Laguna farmers were moderate users of pesticides, while the Nueva Ecija farmers were heavy users (see Table 5.1). Both groups had been exposed to pesticides (particularly Organophosphorous compounds) for 15 to 25 years. The unexposed group included 39 farmers from Lucban, Quezon, where insecticide use for rice cultivation was not common.

Farm data were obtained from weekly monitoring of the 152 farm households during the 1989 to 1991 period, with an emphasis on input use, pest control methods, and pesticide handling and storage practices. The exposed and control groups were also brought to IRRI for detailed medical assessments after the 1989 wet season and the 1990 dry season. Medical data were obtained from interviews, detailed physical examinations, a succession of laboratory tests, and exposure history.

The cross-sectional data were used to define a set of medical indices of pesticide exposure. These include eye, skin, respiratory, cardiovascular, gastrointestinal and polyneuropathy effects. (For a detailed description of these effects and the empirical evidence of the relationship between the health impairments and pesticide, see Pingali, Marquez and Palis (1994)). The medical indices were related econometrically using logit regressions to a set of other characteristics such as age, nutritional status, tobacco and alcohol consumption, and occupational exposure to pesticides (including insecticides and herbicides). The health cost estimation includes the treatment costs (including medication and doctor's fees) and the opportunity cost of farmers' time lost in recuperation. The following log-linear relationship was assumed in the estimation:

$$\ln HC = f(\ln AGE, WTHT, DS, DD, \ln DOSEI, \ln DOSEH) \quad (3)$$

where:

$\ln HC$	=	log of health costs in PhP
$\ln AGE$	=	log of farmer's age
WTHT	=	Farmer's weight (kilograms) by height (meters)
DS	=	0=non-smoker; 1=smoker
DD	=	0=non-drinker; 1=drinker
$\ln DOSEI$	=	log of insecticide dose ^a
$\ln DOSEH$	=	log of herbicide dose ^a

a Dose = total ai used/recommended ai

The regression results of the health cost function are as follows:

$$\ln(\text{HC}) = 4.366^{***} + 1.192^{***} \ln(\text{AGE}) - 0.0756^{**} \text{WTHT} + 0.916^{***} \text{DS} - 0.530^{***} \text{DD} + 0.486^{**} \ln \text{DOSEI} - 0.042 \ln \text{DOSEH} \quad (4)$$

$R^2 = 0.30$ *** significant at 1% **5%

The amount of insecticides applied by farmers and pesticide applicators significantly influences farmer health costs. Costs increase by 0.49% for every 1% increase in insecticide dose. Herbicide dose is not a significant factor in estimating health costs, but age, weight by height, smoking, and drinking habits significantly influence health cost values.

The estimated coefficients from equation (4) were then used to estimate expected health costs of farmer practices in insecticide use. The mean health cost was based on estimates for a non-smoker, non-drinker farmer population, with an average age of 44 years, a weight-height ratio of 23.5, an average herbicide dose of 0.5 and an average insecticide dose of 2. Pingali, Marquez and Palis (1994) and Pingali, Marquez, Palis and Rola (1995) estimated the increase health costs associated with pesticide use was PhP1849 based on farmers' practice for pest control at the time of their study.

Before proceeding, it should be noted that:

1. While the dose for insecticide and herbicide under farmers' practice are 2 and 0.5 respectively, they are specified as 3 and 1.5 in the health cost model to account for the fact that the log of 1 is zero.
2. The per person value for health cost was standardized because farmers operate different size farms such that it is PhP per person per hectare per season.
3. While the regression results of the health cost function are based on data obtained from a relatively small sample size ($n = 152$), the comprehensiveness of the data collected and the homogeneity within each of the sample groups, increases the robustness of the results of the analysis. In addition, as the respondents in the three areas correspond to high, medium and low pesticide users, the results of the model are generally representative of the average Filipino farmer.

Measuring the Change in Health Cost

The impact of the actual change in insecticide use and management practices on farmers' health costs can be simulated by holding all parameters in equation 4 constant except the variable for insecticides¹³. The simulated results can then be compared with the health costs estimated in Pingali, Marquez, Palis (1994) and Pingali, Marquez, Palis and Rola (1995). Because it was undertaken before the implementation of the 1992 to 1996 policy package, it provides baseline data for the 'before-policy' scenario (scenario

¹³ While the characteristics of the respondents from the 1989 to 1991 survey may differ slightly from the 2006/07 respondents, and insecticide use has fallen during this period, farmers in Nueva Ecija are still relatively heavy users of insecticides, while Laguna farmers are still moderate users and Quezon farmers are still very low users.

1). The results of the simulations reflecting the reduction in the quantity of pesticides used and/or changes in pesticide management practices, and the difference between the simulated results and the base results are presented in Table 5.1. The estimating equation for scenario 1 is:

$$HC_1 = \text{EXP}(4.366 + 1.192 \times \ln 44 - 0.0756 \times 23.5 + 0.916 \times 0 - 0.53 \times 0 + 0.486 \times \ln 3.00 - 0.042 \times \ln 1.5) \quad (5)$$

Hence, under scenario 1, the estimated health cost is PhP2033¹⁴ per season (equation 5) or PhP4,065 per year. This figure is in 1991 values but, using the CPI it can be converted to its 2006 equivalent, which is PhP10,459.

Under scenario 2, the regression results are used to estimate average health costs to reflect changes in the quantity of insecticides used, keeping all other factors constant including the type of insecticide used and pesticide management practices. However, as stated above the original health cost function is specified using insecticide dose, rather than quantity, as an explanatory variable. Unfortunately current estimates for dose are unavailable. As a result, the average percentage fall (39%) in the quantity of insecticide used (Table 4.1) and the number of spray (Tables 4.2 and 4.3) is used as a proxy for the change in dose. Using this figure, equation 6 estimated as follows:

$$HC_2 = \text{EXP}(4.366 + 1.192 \times \ln 44 - 0.0756 \times 23.5 + 0.916 \times 0 - 0.53 \times 0 + 0.486 \times \ln 2.23 - 0.042 \times \ln 0.5) \quad (6)$$

The simulated reduction in health costs (in 1991 values) is PhP274 per season (equation 6) or PhP547 for the year. This is equivalent to PhP1,408 in 2006 terms.

In a similar procedure, changes in health costs are also estimated for changes in farmer practices in insecticide use, holding all other factors, including insecticide dose, constant. Under Scenarios 3 and 4, it is assumed that the toxicity of the insecticides used in the dry season 2006 and the wet season 2007 are 50% and 90%, respectively, less than they were in 1991. The reduced toxicity stems from the fact that the farmers no longer use Category I pesticides (which have an acute toxicity rating 10 times higher than Category II pesticides) and a much higher percentage of the farmers have adopted safer pesticide management practices (Section 4.3). The 50% and 90% reductions, upper and lower bounds to reduced toxicity, are considered to be realistic according to Dr Panganiban, who is a prominent Philippine expert in pesticide toxicity and human health (pers. comm. 1 August 2007)¹⁵.

¹⁴ This value is almost 10% higher than the value reported in Pingali, Marquez and Palis (1995). Unfortunately the original estimating equations and data are not available so it is not possible to account for this difference. As such, it was determined that the best way forward is to use the higher figure as the baseline value for the purpose of this study (Drs Pingali and Palis pers. comm., 30 January 2008).

¹⁵ It could also be argued that as farmers were not using only Category I insecticides in the early 1990s but also some Category II insecticides the toxicity would not be reduced by the full 90%. However, it is not only the change in the type of insecticide but also the change in the pesticide management that drives this figure.

Table 5.1: Simulated Estimates of Reduced Health Costs

Scenarios	Heath Cost Estimate		With- and Without-Change Difference			
	Average Season	Annual	Average Season Difference	Annual Difference (1991 base year)	Annual Difference (2006 base year)	Annual % change
Without Change Scenario						
1. Baseline health cost estimate (1991)	2033	4065	na	na	na	
With Change Scenarios						
2: Reduction in insecticide use	1759	3518	274	547	1408	-13
3: Change in type and practices toxicity reduced to 50% of base levels	1547	3095	485	970	2496	-24
4: Change in type and practices toxicity reduced to 10% of base levels	1302	2604	730	1461	3759	-36
5: Reduction in insecticide use and a 50% fall in toxicity	1504	3008	529	1057	2721	-26
6: Reduction in insecticide use and a 90% fall in toxicity	1261	2521	772	1544	3972	-38

These scenarios are simulated by simply reducing the insecticide dose variable by 50% (equation 7) and 90% (equation 8). As can be seen from Table 5.1, the annual reduction in health costs under scenario 3 is PhP2,496 (in 2006 values) and PhP3,759 (in 2006 values) under scenario 4.

$$HC_3 = \text{EXP}(4.366 + 1.192 \times \ln 44 - 0.0756 \times 23.5 + 0.916 \times 0 - 0.53 \times 0 + 0.486 \times \ln 2.00 - 0.042 \times \ln 0.5) \quad (7)$$

$$HC_4 = \text{EXP}(4.366 + 1.192 \times \ln 44 - 0.0756 \times 23.5 + 0.916 \times 0 - 0.53 \times 0 + 0.486 \times \ln 1.20 - 0.042 \times \ln 0.5) \quad (8)$$

Scenarios 5 and 6 reflect a combination of the reduction in insecticide use and the changes in pesticide management practices, which are simulated using equations (9) and (10). As can be seen from Table 5.1, the fall in insecticide use, combined with a 50% reduction in toxicity, results in annual health costs that are PhP2,721 (in 2006 pesos) lower than the without-policy change estimate. Similarly, the fall in insecticide use, combined with a 90% reduction in toxicity, results in a PhP3,972 (in 2006 pesos) reduction in health costs.

$$HC_5 = \text{EXP}(4.366 + 1.192 \times \ln 44 - 0.0756 \times 23.5 + 0.916 \times 0 - 0.53 \times 0 + 0.486 \times \ln 1.614 - 0.042 \times \ln 0.5) \quad (9)$$

$$HC_6 = \text{EXP}(4.366 + 1.192 \times \ln 44 - 0.0756 \times 23.5 + 0.916 \times 0 - 0.53 \times 0 + 0.486 \times \ln 1.123 - 0.042 \times \ln 0.5) \quad (10)$$

While the above measure of health costs (Pingali *et al* 1994; 1995), which includes medical costs and the opportunity cost of reduced productivity, is relatively comprehensive, it could still be considered an under-estimation of the total cost for the following reasons:

- The strength of the detailed medical assessment lies in its ability to detect chronic and sub-acute effects; a weakness is the inherent bias to survivors. Moreover, the medical examinations measured symptoms associated with long-term exposure to pesticides, while pesticide application data used in the estimation were for a single season. Therefore the regression results may have underestimated the size of the relationship between pesticide exposure and health impairments (Antle and Pingali 1994).
- The opportunity cost is limited to rice growing and does not include the lost ability to earn off-farm income. However, as over 90% of the farm area is devoted to rice in irrigated and rainfed rice farms, and off-farm income in the surveyed areas is less than 10% of the total income, this limitation is not considered to be significant.
- There could be other non-quantifiable health-related utility gains that are not included in the health cost estimation. These could stem from:
 - The general sense of feeling well.
 - Knowledge that other household members no longer have to spend caring for those affected by pesticide exposure.
 - Knowledge of the reduced risk of chronic and terminal affects of pesticide use.
 - Knowledge of the reduced risk of intentional and unintentional death caused by insecticides.

- The effect of pesticide exposure to other family members is omitted from the analysis. However, while women wash clothes that contain pesticides, they do not mix or spray the pesticides and so their exposure is relatively limited.
- The reduced economic burden on the public medical system due to a fall in pesticide-related illness is not included because of lack of data.

Notwithstanding the importance of the omitted private and public gains from the reduced use of pesticides and changes in pesticide practices, the computations under scenarios 5 and 6 provide reasonable *base* estimates of the reduction in health costs. As such, these two figures are used to estimate the upper and lower bound of economic gains from the change in pesticide use and practices.

5.2 Economic Benefits due to the Change in Health Costs

In line with the estimation of the reduction in health costs under scenarios 5 (reduction in insecticide use and a 50% fall in toxicity) and 6 (reduction in insecticide use and a 50% fall in toxicity), upper and lower bound estimates of total economic benefits are calculated. This is done multiplying the change in health costs by annual data on the number of hectares used in rice production and a 'compliance' rate to obtain an annual gross value.

It could be argued any policy change would result in an immediate compliance of 100%. However, this is not always the case, as 100% enforcement of a policy change is often impossible. With this in mind, in this study, it is assumed that the decrease in insecticide use and change in pesticide management practices happened gradually reaching a maximum adoption level of 80%. The underlying premise for this assumption is that it takes time for farmers to receive information on alternative pesticide and pest control practices and then to respond to information. Even an outright ban on pesticides did not result in immediate compliance as evident from the FPA circulars and media reports. The relatively high maximum level of adoption of 80% is based on 2006/2007 survey which shows that over 99% of the chemicals being used by the respondents were registered for use in rice production in the Philippines and over 80% have adopted safer pesticide managements (Section 4.3).

The gross value of the annual benefits is then discounted, using a 5% discount rate, to obtain a present value of benefits over a 30 year simulation period¹⁶. The 30 year time span is then divided into two distinct time periods, 1989 to 2006 and 2007 to 2018, to provide estimates of realized and projected benefits.

The results of the analysis are summarized in Tables 5.2 for scenario 5. The present value of the lower-bound economic benefit from the reduction in insecticide use and a change in pesticide management practices is estimated to be around US\$3.3 billion, comprising of just under US\$1.6 billion realized benefits and US\$1.8 billion projected benefits. As these figures seem large, they were benchmarked against the present value of the gross value rice production. The present value of benefits for the 1989 to 2018 time period is around 4% of the gross value of total rice production for the same period, indicating that aggregated benefits arising from lower health cost are plausible.

¹⁶ Both a 5% discount rate and a 30 year simulation period are typically used in impact assessments.

Table 5.2: Summary Estimates for Scenario 5 - Reduction in Insecticide Use and a 50% Fall in Toxicity

Description	US\$ Million
Realized present value of benefits (1989 to 2006)	1,575
Projected present value of benefits (2007 to 2018)	1,753
Total present value of benefits (1989 to 2018)	3,328
Total PVB as a % of total PGVP	4.2

The upper bound estimates are presented in Table 5.3. Under the assumption of a 90% reduction in insecticide use, the estimated present value of total gross benefits is over US\$4.9 billion, with the realized and potential benefits being approximately equal to US\$2.3 billion and US\$2.6 billion, respectively. In this case, the upper-bound cumulative estimate of the flow of benefits over the 30 years ending 2018 is equivalent to roughly 6% the gross value of rice production for the same time period. Hence, these estimates also appear to be plausible.

Table 5.3: Summary Estimates for Scenario 6 - Reduction in Insecticide Use and a 90% Fall in Toxicity

Description	US\$ Million
Realized present value of benefits (1989 to 2006)	2,300
Projected present value of benefits (2007 to 2018)	2,559
Total present value of benefits (1989 to 2018)	4,859
Total PVB as a % of total PGVP	6.2

5.3 Attributing the Economic Benefits to the 1992-1996 Pesticide Policy Package

In Section 5.1, the economic benefits of a change in health costs (under two plausible scenarios) were estimated. These changes in farmer health costs (which drive the results) are based on the observed reduction in the quantity of insecticide used in rice production and the change in pesticide management practices including a switch to less toxic insecticides.

From the preceding sections, it is clear that the 1992-1996 pesticide policy package represent a multi-pronged approach to the safe and effective use of pesticides that directly targeted:

- regulatory policies and implementing guidelines on the importation, formulation, distribution, sale and use of pesticides;
- regulation on the labeling and advertising of pesticides;
- hazard awareness through the agro-medical training program which aims at training rural health officers on the recognition and treatment of pesticide poisoning cases as well as training the dealers, farmers and DA field personnel on the safe handling of pesticides;

- the judicious use of pesticides through FFS-based IPM training involving farmers, trainers and crop production specialists; and
- enhanced product stewardship undertaken jointly by the pesticide industry and the government.

However, simply measuring the before-and after-policy change scenarios may lead to an overestimate of attribution because the observed changes in pesticide use and management may not be due solely to the 1992 to 1996 pesticide policy package. Hence, other possible factors need to be considered to determine a 'without-policy' scenario (the counterfactual) to obtain an accurate measure of the benefits attributable to the 1992 to 1996 policies. Unfortunately, the without-policy scenario is not observable so the analysis here is limited to subjective assessment of those factors (outside the policy changes) likely to affect pesticide use and management practices. Here, two major points are worth considering:

First, the downward trend in the quantity of insecticides used in rice production started three years prior to the implementation of the targeted policies and may have continued, albeit at a slower rate, even if the 1992 to 1996 pesticide policy package was not implemented. The factors (outside the policy arena) that may have contributed to a continued reduction in pesticide use include:

- The continued spread of pest-resistant varieties such as IR64 and PSBRc 82 (Section 2.1). Offsetting this is the adoption of hybrid rice (which is not as pest resistant as the bred lines) in some areas – although adoption levels have been low in the Philippines.
- A fall in the real price of rice particularly in the early 2000s as farmers are likely to spend less on agricultural inputs. However, the real world price of rice has trended upwards since 2001 but the quantity of insecticides used has remained low.
- A two- to three-fold increase in the cost of insecticides (for a given quantity) from 1991 to 2007. Results from a number of household surveys provide some indication of farmers' response to an increase in the price of pesticides. For example, a study of potential IPM farmer cooperators in Laguna revealed that for 40% of the respondents, price would affect their decisions of whether or not to use pesticide inputs (Rola, Chupungco, Adalla, Hoque, Stuart, Sumayao 1988). Similar results were found from a survey of farmers in Iloilo, Visayas, with 41% of farmers stating that increases in the price of pesticides would induce them to use less (Rola 1989). More recently, 52% of respondents from the 2007 dry season survey of farmers in Laguna, Nueva Ecija and Quezon stated that they would reduce the amount of pesticides they used if the price of insecticides increased, with 26% of respondents said they would discontinue use. In addition, 68% of respondents said that they would buy cheaper brands if available. These findings concur with the findings of Rola and Pingali (1993, p36) who stated 'Filipino farmers prefer OPs (organophosphates) to OCs (organochlorines). Organophosphates such as methyl parathion, monocrotophos, and azinphos ethyl are cheaper, widely available, and known for wide-spectrum toxicity. ... Rice farmers also use carbamates which, together with pyrethroids such as cypermethrin, are classified in the moderately hazardous category. However, current prices, almost twice as high as those for OCs and OPs, discourage

farmers from using pyrethroids.¹⁷ This is despite the fact that pesticide costs account for only 2% of the total value of the rice crop (Dawe 2006). Regardless, the increased cost of insecticides was largely due to the 1992-1996 pesticide policy package because of increases in registration, licensing and import fees, and the banning of cheaper Organochlorines.

- Changes in the pesticide tariffs and taxes. From 1991 to 2006, a 10% tariff rate on pesticides was applied to raw and finished material and 5% to intermediate material. Pesticides are also subjected to a value added tax, which was 10% up until 2005 under the National Internal Revenue Code of 1997. In 2006, it was increased to 12%. Therefore, given there has been no change in tariffs and only a marginal change in the value-added tax since 1991, any affect that this may have had on pesticide use is considered to be negligible.

Second, the chemical companies are responding to health and environmental concerns in the development of new pesticides. As such, they are not only developing pesticides that are effective at lower levels of active ingredient (a.i.), the a.i. itself is more specific to the target pest and less toxic to humans and the environment. However, as the price of the 'sophisticated' pesticides is higher compared to the broad spectrum products, it is likely that resource poor Filipino farmers would opt for the cheap, even if more hazardous insecticides, as they had in the past, if it were not for the bans and restrictions.

Recognizing that factors other than the 1992-1996 pesticide policy changes are likely to have contributed to the observed changes in insecticide use and pesticide management practices suggests that attribution should be based on relative importance. While quantification of the cause-and-effect scenarios for such a complex issue is very difficult, given the purpose and broad coverage of the 1992 to 1996 policy changes, including the effect it had on the cost of insecticides, it seems reasonable to assume that the policy package was the primary driver of the change in insecticide use and practices. Consequently, a conservative measure of the contribution of the 1992 to 1996 pesticide policy package to the welfare gains from the reduction in health costs is 75%.

The range of estimates under the 75% attribution assumption for the two scenarios is presented in Table 5.4. The present value of benefits for scenario 5 under the 75% attribution assumption are US\$1.2 billion (realized), US\$1.3 billion (projected) and US\$2.5 billion (total). The corresponding figures for scenario 6 are US\$1.7 billion (realized), US\$1.9 billion (projected) and US\$3.6 billion (total). Hence, the estimated realized benefits range from US\$1.2 million to US\$1.7 billion and the estimated total benefits range from US\$2.5 billion to US\$3.6 billion.

¹⁷ Administrator Cornejo also stated that farmers preferred to use the cheaper, although more hazardous, alternatives to pyrethroids because pyrethroids were twice as expensive as available OPs (pers. comm. 2 August 2007).

Table 5.4: Estimates of the Welfare Gains Due to the 1992 to 1996 policy package under Scenario 5 and Scenario 6

Description	Scenario 5 US\$ Million	Scenario 6 US\$ Million
Realized present value of benefits (1989 to 2006)	1,181	1,725
Projected present value of benefits (2007 to 2018)	1,315	1,920
Total present value of benefits (1989 to 2018)	2,496	3,644

6 Factors that Influenced the 1992 to 1996 Policy Change

Now that the economic benefits attributable to the 1992 to 1996 pesticide policy package have been estimated, the next step is to examine the factors that influenced the policy package. As stated in Section 1, this is not a straightforward task; nor is it easily quantifiable because, as stated above, there are many different influences on a policy-makers decision-making process. In this study, the subjective assessment of the factors that influenced the changes in the regulatory pesticide policies and implementing guidelines that took place between 1992 and 1996 is based on information from a number of key informants. They included past and present FPA officials, members of PPTAC and PPRC, the National IPM Program Coordinator, members of the pesticide industry and an agricultural economist. In addition, a thorough media review was undertaken to gain an understanding of how 'news-worthy' the issues surrounding pesticide use, its impact on human health and the changes to the pesticides regulations were.

6.1 Major Findings from the Subjective Assessment

The opinions of key informants on factors that influence the policies in question were largely obtained through face-to-face discussions. While some one-on-one interviews were held, the FPA and the industry representative requested a group interview. The interviews were largely unstructured or free-flowing. A summary of the interviews was typed up afterwards and sent by e-mail to the informants to ensure that there were no major errors or omissions in the record¹⁸.

A notable omission from the list of key informants is a representative from the NGOs or civil society groups that are often anti-pesticide advocates. Rather than interview a representative from the media, a detailed literature review was undertaken.

Given the range of people interviewed and the fact that it is 15 years since the time of the policy changes, it is not surprising there are some divergent views with regard to the factors that influenced the 1992 to 1996 policy package. A simple cross-tabulation of these views is presented in Table 6.1, where the comments from the informants about the level of influence are categorized as H = high, M = medium, L = low and 0 = zero, and '-' where the influencer was not mentioned.

Before proceeding, it should be noted that a major enabler of the 1992 to 1996 policy change was the policy environment at that time. It was characterized by a strong political will, a receptiveness to change, and the existence of trust between and among those most responsible for policy - President Ramos, Secretary Sebastian and Administrator Cornejo and members of PPTAC, and between Secretary Sebastian, Dr Binamira and PPTAC (Administrator Cornejo and

¹⁸ Except in the case of Professor Agnes Rola who sent her "perspective" by e-mail.

Dr Binamira pers. comm. 2007). The importance of this enabling environment can not be overstated. However, in this analysis, it is being treated as an enabler to change rather than an influencer of change. Further, while PPTAC played an essential role in providing the FPA with policy advice, it is seen here as being a communication vehicle rather than an influencer as such.

Turning to Table 6.1, the influencer that was subjectively ranked the highest is local health-related research. This included health studies from the medical profession, primarily those undertaken by the faculty of the UP College of Medicine (Castaneda and Maramba, 1980, 1986). Environmental and food residue effects were also studied (Magallona 1977, 1989, among others), as well as, pesticide policy research by UPLB (Rola, 1989, Rola 1994). Information on acute occupational poisoning in mango plantations in Cebu and banana plantations in Mindanao was also considered significant.

International health studies were also considered to be highly important factors that influenced pesticide policy in the Philippines, particularly the WHO research on pesticide poisoning undertaken by WHO and the book by Carson (1962).

Table 6.1 Subjective Assessment of Factors that Influenced the 1992 to 1996 Pesticide Policy Package

Influencer	Informant					
	FPA	Daivide	Cornejo	Binamira	Rola	Roa
Research						
Local health-related research- excluding IRR1	H	H	H	L	H	H
International health-related studies	H	H	-	H	-	M
IRR1 'health' research	M	0	0	M	H	L
Environmental studies	-	M			M	L
IPM Research	-	H	-	H	M	-
						L
Media	L	0	M	-	-	L
NGOs/Civil Society	H	0	0	0	L	
International Alliances/Regulations	H	0	H	0	M	

Note: Level of influence categories: H = high, M = medium, L = low and 0 = zero, and '-' not mentioned

The next most highly ranked are international alliances and regulations and research on IPM. Examples of international alliances that were highlighted include:

- The Canadian International Development Agency (CIDA) funded project called the 'Environment and Resource Management Project (ERMP)', based at the UPLB. One of its objectives was to use the project activities and the results of these activities to

support the Government of the Philippines environment sector plans and programs, and policy development (Rola pers. comm. 9 July 2007).

- The IDRC's advice, primarily through Mr Versteeg, on pesticide policy development and implementation in the Philippines.
- The Philippines commitment to Agenda 21 which was crafted in Rio de Janeiro in 1992.
- The liaisons between the FPA and international organizations such as the WHO, FAO, US-EPA, and RENPAP (Regional Network on Safe Pesticide Production and Information for Asia and Pacific) which provided toxicological data on new pesticides and information on the ill effects of currently available pesticides and whether or not these pesticides have been banned for use in other countries.

With regards to IPM research, as discussed in Section 2.1, the FAO initiated IPM activities in the Philippines from the late 1970s, with IRRI also undertaking research on IPM in rice. The results of the IRRI research were translated into recommendations on economic thresholds, resistant varieties, surveillance programs and the identification and definition of the role of natural predators (Rola and Pingali 1993, p.64). The media coverage on IPM was substantial, with the press coverage primarily focusing on natural enemies of rice pests. In the interview, Dr Binamira stated that he used the results of IRRI's IPM research and data from IRRI's Loop Survey to support his case, which went directly from his office to Secretary Sebastian, for implementation of the KASAKALIKASAN program.

The next most important influencer was the IRRI research (which commenced in 1988) on the health and environmental impacts of pesticide use in rice that was funded by the Rockefeller Foundation. According to Professor Rola, the results of the research on crop protection and medical concerns were being communicated directly to the FPA, because some of those involved in the research were FPA consultants or members of the technical advisory committee (Professor Rola, personal communication 2007). Dr Binamira also stated that IRRI's health research was important, but not so much for the results per se, but because he believed that this research signaled a shift in IRRI paradigm, resulting in IRRI no longer being seen as being pro-pesticide use. The policies and conceptual framework that guided the review of the FPA pesticide regulatory policies explicitly said that social costs of pesticide use shall always be considered (Minutes of the Meeting of the Pesticide Policy Review Committee, Feb, 24, 1995, Bureau of Plant Industry, Manila). Consequently, Professor Rola was assigned to look into these social costs. In a subsequent meeting of the PPRC (March 13, 1995, at the UPLB) she explained about health and environmental costs due to pesticide use; and noted that while health costs estimation are available from the IRRI research and other local research, the evidence about environmental costs were still not sufficient. In the position paper that was used by the committee during the regional consultations, IRRI health research results on costs were explicitly cited to justify the need for pesticide policy reforms.

Local research estimation of health costs were from acute cases and the rigor of the IRRI health research was the estimation of these health costs from chronic cases. In citing both acute and chronic cases, but especially the more rigorous chronic case study results of the IRRI study, confidence was higher in influencing policy change than when just using the local health study results. It was also deemed appropriate for IRRI to have partnered with the local national research system in the research and policy advocacy; the combination of rigor and access to policymakers was present.

The credibility given to the IRRI research is also evident from international exposure and NGO acceptance of the study. For example, preliminary results were presented in February 1990 at the annual meeting of the Association for the Advancement of Science, New Orleans. In May 1994, IRRI was invited to present the findings of this project in an NGO forum jointly organized by Pesticide Action Network (PAN - Malaysia) and SIBAT¹⁹ - a local NGO. It was a workshop attended by NGO's and international organizations like IRRI and the International Institute of Rural Reconstruction (IIRR). The invitation to this meeting indicated that the results of the IRRI health projects positively impacted on IRRI's image, especially with the NGOs (F Palis, pers. comm. January 2008). In July 1995, IRRI was invited by WHO, Western Asia Pacific Region, to participate in their technical working group meeting on pesticides and health held in Manila.

While the other informants stated that the information coming from NGOs/civil society could be seen as being biased and, therefore, discounted the value of their influence on policy formulation, the FPA stated that they had significant influence. The groups that were mentioned where the NGOs such as PAN and Greenpeace, and farmer groups and IPM advocates.

Finally, the environmental studies and the media were not seen to be significant drivers of the policy change. The media, however, was important in bringing to the public's attention the industry opposition (primarily Hoechst) of the pesticide bans and restriction, which according to Administrator Cornejo, rallied public support for the FPA decisions.

6.2 Allocation of Benefits to IRRI

Quantifying influence is a difficult task, resulting in a subjective assessment being the common course of action. For this reason, the question of how much of the estimated gains from the implementation of the 1992 to 1996 pesticide policy package are attributable to IRRI's research on pesticide use, farmers' health, and IPM is a difficult one to address. However, despite the fact that there are differing views on the relative importance of each of the influencing factors mentioned, a reasonable conclusion is that IRRI research on the private cost of pesticide use to rice farmers in the Philippines did play a role in bringing about the 1992-1996 pesticide policy changes.

Using the relative importance approach to attribution, which apportions the share of benefits on the basis of a subjective assessment of contribution, a plausible estimate of the contribution made by IRRI would be in the order of 10%. This figure takes into account the possibility that the 1992 to 1996 policy package may have been implemented without the IRRI research, particularly in the case of IPM, albeit at a slower rate.

7 Benefit–cost Assessment

This impact assessment focuses specifically on measuring the economic returns to the IRRI investment in pesticide use and farmer health through the donor-funded projects listed in Table 2.1 rather than the *overall* benefits and costs of the implementation of the 1992 to 1996 pesticide policy package. This is because, as presented above, the aim of this study is to determine the returns to IRRI's contribution to the impact of the changes in pesticide policy. Therefore to obtain a measure of the returns to the IRRI research, the benefit attributable to the relevant IRRI project is compared with the cost of those projects.

¹⁹ Sibol ng Agham at Teknolohiya (SIBAT, Inc.) or Wellspring of Science and Technology is a non-governmental organization or NGO engaged in the promotion and development of appropriate technology in the Philippines

7.1 Measure of Benefits Attributable to IRRI Research

Applying the 10% contribution figure to the estimated benefits attributable the 1992 to 1996 policy package (Table 5.4), provides a measure of the benefits attributable to IRRI. As shown in Table 7.1, the realized benefits are estimated to range from US\$118 million (Scenario 5) to US\$172 million (Scenario 6), projected benefits from \$131 million (Scenario 5) to US\$192 million (Scenario 6) and total benefits from US\$250 million (Scenario 5) to US\$364 million (Scenario 6).

Table 7.1: Estimates of Benefits Attributable to IRRI under 10% Contribution Assumption

Description	Scenario 5 US\$ Million	Scenario 6 US\$ Million
Estimated benefits assuming 75% attribution to the 1992 to 1996 policy package		
Realized present value of benefits (1989 to 2006)	118	172
Projected present value of benefits (2007 to 2018)	131	192
Total present value of benefits (1989 to 2018)	250	364

7.2 Research Costs

The project funding contributions made by Rockefeller Foundation (RF), World Resources Institute (WRI) and Overseas Development Administration (ODA)/Associate Professional Officers Scheme (APOS) for the years 1982 and 1992 totaled US\$780 thousand. In addition to the funding, contributions IRRI supported the project through in-kind contributions of staff and overheads. The value of the in-kind contribution is estimated to be US\$420 thousand. Hence, the total cost of undertaking the IRRI-led research on the ill effects of pesticide use in the Philippines is estimated to be around US\$1.2 million (Table 7.2).

**Table 7.2: Project Costs 1989 to 1992
'000 \$US (2006 Base Year)**

	Cash	In-kind	Total
1989	246	120	346
1990	254	120	354
1991	219	120	339
1992	61	60	121
Total	780	420	1200

7.3 Results

The above analysis provides a range of benefits under two scenarios (5 and 6) based on two key assumptions (75% attribution and 10% contribution). As a result, there are two values for realized, potential and total benefits. Even under the most conservative assumptions the analysis shows a strongly positive return to the investment in the IRRI project. The lower and upper values of the net present value (NPV) of IRRI's influence on the policy-makers' decisions to implement the 1992 to 1996 pesticide policy package are estimated to be US\$248 million and

US\$363 over the 30-year time horizon (1989–2018). The corresponding benefit–cost ratios (BCR) and internal rate of returns (IRR) are 208:1 and 65%, respectively for the lower-bound estimate, and 304:1 and 73%, respectively for the upper-bound estimate (Table 7.3). The returns to investment are high because for a relatively small investment of a million dollars, the outputs of the IRRI project contributed to a policy change that resulted in very large benefits in terms of private health costs avoided.

Table 7.3: Benefit–cost Analysis Results

Item	US\$	
Total Benefits		
PV	250	364
NPV	248	363
BCR	208	304
IRR	65%	73%
Realized Benefits		
PV	118	172
NPV	117	171
BCR	98	144
IRR	65%	73%

8 Conclusions

Policy-oriented research is undertaken to inform laws, regulations, or spending that either benefits or imposes a cost on those that are affected by the policy-related decisions. This reference to ‘policy’ is based on the intended primary pathway to impact rather than on the discipline of research. Hence, it is not limited to social sciences - it can also be undertaken within the biological and physical sciences. What defines policy-orientated research is that it is undertaken primarily to guide policy as a means of generating the ultimate impact. However, measuring the impact of a policy change quantitatively, and attributing that impact on those factors that influenced policy-makers, is particularly complicated. Nevertheless, given the increased spending on policy-orientated research, within and outside the CGIAR, the methodological difficulties of quantification and attribution do not diminish the need for being able to demonstrate the value of policy-orientated research.

During 1989 to 1992, IRRI contributed to the body of research on the harmful effects of pesticide use through a number of detailed analysis of private health costs and environmental effects of pesticide use in rice farming in the Philippines. The uniqueness of the IRRI research was that it was the first study to place an economic value on the chronic effects of long-term use of pesticides in rice production. In particular, the analysis showed that the private health cost of using insecticides in rice production is large and overwhelms any potential economic gains. The primary policy recommendation to come out of the IRRI policy-orientated research on pesticide use was to restrict the use of hazardous insecticides by imposing and implementing bans on those insecticides that pose acute or chronic health effects and/or adversely affect the environment or, if banning is not feasible, to apply a selective pricing policy, taxing the more hazardous pesticides at higher rates than the less toxic pesticides.

In response to the growing health concerns, the Ramos Administration (1992 to 1996) undertook a multi-pronged approach to the judicious use of pesticides. As such, the FPA instigated a suite of pesticide regulatory policies and implementing guidelines aimed at banning or restricting the use of commonly-used but highly toxic insecticides in rice production and encouraging safer pesticide management practices.

While establishing a link between research and policy change may theoretically appear to be fairly straightforward and logical, in practice it is a difficult task. This is because, in general, there are a large number of factors that can influence the policy-formulation process. As depicted in Figure 1, the main factors likely to have influenced the implementation of the 1992 to 1996 policy changes are research, the change in the Philippine government's broader agricultural and environmental policies, international pesticide codes of conduct and regulations, the demands of industry and the concerns of civil society and the media. The main aim of the PORIA is to measure the economic benefits of the 1992 to 1996 pesticide policy package and, where possible and justified, to attribute the policy-induced benefits to the key players, with a focus on relevant research undertaken by IRRI.

There are a number of main points highlighted in this paper. First, given the difficulties in assessing the impact of policy-orientated research, the policy component of the research being assessed, and the policy and regulatory changes that occurred, need to be clearly defined. Second, explicitly mapping out the components of the path from inputs to impact help to clarify the essential elements of a robust PORIA. Third, a detailed media/internet search and comprehensive interviews with key informants is essential to help unraveling the complex nature of the policy process and compliance. Fifth, as attribution and influence are difficult to quantify, the assessment relied heavily on a subjective assessment of how influential IRRI's research was in guiding the development and implementation of the 1992-1996 pesticide policy package.

Taking these difficulties into account, a combination of quantitative and qualitative methods was used to determine the returns to the IRRI-led research on the ill effects of pesticide use in rice growing in the Philippines. As such, the conclusion drawn from the analysis is that even under the most conservative assumptions, the returns to the investment in the IRRI-led research significant. The lower and upper values of the NPV of IRRI's influence on the policy-makers' decisions to implement the 1992 to 1996 pesticide policy package are estimated to be US\$248 million and US\$363 over the 30-year time period to 2018. The corresponding BCRs and IRRs are 208:1 and 65%, respectively for the lower-bound estimate, and 304:1 and 73%, respectively for the upper-bound estimate. The returns to investment are high because for a relatively small investment of a million dollars, the outputs of the IRRI project contributed to a policy change that resulted in very large benefits in terms of private health costs avoided.

References

- Antle JM, Pingali PL. 1991. Pesticides, farmer health and productivity: A Philippine case study. Paper presented at the International Association of Agricultural Economists, 22-29 August 1991, Tokyo. IRRI Social Sciences Division Paper No. 91-10. Los Baños, Laguna, Philippines.
- Antle JM, Pingali PL. 1994. Pesticides, Farmer Health and Productivity: A Philippine Case Study. *American Journal of Agricultural Economics*. August.
- Bantilan CS, Rola AC, Corcolon R. 1990. Causes of mortality among farmers in the Philippines and possible linkages with chemical input use. Paper presented at the 36th PAEDA Convention, Manila, Philippines.
- Carson R. 1962. *Silent Spring*. Boston: Houghton Mifflin Co. Inc.
- Casanova FA, Pedrajas JJ, Querubin CQ. 1984. A study of pesticide problems in Bulacan and Metro Manila. *Philippine Labor Review* 8, 10-13.
- Castañeda CP, NC Maramba. 1980. A three-year retrospective study of acute poisoning due to anticholinesterase insecticide. *The Filipino Family Physician*: 18(2): 1-10.
- Castañeda CP, Maramba NC. 1986. A study on occupational exposure to cholinesterase-inhibiting compounds among Filipino rice farmers in San Leonardo, Nueva Ecija. *Medical Currents* (19): 4-6.
- Davies JE, Freed VH, Whittemore FW 1982. An agromedical approach to pesticide management: Some health and environment considerations. Miami, Florida. University of Florida School of Medicine.
- Dawe D. 2006. The second green revolution – trends and implication in pesticide use. In: Dawe D, Moya PF, Casiwan CB, editors. *Why does the Philippines import rice? Meeting the challenge of trade liberalization*. Manila (Philippines): International Rice Research Institute, and Muñoz (Philippines): Philippine Rice Research Institute. p 85-88.
- Escalada MM, Heong KL. 1993. Communication and implementation of change in crop protection. In *Crop Protection and Sustainable Agriculture*. P.191-207. Chichester: Wiley Ciba Foundation Symposium.
- FAO (Food Agriculture and Organization). 1990. Case studies on IPM Central Luzon, FAO Internal Report, 1990.
- FAO (Food Agriculture and Organization). 1995. Guidelines on Good Labeling Practice for Pesticides. <http://www.fao.org/ag/AGP/AGPP/Pesticid/Code/Download/label.pdf>
- FPA (Fertilizer and Pesticide Authority). 2001. *Pesticide Regulatory Policy and Implementing Guidelines*. 2nd Edition. Quezon City, Philippines.
- Gonzales EZ, Chua RHC. 1984. Organo phosphate poisoning: Cebu (Velez) General Hospital experience, 1974-1983. *Philippine Journal on Internal Medicine*, (22): 262-269.
- Herdt RW, Castillo L, Jayasuriya S. 1984. The economics of insect control in the Philippines. In *Judicious and efficient use of insecticides*. Los Baños, Laguna, Philippines: International Rice Research Institute.

- Herdt RW. 1979. An overview of the constraints project results. In: Farm level constraints to high rice yields in Asia: 1974 - 1977, International Rice Research Institute. Los Baños: IRRI.
- International Rice Research Institute (IRRI). 2007. Farmer Survey on Knowledge, Attitudes and Practices (KAP) in Pesticide Use and Management, wet season 2006 and dry season 2007.
- Kenmore P. 1980. A perspective on IPM. Information Center for Low-External-Input and Sustainable Agriculture Newsletter 13(4): p 8.
- Kenmore P. 1996. Integrated Pest Management in Rice in Biotechnology and Integrated Pest Management edited by GJ Persley, Wallingford: CAB International.
- Khush GS, Virk PS. 2005. IR varieties and their impact. Los Baños, Philippines. International Rice Research Institute. p 163.
- Litsinger JA. 1984. Assessment of a needs-based insecticide application for rice. Paper presented to the MA-IRRI Technology Transfer Workshop. 15 March 1984.
- Litsinger JA. 1987. Integrated pest management assessment in farm communities. Paper presented at the Workshop on Integrated Pest Management and Integrated Nutrient Management in Rice, 28-29 July, 1987. Los Baños: IRRI.
- Loevinsohn M. 1987. Increased mortality in rural Central Luzon, Philippines is correlated with insecticides use.
- Loevinsohn M, Rola AC. 1998. Linking research and policy on natural resource management: the case of pesticides and pest management in the Philippines in: Tabor SR, Faber DC, editors. Closing the Loop: From the research on natural resources to policy change. (Policy Management report No.8). Maastricht: European Centre for Development Policy Management: p 88-113.
- Magallona ED. 1977. Insecticides residue in vegetables: I. Methyl parathion, Mevinphos and Triazophos residues in cabbage. Philippine Entomologist, 3(5-6).
- Magallona ED. 1989. Effects of insecticides in rice ecosystems in Southeast Asia. In: Ecotoxicology and climate, P Bourdeau, JA Haines, W Klein and CR Krishna Murti. New York: John Wiley: p. 265-279.
- Maramba N. 1985. Current Situation of pesticide poisoning and on-going scheme to collect data and action towards prevention in the Philippines, Informal Consultation on Planning Strategy for the Prevention of Pesticide Poisoning, Geneva, 25-29, November, 1985.
- Marquez CB, Pingali PL, Palis FG, Rodriguez VC, Ramos MGP. 1990. Evaluation of the health effects of pesticide use among Laguna farmers. Paper presented at the Workshop on Environmental and Health Impacts of Pesticide Use in Rice Culture, 28-30 March 1990, IRRI, Los Baños, Philippines.
- Matteson PC. 2000. Insect Pest Management in Tropical Asian Irrigated Rice. Annual Review Entomology 45:549-574.
- Matulac LA. 1993. IPM Messages: What Have We Learned: In: IDC Faculty Series 1(1s). Los Baños, Laguna, Philippines: University of the Philippines.
- Palis FG. 1998. Changing farmers' perceptions and practices: the case of insect pest control in Central Luzon, Philippines. Crop Protection 17(7):507-607.

- Palis FG. 2002. The impact of social capital in technology sharing and learning on integrated pest management in Central Luzon, Philippines. A dissertation submitted to the College of Social Sciences and Philosophy, University of the Philippines, Diliman, Quezon City.
- Panganiban LR. 2002. Epidemiology of Acute Pesticide Poisoning in the Philippines International Conference on Pesticide Exposure & Health, Society of Occupational & Environmental Health. Bethesda, MD, USA, July 2002.
- Panganiban LR. 2005. Pesticides: Impact on Human Health & the Environment UNCTAD Meeting, Manila, November 29, 2005.
- Pingali PL, Marquez CB. 1990. Health costs of long-term pesticide exposure in the Philippines-a medical and economic analysis. IRRI Social Sciences Division Paper No. 90-04, Los Baños, Laguna, Philippines.
- Pingali PL, Palis FG. 1990. Impact of Pesticides on the Environment and Human Health: A Preliminary Assessment in the Philippines. Paper Presented at the Annual Meeting of the American Association for the Advancement of Science, New Orleans, Louisiana, USA, Feb 22-25, 1990.
- Pingali PL, Marquez CB, Palis FG. 1992. Farmer health impact of long term pesticide exposure—a medical and economic analysis for the Philippines. Paper presented at the Workshop on Measuring the Health and Environmental Effects of Pesticides, 30 March-3 April 1992, Bellagio, Italy.
- Pingali PL, Marquez CB, Palis FG. 1994. Pesticides and Philippine Rice Farmer Health - a medical and economic analysis of impact. *American Journal of Agricultural Economics* 76 (August 1994): 587-592.
- Pingali PL, Marquez CB, Palis FG, Rola AC. 1995. The impact of pesticides on farmer health: A medical and economic analysis in the Philippines. In: Pingali PL, Roger PA, editors. *Impact of pesticides on farmers' health and the rice environment*. Norwell (Massachusetts): Kluwer Academic Publishers and Los Baños (Philippines): International Rice Research Institute. p 344-360.
- Pingali PL, Palis FG, Rodriguez V. 1989. Pesticide externalities in Asian rice production: progress report. Paper presented at the Progress Reports Meeting of the Environmental Costs of Chemical Input Use in Southeast Asian Rice Production, 31 October 1989, IRRI, Los Baños, Laguna, Philippines.
- Pingali PL, Roger PA, editors. 1995. *Impact of pesticides on farmers' health and the rice environment*. Norwell (Massachusetts): Kluwer Academic Publishers and Los Baños (Philippines): International Rice Research Institute. p 664
- Rola AC. 1986. Policy recommendations for pesticides. Center for Policy and Development Studies Working Paper Number 86-03. University of the Philippines at Los Banos.
- Rola AC. 1989. Pesticides, health risks and farm productivity: A Philippine experience. Agricultural Policy Research Program Monograph No. 89-01, University of the Philippines at Los Baños, College, Laguna.
- Rola, AC. 1994. Impact of Pesticides on Farmers' Health: Review of Evidence from the Philippines. *Philippine Journal of Crop Science*. Vol. 19, No. 2, August 1994.
- Rola AC, Chupungco AR, Adalla CB, Hoque MM, Stuart TH and Sumayao BR. 1988. Results of a benchmark survey. Integrated Pest Management Extension and Women Project. Los Baños, Laguna, Philippines

- Rola AC, Pingali PL. 1993. Pesticides, rice productivity, and farmers' health: an economic assessment. International Rice Research Institute, Manila Philippines, and World Resources Institute, Washington, DC.
- Rola AC, Widawsky DA. 1998. Pests, Pesticides, and Integrated Pest Management in rice. In Pingali, PL Hossain M. 1998. Impact of Rice Research. Proceedings of the International Conference on the Impact of Rice Research. 3-5 Jun 1996, Bangkok, Thailand. Thailand Development Research Institute, Bangkok and International Rice Research Institute, Manila, Philippines.
- Smith J, Litsinger JA, Bandong JP, Lumaban MD, de la Cruz CG. 1989. Economic thresholds for insecticide application to rice: profitability and risk analysis to Filipino farmers. *Journal of plant protection in the tropics* 6(1):61-87.
- Smith KR, Carpenter RA, Faulstich 1988. Risk assessment of hazardous chemical systems in developing countries. Occasional Paper No 5. Honolulu, Hawaii. East-West Environment and Policy Institute.
- Stuart TH. 1993. Constraints in Technology Transfer: A Users' Perspective with a Focus on IPM, Philippines. In: Penning de Vries FWT, *et al*, editors. *Systems Approaches for Agricultural Development*. Amsterdam (Netherlands): Kluwer Academic Publishers.
- Sumangil JP, Daniel AJ, Davide RG. 1991. National IPM Program of the Philippines. In: Proceedings of the Conference on IPM in the Asia-Pacific Region. Eds. P.A.C Choi, G.S. Lim, T.H Ho, P.L. Manalo, J. Waage 23-27 September 1991 Kuala Lumpur, Malaysia.
- Teng P, editor. 1990. *Crop Loss Assessment in Rice*. Philippines: International Rice Research Institute (IRRI).
- Versteeg H. 1992. Recommendations on ways to improve pesticide policy in the Philippines. Environment and Resource Management Project. UPLB, Laguna Philippines and Dalhousie University, Halifax, Nova Scotia, Canada.
- Warburton H, Palis FG, Pingali PL. 1995. Farmer perceptions, knowledge and pesticide use practices. In: Pingali PL, Roger PA, editors. *Impact of pesticides on farmer health and the rice environment*. Boston (Massachusetts) USA: Kluwer Academic Publishers. p 59-96.

Acknowledgment

The authors are very grateful to all those who assisted in the preparation of this report.

The Standing Panel on Impact Assessment (SPIA) of the Science Council of the CGIAR provided financial support.

The study greatly benefited from the knowledge and expertise of numerous informants including: Administrator Frank Cornejo (Executive Director, University of the Philippines Alumni Association); Dr Norlito Gicana (Executive Director, FPA); Dr Dario C. Sabularse (Deputy Executive Director, FPA); Ms Aida Ordas (Chief, Pesticide Regulatory Service Division, FPA); The Honorable Romulo Davide (Academician, National Academy of Science and Technology); Dr Lynn Crisanta Panganiban (Head, National Poison Management and Control Center); Dr Jesus Binamira (National IPM Program Officer, Department of Agriculture); Mr Leonardo Lim Roa (Vice President, Business Development, Radisson Agrochemical Corp); Mr Rodelio Macatula (President, CropLife Philippines, Inc.); Mr Max Obusan (Consultant and Executive Director, Crop Protection Association of the Philippines); Professor Agnes Rola (Dean, College of Public Affairs, UPLB).

Professor Bruce Gardner (University of Maryland), Dr Robert Paarlberg (Wellesley College), Dr Carol Weiss (Harvard Graduate School of Education), Dr Jim Ryan (SPIA) and Dr Tim Kelley (SPIA) reviewed this report. Valuable comments were also provided by Drs Peter Kenmore (FAO), Herman Waibel (University of Hannover) and Prabhu Pingali (FAO). Drs K L Heong and Florencia Palis (both from IRRI) also provided important information and clarification on IRRI IPM and pesticide use and human health research.

Data encoding and/or collection was undertaken by IRRI staff and contractors namely: Ms Aida Papag, Ms Pamela Castanar, Ms Teodora Malabanan, Mr Joel Reaño, Ms Esther Marciano, Mr Raymond Asilo, Ms Zenaida Huelgas and Ms Lorie Villano. Technical and administrative support was provided by Ms Christine Doctolero. Mr Raymond Asilo also assisted in compiling the Appendices.

Logistics support for the household surveys was provided by the Municipal Agriculturists and local barangay officials, namely: Ms Cesariya Cortes (Lucban, Quezon), Ms Fabiana Ballesteros (Calauan, Laguna), Mr Benjie Luna (Calamba, Laguna), Ms Luzviminda Ednalino, Ms Gloria Lauguico and Ms Analiza Dedicatoria (Cabuyao, Laguna).