Building on an earlier exploratory study, in 2007–2008 the CGIAR's Standing Panel on Impact Assessment (SPIA) undertook an initiative in collaboration with seven CGIAR centers to augment the evidence of policy-oriented research (POR) impacts within the CGIAR system and to further the development of methodologies in this challenging area of impact assessment. Seven case studies were commissioned. This impact brief describes the major results that emerged from the International Rice Research Institute (IRRI). The summary version of the full case study report can be found in: Templeton, D. and Jamora, N. 2008. Economic assessment of policy-orientated research on the private health costs of pesticide use in the Philippines. In: CGIAR Science Council. 2008. *Impact Assessment of Policy-Oriented Research in the CGIAR: Evidence and Insights from Case Studies*. A study commissioned by the Science Council Standing Panel on Impact Assessment. CGIAR Science Council Secretariat: Rome, Italy. (Available at http://impact.cgiar.org/)

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Pesticide Use in the Philippines: Assessing the Contribution of IRRI's Research to Reduced Health Costs

In the Philippines, the use of pesticides in rice production expanded rapidly during the 1970s and into the 1980s. This was partly due to concerns that crop losses from pests would negate the gains from planting modern rice varieties. However, by the mid-1980s, it was clear that the indiscriminate use of pesticides could cause ecological imbalances that could exacerbate, rather than alleviate, a pest problem. Moreover, research was providing evidence of negative environmental and human health effects from the excessive use of pesticides.

Between 1989 and 1992, the International Rice Research Institute (IRRI) contributed to the body of research on the harmful effects of pesticide use through a number of detailed analyses of the private health costs and environmental consequences of pesticide use in rice farming in the Philippines[1]. In particular, the analyses showed that the private health cost of using insecticides in rice production is large and overwhelms any potential economic gains. The primary policy recommendation resulting from this IRRI policy-oriented research (POR) was to restrict the use of hazardous (Category 1) pesticides by banning those that pose acute or chronic health effects, or adversely affect the environment; or, if banning was not feasible, to apply a selective pricing policy, taxing the more hazardous pesticides at higher rates than the less toxic alternatives.

Policies banning the use of some hazardous pesticides had been enacted by the Fertilizer and Pesticide Authority (FPA) of the Philippines in the early 1980s. In 1989, the Ramos administration began developing the pesticide policy package (PPP), which was implemented between 1992 and 1996. The PPP was a multi-pronged approach to the safe and effective use of pesticides that directly targeted:

- The use of highly toxic insecticides in rice growing
- Regulatory policies and implementing guidelines on the importation, formulation, distribution, sale, and use of pesticides

- The illegal smuggling of pesticides
- Regulation on the labeling and advertising of pesticides
- Hazard awareness, through an agro-medical training program
- Improved product stewardship, undertaken jointly by the pesticide industry and the government.

The role of IRRI's research

This brief, which is based on a longer study[2], estimates the economic value of the private health costs saved due to the 1992–1996 PPP and identifies the portion of that saving attributable to research by IRRI.

A number of factors are likely to have influenced the design and implementation of the 1992–1996 PPP, including non-IRRI research on the health implications of pesticide use. However, even though the body of such research conclusively showed that insecticides were harmful to the health of farmers and contracted sprayers, policy-makers may have been unwilling to ban highly toxic pesticides if they were not confident that farmers had alternative means of pest control. IRRI's research and development of pest-resistant rice cultivars, and the introduction of integrated pest management (IPM) to the Philippines from the mid- to late-1970s onwards, provided farmers with less toxic alternatives for pest control. The results of IRRI's research on IPM, confirming that more judicious use of pesticides would not result in yield losses, was considered by the Pesticide Policy and Technical Advisory Committee (PPTAC) when providing pesticide policy advice to the FPA.

External influences were also important in the policy change process. In this case, a shift occurred in the Philippine agricultural agenda, from a paradigm that strongly encouraged the use of agricultural chemicals (Marcos regime, 1965–1986) to one that explicitly considered the harmful effects of pesticides on the environment and human health (Ramos era, 1992–1998). This provided policy-makers with a strong political platform from which to pursue policies that promote the safe and judicious use of pesticides. It was this shift that enabled the 1992–1996 PPP to be implemented. International conferences organized by the Food and Agriculture Organization of the United Nations and the World Health Organization on the harmful effects of toxic agricultural chemicals may also have influenced policy-makers.

Indicators of change

A number of indicators were used to determine whether or not the 1992–1996 PPP made a discernible difference at farm level. These included:

- Trends in the quantity of pesticides used over time
- Survey data on the type of pesticides used and on pesticide handling, storage, and disposal practices
- Changes in the reported incidence of pesticide poisoning.

Data from IRRI farm-level surveys undertaken in the Laguna, Nueva Ecija, and Quezon provinces showed that insecticide use fell from 0.8 kg active ingredient (ai)/ha in 1991 to 0.17 kg ai/ha by 2007 – only 0.07 kg ai/ha above the pre-Green Revolution levels.

Further comparison with farm-level household survey data also showed that by 2007 rice farmers were using safer pesticides and had adopted safer pesticide management practices than they were using in 1991. In addition, hospital records on the type and incidence of pesticide poisoning show that not only has the incidence of acute pesticide poisoning fallen, but also that the primary cause is no longer Category I insecticides.

Estimating the economic benefits

The economic value of these changes was measured in terms of reduced health costs per person per hectare[3]. However, this single measure does not capture all benefits and costs. While the health cost value, which is based on the medical costs borne by the farmers and the opportunity cost of reduced productivity due to pesticide-induced health impairments, is relatively comprehensive, it could still be considered an underestimation. This might be because, for instance, the medical assessment has an inherent bias towards survivors, and the value of foregone leisure and reduced life expectancy are not included in the health cost function; the opportunity cost of reduced productivity is limited to rice growing and does not include lost ability to earn off-farm income; and the reduced economic burden on the public medical system is not included. Despite the potential importance of these and other costs, it was considered that the calculations of the changes in health costs provided reasonable 'base' estimates of benefits.

The estimated economic benefit was based on the observed fall in pesticide use and a 50 percent reduc-

tion in pesticide toxicity levels. Total benefits were estimated by multiplying the estimated fall in private health costs by annual data on the number of hectares used for rice production and a 'compliance' rate to obtain an annual gross value. It was assumed that compliance with the recommendations to decrease pesticide use and changes in pesticide management practices happened gradually, reaching a maximum adoption level of 80 percent. This relatively high maximum level of adoption was based on 2006–2007 survey data, which showed that over 99 percent of the chemicals used by respondents were registered for use in rice production in the Philippines and that over 80 percent of users had adopted safer pesticide management practices.

The gross value of the annual benefits was then discounted, using a 5 percent discount rate, to obtain a present value of benefits over a 30-year simulation period. The present value of the economic benefit from the reduction in pesticide use and the changes in pesticide types and management practices is estimated to be around US$3.3 billion.

Attributing the benefits to the pesticide policy package

The observed changes in pesticide use may, of course, not be due solely to policy change. Other factors outside the policy arena that may have contributed include the continued spread of pest-resistant crop varieties and changes in the price of rice and cost of pesticides. However, given the measures implemented and broad coverage of the 1992–1996 PPP, including the effect it had on the price of chemical pest control because of the switch to less toxic pesticides, it seems reasonable to assume that the policy package was the primary driver of the changes in pesticide use and practices. Consequently, a conservative measure of the contribution of the PPP to the welfare gains from the reduction in health costs is 75 percent of the total benefits.

Identifying influence

An assessment was undertaken of the factors that influenced the changes in the regulatory pesticide policies and implementing guidelines between 1992 and 1996, based on information from a number of key informants. These included past and present FPA officials, members of PPTAC and the Pesticide Policy Review Committee, 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 'newsworthy' were the issues surrounding pesticide use, its impact on human health, and the changes to the pesticides regulations.

It should be noted that a major enabler of the 1992–1996 PPP was the policy environment at that time, which was characterized by a strong political will, a receptiveness to change, and relationships of trust among those most responsible for agricultural policy in the Philippines. The importance of this enabling environment cannot be overstated.

Key informants subjectively ranked the influencers of policy change. Local health-related research was ranked the highest influencer, while international health studies were also considered to be highly important. The next most highly ranked were international alliances and regulations, and research on IPM. This was followed by the IRRI research on the health impacts of pesticide use in rice production.

Quantifying influence is a difficult task, so subjective assessment is the most common approach taken. As a starting point, it is reasonable to assume that IRRI research on the private health costs of pesticide use did play a role in bringing about the 1992–1996 PPP. Using the relative importance approach to attribution, which apportions the share of benefits on the basis of a subjective assessment of contribution, a conservative estimate of the contribution made by IRRI is in the order of 10 percent.

Research benefits and costs

Finally, the study compared the measured benefits attributed to the IRRI POR with the cost of undertaking the research to calculate the net present value (NPV), internal rate of return (IRR), and benefit–cost ratio (BCR). Under the two key assumptions (75 percent attribution and 10 percent contribution), the analysis shows a strongly positive return to the investment in the IRRI POR. The NPV of IRRI's influence on the policy-makers' decision to implement the 1992–1996 PPP is estimated to be US$248 million over a 30-year time horizon (1989–2018). The corresponding BCR is 202:1 and the IRR is 65 percent (Table 1). The returns to investment are high because, for a relatively small outlay of US$1 million, the IRRI POR contributed to a policy change that resulted in very large benefits

Table 1.
Benefit–cost analysis results

Total benefits	
Present value	250 (US$million)
Net present value (NPV)	248 (US$million)
Benefit–cost ratio (BCR)	202:1
Internal rate of return (IRR)	65%

in terms of the private health costs avoided. The conclusion is that, even with conservative assumptions, the returns to the investment in the IRRI-led POR were significant.

The study also highlighted a number of methodology issues. First, given the difficulties of assessing the impact of POR, it is essential that the policy implications of the research, and the policy and regulatory changes that actually occur, should be clearly defined. Second, explicitly mapping the components of the path from research inputs, through outputs, to policy design, implementation, and impact helps to clarify the essential elements of a robust POR impact assessment. Third, a detailed media/internet search and comprehensive interviews with key informants are essential in unraveling the complex nature of the policy process and of farmer compliance with recommended changes in practice. Fourth, as attribution and influence are difficult to quantify, the analyst must rely heavily on subjective assessment to determine the likelihood and extent of influence. And finally, given that the effects of a policy can be far-reaching, it may not be possible to quantify the full impact of the policy change.

Notes

1 See, for example: Pingali, P.L. and Roger, P.A., Eds. 1995. *Impact of Pesticides on Farmers' Health and the Rice Environment*. Kluwer Academic Publishers: Norwell, Massachusetts, USA and International Rice Research Institute (IRRI): Los Baños, Laguna, the Philippines. 664 pp.

2 This brief summarizes research described in full in: Templeton, D.J. and Jamora, N. 2008 (in press). *Economic Assessment of IRRI's Policy-orientated Research into the Private Health Costs of Pesticide Use in Rice Farming in the Philippines*. IRRI Impact Assessment Report No. 1. International Rice Research Institute (IRRI): Los Baños, Laguna, the Philippines.

3 Following Pingali, P.L., Márquez, C.B., and Palis, F.G. 1994. Pesticides and Philippine rice farmer health – a medical and economic analysis of impact. *American Journal of Agricultural Economics*, 76, 587–592; and Pingali, P.L., Márquez, C.B., Palis, F.G., and Rola, A.C. 1995. The impact of pesticides on farmer health: A medical and economic analysis in the Philippines. pp. 344–360. In: *Impact of Pesticides on Farmers' Health and the Rice Environment* (Pingali, P.L. and Roger, P.A., Eds). Kluwer Academic Publishers: Norwell, Massachusetts, USA and International Rice Research Institute (IRRI): Los Baños, Laguna, the Philippines.

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