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The Economy and Environment Program for Southeast Asia (EEPSEA) was established in May 1993 to support training and research in environmental and resource economics across its 10 member countries: Cambodia, China, Indonesia, Lao PDR, Malaysia, Papua New Guinea, the Philippines, Sri Lanka, Thailand, and Vietnam. Its goal is to strengthen local capacity for the economic analysis of environmental problems so that researchers can provide sound advice to policymakers.

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Pesticides and Policy: The Impact of Integrated Pest Management on the Indonesian Economy

EEPSEA POLICY BRIEF • No. 2001 - PB11

Throughout Asia, hazardous chemicals, mainly farm pesticides, are stockpiled in warehouses and factories, posing major safety and health hazards to residents. The problem has become so serious that it has been labeled a 'toxic time bomb' by the Food and Agriculture Organization. →

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A summary of EEPSEA Research Report 2001-RR11, *The Economy-wide Impact of Integrated Pest Management in Indonesia*, by Budy P. Resosudarmo (Graduate Program in Economics - Faculty of Economics, Gedung B, Fl. 2nd, University of Indonesia, Depok, Indonesia; contact: pradnja@indo.net.id).

The IPM program *benefits the Indonesian economy*

→ One of the most important measures to reduce the use of pesticides is integrated pest management (IPM), a package of practices that includes the use of manual labour, natural predators and careful timing of smaller doses. A key element of the program, and one of its biggest costs, is training of farmers in its use.

Indonesia has been one of the leaders in the use of IPM. Since 1989, a national IPM program has helped farmers in Indonesia reduce their dependence on pesticides and increase their harvests. It has also dramatically reduced the incidence of pesticide-related illnesses and environmental pollution. However, in 1999 the World Bank loan that was financing the program was terminated and the scheme was all but cancelled. Now, a new piece of research has shown that, rather than abandoning the program, it makes economic sense for the Indonesian government to self-finance the scheme and increase the national IPM budget.

The study, by Budy P. Resosudarmo from the Graduate Program in Economics at the University of Indonesia, found that the IPM program is not only beneficial to farmers and the environment but that it also stimulates and benefits the overall Indonesian economy.

Dealing with pesticides

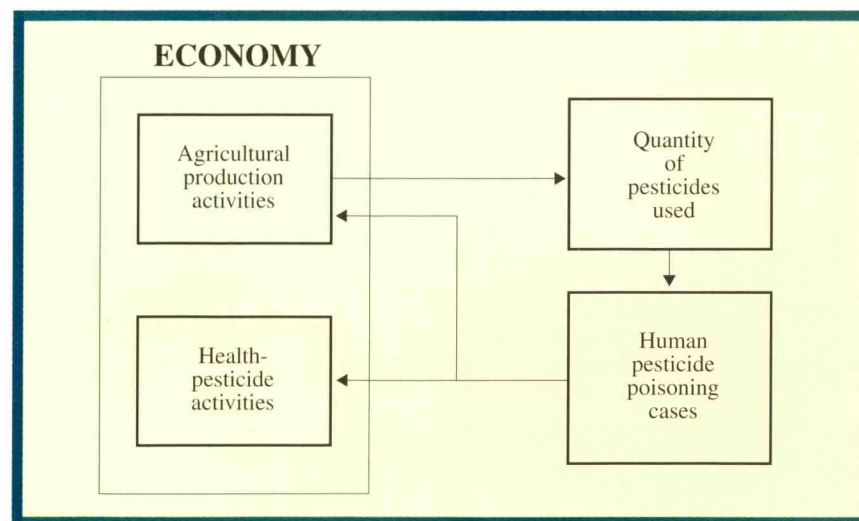
IPM was introduced in Indonesia to deal with problems created by the excessive use of pesticides during the 1970s and 1980s. This overuse was brought about by the government's push for food production intensification. It caused serious environmental problems such as acute and chronic human poisoning, animal poisoning, the contamination of agricultural products, the destruction of beneficial natural pest predators and the development of pesticide resistance in pests.

The central activity of the national IPM program was to educate farmers using the 'learning by doing' method. By the end of 1991, 2,000 extension workers and 1,000 field pest officers were able to train approximately 100,000 farmers. After 1991, about 200,000 farmers were trained each year at a cost of about

11.25 billion rupiah (USD 5.36 million). During the first few years of the IPM program, it helped reduce pesticide use by approximately 56% and increased yields by about ten percent. Despite this success, little research was done to look at the impact of the program on the Indonesian economy and on the household incomes of different socio-economic groups.

Modeling the economy

To fill this gap in understanding and to find out if the Indonesian government should allocate funds to the continue the program, Resosudarmo used a Computable General Equilibrium (CGE) model to analyze the overall impact of the IPM program. A CGE model is a system of equations that represent all agents' behaviors and market clearing conditions in a national economy.



Link Between the Economy and Pesticide in Agriculture.

Resosudarmo's model incorporated six blocks of equations to model the behavior of all relevant areas of Indonesia's economy - from food producers and consumers to the export and import of goods, and the market clearing conditions for labor, goods and services.

The key element of Resosudarmo's approach was the way in which it modeled links between agricultural pesticide use and human health conditions. This allowed the researcher to investigate the complex interaction between the overall economy and agriculture, involving factors such as the productivity of farmers, land and capital, and health costs. For example, one of the direct results of the IPM program was a reduction in health costs associated with pesticide-related illnesses. This created extra income for agricultural households to spend on other goods and services, which, in turn, benefited the producers of these items.

Budgets and data

Resosudarmo's model also looked at how the budget for the IPM program would affect the overall economy, since any money spent on the IPM program results in a smaller budget for expenditure and investments in other sectors. Most importantly, Resosudarmo also analyzed how the IPM budget affected the number of farmers

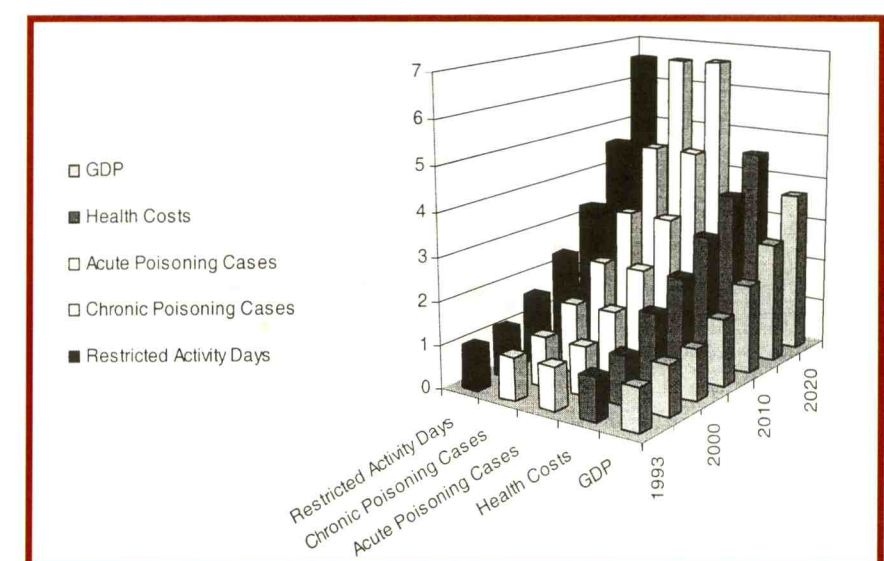
adopting IPM techniques. He found that 90% of the farmers entering the national IPM training program actually became IPM farmers, and this direct relationship was incorporated into his model.

Resosudarmo's main sources of data for his research were the 1993 Indonesian Social Accounting Matrix and Input-Output Table produced by the Indonesian Central Bureau of Statistics. He found that in 1998 there were approximately 3,000 cases of acute poisoning associated with the use of pesticides in the agricultural sector. Of the farmers who used pesticides, 20-50% contracted chronic pesticide-related illnesses, including headaches, weakness, insomnia and difficulties in concentrating. These chronic problems caused farmers to miss an average of one day of work per complaint.

The impact of IPM

To find out the impact of the IPM program, Resosudarmo investigated three different scenarios. The first 'base' scenario modeled what would happen if the IPM program was not continued. Resosudarmo found that in this case, Indonesia's GDP would increase by about 3.5 times between 1993 and 2020. However, he also found that the health problems associated with the use of pesticides would increase by more than six times and associated health costs by more than 450%.

The second and third scenarios looked at a situation where the Indonesian government would implement the national IPM scheme again, financed by foreign loans. This financial support was 11.25 billion rupiah (invested between 2001 and 2020) in scenario two and double this in scenario three.



Changes of GDP and Health Costs and Problems Associated with Pesticides in the Base Scenario.



Resosudarmo found that in scenario two, the total gain in GDP between 2001 and 2020 (as compared to the base 'no IPM' scenario) would be approximately 14 trillion rupiah. Under the 'double' scenario, this would be 28 trillion rupiah. Under both IPM scenarios, Resosudarmo found that the incomes of rural and urban households would increase more than those of agricultural households. This is because more efficient rice production induces a lower price for rice allowing people to consume more goods and services - so rural and urban households would receive higher benefits than agricultural households from a continuation of the national IPM program.

Resosudarmo also found that the implementation of the national IPM program (as described for scenario two) would avoid about 3,500 acute poisoning cases among farmers, approximately 12 million chronic poisoning cases and approximately

12 million restricted activity days in 20 years. Such an approach is also expected to reduce farmers' health costs by as much as 12 million rupiah in ten years. In scenario three, reductions in health problems were even more impressive - more than double those in scenario two.

Self-financing

Resosudarmo finished his analysis by looking at the effect of the Indonesian government imposing a tax on pesticides as a source of self-funding the IPM program. He found that by increasing the tax on pesticides by five percent, the government could earn enough revenue to train more than 80% of rice farmers in the next 15 years. This would translate into a total GDP gain (compared to the base 'No IPM' scenario) of 86 trillion rupiah in the 20 years up to 2020. All households were found to have higher incomes than under the base scenario. Moreover, if, under this

fourth scenario 80% of rice farmers practiced the IPM technique in the next 20 years, approximately 23,000 and 79 million cases of acute and chronic pesticide poisoning, respectively, could be avoided.

Endorsing the Program

Resosudarmo concluded that the Indonesian government should continue its national IPM program and increase its budget to maximize its positive effects. If external funding for this move is not available, he says, it would make economic sense for the government to self-fund the program, since disease and illness will be reduced, GDP will grow and total household incomes will go up.

8,775 Rupiah = 1 USD (August/01)

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