Economic evaluation of costs and benefits of pesticide use – the case for action to reduce pesticides[1]

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In the field of pesticide use, the prevailing institutional structure is such that products which enter the market have to undergo an approvals process with regard to biological effectiveness as well as toxicological and ecotoxicological impacts; and the users of pesticides have restrictions placed upon them regarding how they are used. At a first glance, this institutional structure excludes any benefit cost assessment.

The question remains as to what economics can contribute to the debate about pesticide use reduction. This paper elaborates on three major areas in which economic evaluation has provided useful insights. Results of case studies, both in OECD countries and the developing world, suggest that there is a classical win-win situation that should be exploited.

The first area of interest is pesticide overuse at farm level. Specified use levels and field recommendations are often geared towards maximum effectiveness in combating pests, not sufficiently taking into account economic efficiency. Furthermore, farmers tend to neglect secondary costs, caused by negative side effects of pesticide use on their agroecological resource base, e.g. damage to natural predators, resistance against pesticide use etc.

There seems to be a large potential to reduce pesticide waste at farm level. Results from medium and long-term field trials in Germany, using integrated pest and fertiliser management strategies, suggest that pesticide costs can be reduced by more than 50 % without any loss in farm profits. Even the federal registration authority in Germany estimates that 30 % of pesticide product quantity can be eliminated especially in herbicide use.

Evaluation of the damage of pesticide use to human health and the natural environment is the second area where economics plays a useful role. These non-market costs can be evaluated using a range of tools such as factor costs and willingness-to-pay. Environmental economics has become a broadly accepted branch of mainstream economics. Within the last decade, there have been a number of case studies dealing with the external costs of modern agriculture, especially pesticide use.

Non-market costs of pesticide use are those that are not internalised into decision making on input use. Those external costs include damage to the health of workers and consumers, contamination of drinking water sources, damage to off-farm beneficial organisms (for example, fish, pollinators), spread of pest resistance, loss of biodiversity and contribution to global loads of persistent pollutants in the environment. External costs are borne by the society at large, e.g. through taxes financing damage clean-up and prevention strategies.

Whereas the current level of use is at a level which maximises private benefits, the optimal level of use would be where the benefit-cost ratio (benefits: private plus external costs) is maximised. On the basis of estimates of external costs and of pesticides' productivity, it can be concluded that the current level of pesticide use exceeds the optimal level of use. Exactly by how much is a question for which no easy answer exists. The fact remains, however, that internalisation of costs appears to be well justified on the basis of assessments of costs and benefits associated with pesticide use.

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Estimates of the current level of external costs vary, depending on the nature of the study. Some preliminary estimates of studies from Germany, USA and Thailand are given in Table 1. However, it should be assumed that available data, e.g. from the study in Germany, rather underestimate the true cost of pesticide use. Costs associated with preventing actual damage are more easily accessible than the actual damage cost. For example, biodiversity losses are potentially the least well understood of the external costs. Also, there are ethical issues involved concerning some of the cost estimates, e.g. the value of damage to human health or loss of life. In the German case study, 63 % of the total cost are damage prevention cost.

Table 4: External costs of chemical pesticides

	External costs [Mill US$ per annum]		
Type of costs	**Thailand**	**Germany**	**USA**
Public health	0.6	13.6	787
Domestic animals and fish	n.a.	n.a.	54
Loss of beneficial organisms/biodiversity	2.4	5.9	520
Residues in food	209.0	n.a.	n.a.
Pesticide resistance	n.a.	n.a.	1400
Production loss	n.a.	1.2	1062
Bird losses	n.a.	n.a.	2100
Groundwater contamination	n.a.	75.3	1800
Government regulation & research	16.8	52.2	200
Total	**228.9**	**148.2**	**7923**
Value of pesticides used	247	647.1*	4100
Ratio (external cost/pesticide expenditure at farm level)	**0.93**	**0.23**	**1.93**

* West German states

Source: US (Pimentel et al 1992), Thailand (Jungbluth 1996), Germany (Waibel and Fleischer 1998)

If pesticide use is too high from the viewpoint of social costs and benefits, what case exists for an economic instrument applied to pesticides to minimize risks and approach the optimal level? Farmers base their decision-making on relative prices of inputs and outputs. All available estimates of the elasticity of pesticide demand (i.e. the reaction of pesticide consumption on price changes), point in the direction of a price-elastic response. Farmers usually have several options to adapt to price signals. For example, they choose non-chemical alternatives that are not affected by price increase, or cut pesticide use by using integrated pest managent strategies. However, cropping systems that depend highly on pesticide inputs (e.g. intensive horticulture) may respond only marginally to pesticide price increases in the short run. This implies that production costs will rise and farm income will drop. In the long-run, also these farmers will strive to reduce the impacts of a pesticide price increase. The latter serves as an incentive to develop alternative crop protection strategies (such as biological control, crop rotation and resistant varieties) and to diversify the farming system. Thus, simulating the economic consequences based on a scenario of drastic pesticide use reduction highlights the short run impacts which may underestimate the capacity of farming systems to respond over a longer period.

The most important economic instruments in pesticide policies are subsidies and taxes. In many developing countries, pesticide use is still supported through a wide range of direct and indirect subsidies, aimed at supporting the modernisation of smallholder agriculture. Many countries have still to accomplish a reduction and abolishment of subsidies which are often protected by special interests of input suppliers and parts of the farming community, e.g. export commodity producers.

In principle, a tax on pesticides is justified on the basis of pesticide-related externalities. There are external costs associated with their use which, if internalised, might alter their consumption. Pesticide taxes have been introduced in some European countries, such as Denmark and Sweden. Although it is obvious, that pesticide taxes alone have not brought down pesticide use in these countries, they are nevertheless a suitable instrument in a comprehensive pesticide reduction policy package. Taxes have the function to raise producer’s awareness about external costs, to stimulate demand on non-pesticide alternatives, and to generate revenues for targeted support to research and development of environmentally-friendly technologies.

Economic evaluation of pesticide use is an important element in strategies that aim at increased transparency in policy making. Lessons learned from a project jointly conducted by GTZ and Hannover University, with the support of FAO and the World Bank, suggest that stakeholder fora can benefit from rigorous studies that compile available evidence on social costs and benefits of pesticide use. Pesticide policy action plans have been developed in such diverse countries such as Thailand, Pakistan and Mali. Here, awareness of stakeholders has been raised by a situation of crisis, e.g. high pesticide residues in food exports (Thailand), and escalating pest control cost in cotton caused by pest resistance (Pakistan, Mali).

Results of economic evaluation are often used as part of the communication strategies of interest groups. Focusing on the negative impacts of an unrealistic policy scenario can frame the policy debate in a language of loss and stymie attempts to devise effective policies governing pesticide use. For example, the benefit-cost ratio derived from a 100 per cent chemical reduction scenario is of little use to draw policy conclusions. Instead, the policy debate could greatly benefit from economic studies that are based on scenarios of gradual pesticide use reduction. In this area, still a lot has to be done.