Health costs of pesticide use in a vegetable growing area, central mid-hills, Nepal

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This pilot study estimated the health costs resulting from pesticide-related acute health symptoms in a mid-hill vegetable growing area of Nepal. Farmers reported up to 13 acute symptoms due to the use of pesticides. Using the averting cost approach, on average a farmer spent NR 119 (US$ 1.58) annually for safety gear (at the time of study, NR 75 equaled US$ 1). Using the cost-of-illness approach, the total annual household expenditures due to the use of pesticides ranged from NR zero to NR 4451, with an average of NR 1261. Similarly, household willingness to pay (WTP) for safer pesticides ranged from as low as NR 1500 per year to as high as NR 50,000.

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Household is the primary supplier of labor inputs required to operate subsistence farms, hence the health of household members is critical to productivity, and it is no secret that the use of pesticides in farms has a significant impact on farmers' health (Rola and Pingali 1993, Antle and Pingali 1995, Antle et al. 1998, Ajayi 2000). There are also correlations among higher productivity, high chemical input use, environmental degradation and adverse effects on human health wherever commercial agriculture is widespread (Wilson 2000). In Sri Lanka, studies using the cost-of-illness approach (Wilson 2000, Wilson and Tisdell 2001, Wilson 2002a and b, Wilson 2003) have estimated that a farmer on average incurs a cost of around US $ 97.58 annually in handling and spraying of pesticides. Using the defensive behavior approach, the cost was estimated to be around US $ 7.23 a year. Additionally, WTP came up with a higher value, US $ 204.83, because it considers all costs, including the tangible costs of ill health (both direct and indirect), and averting/defensive behavior costs as well as intangible costs. Dung and Dung (1999) estimated the health cost at over US $ 6.92 per rice season. Ajayi (2000) estimated US $3.92 per household per season in the case of cotton-rice systems in Cote d'Ivoire, West Africa. Yanggen et al. (2003) found that the immediate costs equaled the value of 11 days of lost wages per year in the Carchi, Ecuador. Clearly, the environmental and social costs of pesticide use are enormous. **Table 1** summarizes findings from assessments in a number of countries, revealing costs totaling millions of dollars.

Farmers, especially in developing countries like Nepal, do not take account of the expenditure incurred in the treatment of illness arising from direct exposure to pesticides, and they dismiss intangible costs such as discomfort, pain and suffering as a normal part of their work. Because of the lack of appropriate methodologies and reliable data, the health impacts of pesticide use have traditionally been omitted from the analysis of returns on agricultural research and from the evaluation of specific agricultural policies. Therefore, this study focuses on estimating the averting behavior costs, costs-of-illness, and WTP – i.e., the economic value of costs incurred by subsistence farmers due to direct exposure to pesticides during handling and spraying.

In the study area, farmers spray insecticides such as parathion-methyl (classified as extremely hazardous 'Ia' by WHO, see IPCS 2002); dichlorvos (highly hazardous 'Ib'); cypermethrin, deltamethrin, and fenvelerate (moderately hazardous 'II'), and fungicides such as mancozeb, and carbendazim (non-hazardous under normal use 'U') on crops such as potato (*Solanum tuberosum*), tomato (*Lycopersicon esculentum*), bitter gourd (*Momordica charantia*), cucumber (*Cucumis sativa*), chili (*Capsicum* spp.), cabbage (*Brassica oleracea* var. *capitata*) and cauliflower (*Brassica oleracea* var. *botrytis*). On average farmers were spraying pesticides on crops like potato for 12.3 years, tomato for 9.8 years, and other crops such as bitter gourd and cucumber for 2.7 years. Introducing new crops meant dealing with more toxic pesticides. Surprisingly, only one-fifth of the respondents had taken integrated pest management (IPM) training. Thus, there is an urgency to raise awareness on pesticides, their alternatives and IPM. Many respondents reported eye irritation, headache and skin irritation or burns (**Table 2**). Similarly, one-third had experienced weakness, respiratory depression, sweating, muscle twitching and chapped hands. As many as 13 symptoms were identified as immediate effects of pesticide exposure, averaging six acute symptoms per person per year.

Many farmers believed that safety measures only hinder their work. For example, they thought that wearing a mask makes breathing difficult. They preferred to wear a long-sleeved shirt or long pants (75% of the respondent) or a handkerchief (37.5%). However, 12.5% of the respondents were not using any protective measures – not even a long-sleeved shirt or long pants. One of the main reasons for not using any safety measure is the lack of awareness of the acute and chronic effects that pesticides are known to have on human health.

On average, averting costs for each farmer was a meager NR 119.2 annually on safety gear (**Table 3**). Farmers also treat acute symptoms with local cures such as salt-water gargle, oil massage, turmeric (*Curcuma longa*) water, papaya (*Carica*

thirst, etc. 7 (29.2%)

TABLE 1. Environmental and social cost of pesticide use in different countries

Country	External cost estimated per year	Source
Sri Lanka	Ill health cost to farmers from pesticide exposure = 10 weeks' income	Wilson and Tisdell (2001)
Philippines	61% higher health costs for farmers exposed to pesticides than those not exposed	Pingali et al. (1995)
Vietnam	Health cost of over US $ 6.92 each per rice crop	Dung and Dung (1999)
Mali	Annual indirect and external cost of pesticide use = US$10 million	Ajayi et al. (2002)
West Africa	The economic value of the pesticide-related health costs equals to US$ 3.92 per household per season in the case of cotton-rice systems	Ajayi (2000)
Ecuador	The immediate costs of a typical intoxication (medical attention, medicines, days of recuperation, etc.) equaled the value of 11 days of lost wages	Yanggen et al. (2003)
Zimbabwe	Cotton growers incur a mean of US $ 4.73 in Sanyati and $ 8.31 in Chipinge on pesticide related direct and indirect acute health effects	Maumbe and Swinton (2003)

TABLE 2. Incidence of acute health symptoms. Number of respondents, N = 24

Acute symptoms	Suffered respondents
Eye irritation	23 (95.8%)
Headache	20 (83.3%)
Skin irritation/burn	20 (83.3%)
Weakness	11 (45.8%)
Respiratory depression	9 (37.5%)
Excessive sweating	8 (33.3%)
Muscle twitching/pain	8 (33.3%)
Chapped hands	8 (33.3%)
Throat discomfort	7 (29.2%)
Pain in chest	6 (25%)
Nausea	5 (20.8%)
Blurred vision	5 (20.8%)
Lacrimation	4 (16.7%)
Vomiting	1 (4.2%)
Diarrhea	1 (4.2%)
Other symptoms like dizziness, nose irritation, thirst, etc.	7 (29.2%)

papaya) and tomato, eating mint (*Mentha* spp.) and basil (*Ocimum sanctum*) plant; they seek medical attention only when suddenly exposed to pesticides**.** On average, farmers spent only NR 97.5 as medication costs each year to treat acute illness because most of these symptoms last only for a single day in general (**Table 3**).

On an average, households' productivity loss was found 6.54 days (equals NR 981.7) a year due to pesticide-related health problems (**Table 3**). One respondent mentioned that, due to illness, she could not sprayed pesticides on her bitter gourd when necessary, resulting in a loss of NR 1500 that season. On average, other costs associated with pesticide exposure come to NR 181.2 per year per household. Loss of productivity due to pesticide exposure was found to be greater than the total cost of averting behavior, medication and other costs. This indicates that pesticide use associated health problems increased the indirect costs rather than the direct costs. It is therefore important that cost-benefit analyses of pesticide use should take such costs into account, along with the cost of environmental degradation.

Finally, an open-ended WTP bid for safer pesticides was administered, keeping crop area and productivity constant (same as the previous year), with expenditure on pesticides during the previous year being used as a reference point and taking into account the full range of consequences of illness including productivity loss, effects on other family members, and possible long term health impacts as well as immediate discomfort, pain and stress. The possible effects of pesticides on environment: soil, water, air, animals and birds were not explained to participants at the time of the exercise. Considering the aforementioned effects of pesticides, farmers were asked, "How much would you be willing to pay per year (please state the highest value) for the use of a safer pesticide?" This study found a wide range of WTP bids, ranging from NR 1500 to NR 50, 000 per year per household (**Table 3**). The WTP bids exceeded the sum of cost of illness and averting cost because the WTP bids take into account pain, suffering, discomfort and other intangible costs in addition to the aforementioned costs. Farmers in the study area were willing to increase their pesticide expenditure by 94.2% if provided with safer pesticides or other sound alternatives.

In conclusion, while commercialization of agriculture has resulted in the introduction of new crops such as bitter gourd and cucumber, it has also resulted in increased exposure to hazardous pesticides due to which farmers are experiencing acute health symptoms. The medication and averting expenditures are inadequate. The productivity loss was found to be significant. It is strongly recommended that a nationwide survey be conducted to determine the overall costs of pesticide use in Nepal. Such costs should be taken into account when programs and policies relevant to pesticide use are formulated.

Methods

Only acute symptoms that appeared within 48 hours of pesticide sprays were considered. Long-term and chronic health impairments were not considered due to methodological difficulties. This study applied three morbidity valuation methods: cost-of-illness (COI), which measures the cost incurred as a result of illness; contingent valuation (the most commonly used stated preference method), which measures respondents' WTP for hypothetical health improvements and the averting behavior (a revealed preference method) that estimates WTP from observed behavioral responses to real situations. See **Table 4** for a summary of the three most common morbidity valuation methods for this study. COI includes medication costs (present market value of the materials used and time taken to prepare local treatments, consultation fee, hospitalization cost, laboratory cost, medication cost, travel cost to and from, time spent in traveling, and dietary expenses resulting from illness), productivity loss (work efficiency loss in farm, loss of work days in farm, number of family members involved and time spent by them in assisting or seeking treatment for the victim), and other costs (crop losses/damage due to inability to tend them, costs associated with hiring replacement labor, and any income foregone due to illness). Averting costs includes precautions taken to reduce direct

TABLE 3. Statistical measures for the selected variables (N = 24)

Symptoms	Unit	Min	Max	Mean	SE of Mean
Sex	Female = 0, Male = 1	0	1	0.7	0.09
Age	Years	17	53	35	1.90
Education	Years of schooling	0	12	5.9	0.89
IPM Training	No = 0, Yes = 1	0	1	0.21	0.08
Pesticide use in potato	Year	2	25	12.3	1.31
Pesticide use in tomato	Year	2	20	9.8	1.10
Pesticide use in other crops	Year	0	10	2.7	2.85
Symptoms experienced	No/person/year	0	13	5.9	3.50
Averting Costs	NRS/year/person	0	373.3	119.2	18.34
Medication Costs	NRS/year/household	0	536	97.5	37.25
Productivity loss	NRS/year/household	0	4443.7	981.7	232.91
Other Costs	NRS/year/household	0	2550	181.2	120.79
Total cost-of-illness (sum of medication, productivity and other costs)	NRS/year/household	0	4451.3	1261	296.62
WTP for safer pesticides	NRS/year/household	1500	50000	9962.5	2062.60
Expenditure on unsafe pesticides	NRS/year/household	1300	16000	4800	705.95

TABLE 4. Evaluations of three most common methods for morbidity valuation

Method	Approach	Advantages	Disadvantages
Cost-of-illness	Measures direct costs such as medical expenses and indirect costs such as foregone earnings.	Relative ease of application and explanation. Does not require household surveys.	Does not measure WTP. Ignores important components of WTP such as pain and suffering.
Contingent Valuation	Surveys elicit WTP for hypothetical changes in health effects.	Flexibility allows application to variety of health effects. If designed properly, allows measurement of complete WTP, including altruism.	Hypothetical nature introduces many sources of potential inaccuracy and imprecision. Method is controversial and often expensive.
Averting Behavior	Infers WTP from costs and effectiveness of actions taken to defend against illness.	WTP estimates based on actual behavior.	Difficult to isolate value of health from other benefits of averting action. Difficult to measure individual perceptions of cost and effectiveness of averting action.

Source: EPA (2000)

exposure to pesticide such as mask, handkerchief, and so on.

The study was carried out during 2004 in Srirampati of Hokse Village Development Committee in Jhikhu Khola Watershed of Central Nepal, which is about 40 km northeast of the capital. Twenty-five farmers spraying pesticides in his/her farm were randomly selected and interviewed with a carefully designed questionnaire that was also translated into Nepali language. For this study, due to the small sample, minimum, maximum, mean and standard deviation of mean for the selected variables are provided. One questionnaire was excluded due to duplication: both father and son were inadvertently interviewed. ■

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