Pesticide Use and Health Costs

A Brief Bibliographical Survey

Prepared by: Anuradha Kafle

SANDEE
South Asian Network for Development and Environmental Economics

SANDEE Bibliography No.6- 04

www.sandeeonline.org

Table of Content

Pesticides and Health Costs

1. Ajayi, Oluyede O. C. (2000): "Pesticide use practices, productivity and farmers' health: the case of cotton-rice systems in Cote d'lvoire, West Africa", *Pesticide Policy Project Special Issue Publication Series No. 3*, University of Hanover, Germany. http://www.ifgb.uni-hannover.de/ppp/ppp_s03.pdf

2. Antle, John M. and P. L. Pingali (1994): "Pesticides, Productivity, and Farmer Health: A Philippine Case Study", *American Journal of Agricultural Economics*, Vol.76 (3), Pg. 418-430.

3. Antle, John M. and P. L. Pingali (1994): "Pesticides, Productivity, and Farmer Health: Implications for regulatory policy and agricultural research", *American Journal of Agricultural Economics*, Vol. 76, Pg. 598-602.

4. Brethour, C. and A. Weersink (2001): "An economic evaluation of the environmental benefits from pesticide reduction", *Agricultural Economics*, Vol. 25, Pg. 219-226.

5. Cole D. C., F. Carpio, J. Julian and N. Leon (1998): "Economic burden of illness from pesticide poisonings in highland Ecuador", *Pan American Review of Public Health*, Vol. 8, No.3, Pg. 196 -201.

6. Crissman, C. C., J. M. Antle and S. M. Capalbo (1997): "Economic, Environmental and Health Tradeoffs in Agriculture: Pesticides and the Sustainability of Andean Potato Production", Kluwer Academic Publishers, Boston.

   Abstract: Today the goal of designing highly productive, sustainable agricultural production systems is at the forefront of the agricultural research agenda around the world. The key to designing sustainable agricultural production technologies is in understanding their economic, environmental, and human health impacts. This volume presents a methodology designed to quantify such impacts and to represent them as tradeoffs. This tradeoff methodology is proposed as an approach to accomplish two essential elements in achieving agricultural sustainability. First, the tradeoffs method is a key to the design of successful interdisciplinary research projects to assess sustainability of production systems. Second, the tradeoffs method provides a successful means to communicate research findings to policy makers and the public.

7. Dung, N. H. and T.T. Thanh Dung (1999): "Economic and Health Consequences of Pesticide Use in Paddy Production in the Mekong Delta, Vietnam", *EEPSEA Research Report Series*, IDRC, Singapore. http://203.116.43.77/publications/research1/ACF124.html

8. Feldstein, P.J. (1993): "Health Care Economics", 4th Edition, Delmar Publishers, Albany, New York.

9. Harriton, W. and M. A. Toman (1994): "Methods for Estimating the Economic Value of Human Health Benefits from Environmental Improvement", *Discussion Paper 94-41*, Resources for the Future, August 1994.

10. Harper, R. C. and D. Zilberman (1992), 'Pesticides and Worker Safety', American Journal of Agricultural Economics, Vol.74, No. 1, Pg.68-78.

11. Marquez, C.B., P. L. Pingali and F. G. Pallis (1992): "Farmer Health Impact of Long Term Pesticide Exposure: A Medical and Economic Analysis in the Philippines", Los Banos, Philippines: International Rice Research Institute.

12. Pimentel, D. et al (1992): "Environmental and human cost of pesticides use", *Bioscience*, Vol. 42, Pg. 740-760.

13. Pimental, D. and A. Grenier (1997): "Environmental and socio-economic costs of pesticide use", D. Pimental (Ed.), *Techniques for Reducing Pesticide Use: Economic and Environmental Benefits*, John Wiley and Sons, Chichester, Pg. 51-78.

14. Pimental, D. et al. (1993): "Assessment of environmental and economics costs of pesticide use", Pimental, D. and Lehman, H. (Eds.), *The Pesticide Question: Environment, Economics and Ethics*, Chapman & Hall, New York, NY.

15. Pingali, P. L, C. B. Marquez, F. G. Palis and A. C. Rola (1995): "The Impacts of Pesticides on Farmers health: A medical and economic Analysis in the Philippines", Prabhu L. Pingali and Pierre A. Roger (eds) 1995, *Impact of Pesticides on Farmer Health and the Rice Environment*, International Rice Research Institute (IRRI), Philippines.

16. Pingali, P. L., C. B Marquez and F. G. Palis (1994): "Pesticide and Philippine Rice Farmer Health: A medical and Economic analysis", *American Journal of Agricultural Economics*, Vol. 76 (3), Pg.587 – 592

17. Pingali, P.L., C. B. Marquez, and F.G. Palis (1993): "Health Costs of Long-term Pesticide Exposure in the Philippines: A Medical and Economic Analysis", *Social Science Division*, IRRI.

18. Stefan, A. (1996): "Economic Analysis of Crop Protection Policy in Costa Rica Pesticide Policy Project", *Publication Series No. 4.*

19. Wilson, C. (2000): "Environmental and human costs of commercial agricultural production in South Asia", *International Journal of Social Economics*, Vol. 27, No. 7/8/9/10, Pg. 816-846, MCB University Press.

20. Wilson, C. (2003): "Empirical Evidence Showing the Relationships between Three Approaches for Pollution Control", Environment *and Resource Economics*, Vol. 24, Pg. 97-101.

21. Wilson, C. I. (1999): "Pesticide avoidance: Results from a Sri Lankan Study with Health Policy Implications", in Economics of pesticides, sustainable food production, and organic food market, edited by D. C. Hall and L. Joe Moffot, Elsevier Publication.

22. Wilson, C. (2002b): "Private cost and the relation between pesticide exposure and ill health: evidence from Sri Lanka", *Environmental Economic and Policy Studies*, Vol. 5, No. 213-227.

23. Williamson, S. (2003): "Economic costs of pesticide reliance", *Pesticides News*, No. 61, Pg.3-5, Sept. 2003.

24. Yanggen, D., D. Cole, C. Crissman and S. Sherwood (2003): "Human Health, Environmental and Economic Effects of Pesticide Use in Potato Production in Ecuador", *Research Brief*, May 2003.

25. Zilberman, D. and F. Castillo (1994): "Economic and Health Consequences of Pesticide Use in Developing Country Agriculture: Discussion", *American Journal of Agricultural Economics*, Vol. 76, Pg. 603-604.

26. Zilberman, D. et al. (1991): "The Economics of Pesticide Use and Regulation", *Science*, Vol. 253, Pg. 518-522, (August 1991).

Pesticides, Health and Environmental Issues

27. Ajayi, O. C., M. Camara, G. Fleisher, F. Haidara, M. Sow, A. Traore, & H. Van Der Valk (2002): "Socio-economic assessment of pesticide use in Mali", *Pesticide Policy Project Special Issue Publication Series No. 6*, University of Hanover, Germany. http://www.ifgb.uni-hannover.de/ppp/PPP_s06.pdf

28. Akhabuhaya, I., L. Castello, B. Dinham, G. Ekstrom, N. H. Huan, P. Hurst, S. Petterson and C. Wesseling (2000): "Multistakeholder Collaboration for Reduced Exposure to Pesticides in Developing Countries", PAN International Website http://www.pan-uk.org/briefing/SIDAFIL /Chap1.htm

29. Al-Saleh, I. A. (1994): "Pesticides: A Review Article", *Journal of Environmental Pathology, Toxicology and Oncology*, Vol. 13, No. 3, Pg. 151-56.

30. Albertson, T. E: "Pesticides in the workplace: A worldwide issue", Editorial.

31. Antle, J. M.., D.C Cole and C. C. Crissman (1998): "Further evidence on pesticides, productivity and farmer health: Potato Production in Ecuador", in *Agricultural Economics*, Vol. 18, Pg. 199 -207.

32. Antle, J. M. and S. M. Capalbo (1995): "Measurement and Evaluation of the Impacts of Agricultural Chemical Use: A framework Analysis", *Impact of Pesticides on Farmer Health and the Rice Environment*, Pg. 23-55.

33. Arcury, T. A., S. A. Quandt, L. McCauley (2000): "Farm workers and pesticides: community-based research", *Environmental Health Perspect*, Vol. 108, No.8, Pg. 787-792.

34. Atkin, J. and K. M. Lesinger (eds.) (2000): "Safe and Effective Use of Crop Protection Products in Developing Countries", London: UK CABI Publishing, 163pg.

35. Azaroff, L. S. and L. M. Neas (1999): "Acute health effects associated with non-occupational pesticide exposure in Rural El Salvador", *Environmental Research Section*, Vol. 80, Pg. 158-164.

36. Ballard, T. J and G. M. Calvert (2001): "Surveillance of acute occupational pesticide-related illness and injury: the US experience", *Ann Ist Super Sanita*, Vol. 37, No. 2, Pg. 175 – 179

37. Blair, A. and Zahm, S. H. (1993): "Patterns of pesticide use among farmers: Implications for epidemiologic research", *Epidemiology*, Vol. 4, Pg.55-62.

38. Bull, D. (1982): "A Growing Problem: Pesticides and Third World Poor", Oxford: OXFAM

39. Castaneda C.P. (1988a): " Pesticide Poisoning Data Collection in the Philippines", P. S. Tenga and K. L. Heong (eds), *Pesticide Management and Integrated Pest Management in Southeast Asia*, Manila: Island Publishing House.

40. Castaneda C.P. (1998b): "A study of Occupational Exposure among Filipino Farmers in San Leonardo, Neuva Ecija," P. S. Tenga and K. L. Heong (eds), *Pesticide Management and Integrated Pest Management in Southeast Asia*, Manila: Island Publishing House.

41. Castaneda C.P., N.C. Maramba and A. V. Ordas (1989): "A Field Worker Exposure Study to Methyl Parathion among Selected Rice Farmers," *Acta Medica Philippina*, Vol. 25, No. 3.

    Abstract: Forty five randomly selected farmer-volunteers were divided into eight groups corresponding to eight pesticide-related activities; mixing and loading; spraying; cleaning and

disposal; days one and seven re-entry; and a group who did all activities. Methyl parathion 50EC was applied at approximately 327 to 467 grams ai/ha. Potential dermal penetration through the protective clothing material was highest for the group doing all activities (46.84%). Regional exposure was predominant in the hands (23 to 73percent) for all field activities. Potential dermal contamination was highest during mixing and loading, with the left hand the most contaminated. Urinary metabolite (paranitrophenol) levels were lowered after exposure in seven of the eight tested activities. it should be noted that the farmer subjects have been chronically exposed to different pesticides types for an average of nine years, such that even the (high) baseline levels already showed presence of paranitrophenol.

42. Chawla, R.P., V. M. Sharada, B.S. Jodia and R.L, Karla (1977): "A Survey of Residues of Organochlorine Insecticides in Biopsy of Human Fat Samples", Punjab Agricultural University, Ludhiana, India.

Abstract: from 1976 to 1977, 51 30-ml biopsy human fat samples from patients undergoing surgery were examined. All samples contained DDT residues; highest level of DDT and related compounds (DDT-R) was 31.34 ppm, averaging at 9.14 ppm. HCH residues were also found with the highest level at 30.05 ppm, averaging 4.30ppm. The major component of its residues was of beta-HCH (known for its accumulation behavior), with alpha and gamma-isomers. The high HCH incidence confirms its bioconcentration in fatty tissues, while those of the isomers indicate rather recent exposure.

43. Cielsielski, S., D. P. Loomis, S. R. Mims and I. A. Calvert (1997): "Pesticide exposures, cholinesterase depression, and symptoms among North Carolina migrant farm workers", *American Journal of Public Health*, Vol.84, Issue 3, Pg.446 - 451.

44. Clarke, E. E., L. S. Levy, A. Spurgeon and I. A Calvert (1997): "The problems associated with pesticides use by irrigation workers in Ghana ",*Occupational Medecine*, Vol. 47, Issue 5, Pg. 301-308.

Abstract: The use of pesticides in Ghanaian agriculture, though beneficial in reducing crop loss both before and after harvest, has been associated with threats to human health often due to the misapplication of the chemicals. This study was an initial attempt to explore the knowledge, attitudes and practices of 123 farm workers on three irrigation project areas in the Accra Plains, Ghana, regarding the safe handling and use of pesticides, to assess the prevalence of symptoms associated with organophosphorus pesticides (OPs) and carbamates and to determine the prevalence of pesticide-related symptoms, and blood cholinesterase. The study design was cross-sectional in type. Methods used were interviews and observation, and biological monitoring. The results revealed moderate levels of knowledge of the routes of absorption of pesticides and of potential symptoms following exposure. Knowledge of personal protective measures was poor to moderate. High risk practices included frequent handling of the chemicals, home storage of pesticides and short re-entry intervals. Despite knowledge of some health risks associated with pesticides, the use of personal protective equipment (PPE) was minimal due primarily to financial constraints. The prevalence of symptoms was higher and cholinesterase levels lower than in a control group of teachers. It is suggested that there is a need for more epidemiologic studies to investigate the problems associated with pesticide induced ill health as well as research into appropriate and affordable PPE. PPE needs to be subsidized. Training of agriculture and health workers in safety precautions, recognition, and management of pesticide-related ill health is a matter of urgency.

45. Cole, D. C., N. Leon and F. Carpio (1998a): " Health impacts of pesticide use in Carchi farm populations", Crissman, C. C., J. M. Antle and S. M. Capalbo (Eds.), *Economic, Environmental and Health Tradeoffs in Agriculture: Pesticides and the Sustainability of Andean Potato Production*, Chapter 9, Kluwer Academic Publishers, Boston.

46. Copplestone, J. F. (1985): “Pesticide Exposure and Health in Developing Countries”, in G.J. Turnbull (ed), *Occupational Hazards of Pesticide Use*, London: Taylor and Francis.

47. Cowan, R. and P. Gunpy (1996): “Sprayed to death: path dependence, lock-in and pest control strategies”, *Economic Journal*, Vol.106, Pg.521-542.

Abstract: Theoretical literature on the economics of technology has emphasized the effects on technological trajectories of positive feedbacks. In a competition among technologies that all perform a similar function, the presence of increasing returns to adoptions can force all but one technology from the market. Furthermore, the victor need not be the superior technology. This paper provides an empirical study of one technological competition which illuminates this theoretical work. It uses theoretical results to explain why chemical control of agricultural pests remains the dominant technology in spite of many claims that it is inferior to its main competitor, integrated pest management.

48. Cox, P. (1985): “Pesticide use in Tanzania”, Overseas Development Institute, UK

49. Crissman, C. C., D.C. Cole and F. Carpio (1994): “Pesticide Use and Farm Worker Health in Ecuadorian Potato Production”, *American Journal of Agricultural Economics*, Vol. 76, Pg. 593-597

50. Crissman, C., C. Donald, S. Sherwood, P. A. Espinosa and D. Yanggen (2002): “Potato Production and Pesticide Use in Ecuador: Linking Impact Assessment Research and Rural Development Intervention for Greater Eco-System Health”, Paper prepared for International Conference on Impact Assessment, San Jose, Costa Rica, February 4-7, 2002.

51. Cunyo, L.C.M., G. W. Norton and A. Rola (2001): “Economic analysis of environmental benefits of integrated pest management: A Philippine Case Study”, Agricultural *Economics*, Vol. 25, Pg. 228-233.

52. Dahal, L. (1995): “A study on pesticide pollution in Nepal”, National Conservation strategy implementation project, NPC/HMG and IUCN.

53. Das, R., A. Steege, S. Baron, J. Beckman and R. Harrison (2001): “Pesticide related illness among migrant farm workers in the United States”, *International Journal of Occupational Environmental Health*, Vol.7, Pg.303-312

54. Davies, J. E., V. H. Freed and F.W. Whittemore (eds) (1982): “An Agro medical Approach Pesticide Management: Some Health and Environmental Considerations”, Miami, Florida: University of Miami School of Medicine in Co-operation with the Agency for International Development and Consortium for International Crop Protection.

55. Dharmawardena, L. I. M. (1994): “Pesticide poisoning among farmers in a health area in Sri Lanka”, *Ceylon Medical Journal*, Vol.39, Pg. 101-103.

56. Dinham, B. (1993): “The pesticide Hazard: A global health and environmental audit”, London, UK, Zed Books for the Pesticide Trust.

57. Dixon, R. L. and C. H. Nadolney (1987): “Problems in Demonstrating Disease Causative following Multiple Exposure to Toxic or Hazardous Substances”, S. Draggen, J. J. Cohrssen and R. E. Morrison (eds), *Environmental Impacts on Human Health – the Agenda for Long-term Research and Development*, Praeger.

58. El-Sebae, A. H. (1993): “Overview of environmental chemistry and toxicology of pesticides used in Egypt”, *Arab Symposium on Environment*. UNSCO, University of Jordan, 1983.

59. El-Sebae, A. H. (1993): “Special problems experienced with pesticides use in developing countries”, *Regulatory Toxicology and Pharmacology*, Vol. 17, Pg. 287–91.

Abstract: The developing countries comprise more than 75% of the total world population covering most of Africa, Asia, Latin America, and South Europe. Their warm climate favors cultivation of many strategic crops including cotton, rubber, rice, corn, spices, tea, coffee, cocoa beans, sugarcane, tobacco, legumes, tropical and subtropical fruits, and vegetables. They are bound to the industrialized countries for exporting their cash crops and importing all production equipment and materials including pesticides and fertilizers. They suffer from illiteracy, overpopulation, and low standards of living. Their deficient economy and infrastructure hinder their ability to regulate efficiently registration of pesticides. Their inhabitants are at high risk due to the acute and chronic adverse health effects induced by pesticide exposure under both occupational and epidemiological conditions. Their legislations, regulations, technical capabilities, and medical care need to be upgraded to a reliable standard. This is essential for the global welfare because any hazardous pesticides dumped or released in the environment in these countries will not be dissipated but can reappear as residues in imported raw foods or by destroying terrestrial and aquatic life, through their transportation within the atmosphere, or in liquid discharges to soil and water bodies. International assistance and support are badly needed by United Nations Agencies, mainly WHO, UNEP, FAO, ILO, IPCS, IRPTC, and other relevant international organizations.

60. El-Sebae, A. E. and J. M. Safi (1998): “Pesticides residues and environmental pollutants as cytotoxic endocrine disrupters in human and wild life”, *Egyptian Journal of Occupational Medicine*, Vol. 22, Pg. 177–95.

61. Ecobichon, D. J. (2000): “Our changing perspectives on benefits and risks of pesticides: A historical review”, *Neurotoxicology*, 21, Pg.211-218.

62. Eddleston, M., M. J. Rezvi-Sheriff and K. Hawton (1998): “Deliberate self harm in Sri Lanka: an overlooked tragedy in the developing world”, *British Medical Journal*, Vol. 317, Pg. 133-135

63. FAO (1990): “International code of conduct on the distribution and use of pesticides”, Food and Agriculture Organization of the United Nations, Rome

64. FAO/WHO (1989): “Pesticide Residues in Food”, FAO plant production and protection paper No.72/11, Rome, Italy.

65. FARMLINE/December (1980): “Pesticides: Weighing Benefits against Risks”.

66. Fayomi, B., E. Lafia, L. Fourn et al (1998): “Knowledge and behavior of pesticide users in Benin”, *African Newsletter on Occupational Health Safety*, Vol.8, Pg. 44-47.

67. Finkelman, J. and G. Molina (1988): “Pesticides and Health: Situation in Latin America”, Metepec, Mexico: Pan American Center for Human Ecology and Health.

68. Forget, G. (1989): “Pesticides: Necessary but dangerous poisons”, *IRDC Reports*, Vol.18, No. 3, Pg. 4-7

69. Forget, G. (1991): “Pesticides and the third world”, *Journal of Toxicology and Environmental Health*, Vol.32, Pg. 11-13.

Abstract: Many developing countries are importing industrial processes that make use of toxic chemicals. By the same token, pesticides, which are toxic by design, are also used increasingly in agriculture and in public health programs to control pests and vector-borne diseases. Recent estimates suggest that pesticides account for more than 20,000 fatalities yearly, and that most of these will have occurred in developing countries. This may actually be a gross

underreporting. Although organophosphate and carbamate insecticides are still responsible for many of those poisoning cases, herbicides such as paraquat are also increasingly being implicated in fatal poisoning cases. Newer pesticides such as the synthetic derivatives of pyrethrin, which were believed to be relatively safe to humans, now appear to be implicated in some serious cases of intoxication. Community-based pest control using locally available botanical pesticides could have severe consequences unless the toxicity of these compounds is carefully assessed relative to nontarget organisms. A high proportion of pesticide intoxications appear to be due to lack of knowledge, unsafe attitudes, and dangerous practices. The technology available to small farmers for pesticide application is often inappropriate: faulty sprayers, lack of protective equipment adapted to tropical conditions, nonexistent first-aid provisions. Agricultural extension is often not oriented to the transfer of information relative to the dangers inherent in the use of pesticides. The lack of information at all levels may be one of the most important causative factors of chemical intoxication in developing countries. Research should at this time concentrate on behaviors leading to chemical intoxication. This should be done concurrently with proper prospective and retrospective surveys of poisonings in developing country communities. More information should be sought relative to the decision processes of import, legislation, and licensing. Research and development efforts in appropriate technology and safety devices are also critically needed.

70. Frank, A. L., R. McKnight, S. R. Kirkhorn and P. Gunderson (2004): "Issues of agricultural safety and health", *Annual Review of Public Health*, Vol.25, Pg. 225 -45.

71. Garcia, A. M. (2003): "Pesticide exposure and women's health", *American Journal of Industrial Medicine*, Vol. 44, Pg.584-594.

72. Garry V.F. et al. (2002): "Birth defects, season of conception, and sex of children born to pesticide applicators living in the Red River Valley of Minnesota, USA", *Environmental Health Perspectives*, Vo.110, No. 3, Pg. 441-449.

Abstract: The Red River Valley in Minnesota, a major agricultural region, has been shown in earlier studies to have significantly higher rates of birth defects than other areas of the state. These studies found that rates of birth defects were even higher among families of pesticide applicators in the region, suggesting these effects may be due to paternal exposure to agricultural pesticides. A new follow-on study surveyed state-licensed pesticide applicators and examined the rate of birth defects in their children and the type of pesticides they applied (i.e. fungicides, herbicides, insecticides, fumigants, or combinations). Of the 536 pesticide applicators with children, a total of 54 children had confirmed birth defects – 10.1 percent compared with a national average of 3.7 percent. The highest rate of birth defects was found among children born to applicators using combinations of herbicides, insecticides, and fumigants. The study also found fewer male children born to pesticide applicators using fungicides and higher rates of birth defects among children conceived in the spring (a time when herbicides are typically applied). The authors suggest that environmental agents present in the spring are responsible for the increased birth defect rate, and that fungicides may be selectively affecting the survival of the male fetus.

73. Gnanachandran, S. and C, Sivayoganathan (1989): "Hazards associated with the spraying of pesticides to chilli and brinjal in Jaffna district", *Tropical Agricultural Research*, Vol. 1, Pg.132 -141.

74. GOHNET Newsletter: "The Global Occupational Health Network", Issue No.1, GOHNET Newsletter.

75. Gough, M. (1989): "What Does Epidemiology Tell Us about Relationships Between Environmental Exposure to Pesticides and Diseases", Center for Risk Management, Resource for Future.

76. Gomes, J., O.L. Lloyd and D.M. Revitt (1999): "The influence of personal protection, environmental hygiene and exposure to pesticides on the health immigrant farm workers in a desert country", *International Journal of Occupational and Environmental Health*, Vol.54, No.6, Pg. 430-435.

77. Gomes, J., O. Lloyd, D. M. Revitt et al. (1998): "Morbidity among farm workers in a desert country in relation to long-term exposure to pesticides", *Scandinavian Journal of Work, Environment and Health*, Vol. 24, Pg. 213–19.

78. Gunn, D. L. and J.G.R. Stevens (1976): "Pesticides and Human Welfare", Oxford: Oxford University Press.

79. Gupta, Y.P (1989): "Pesticide Poisoning", *Science Report*, Vol.26, No.9, Pg. 491 - 492.

80. Hanrahan, L.P., H.A. Anderson, L. K Haskins, J. Oslon, K. Lappe and D. Redding (1996): "Wisconsin farmer cancer mortality, 1981-1990: Selected Malignancies",*Journal of Rural Health*, Vol. 2 (suppl), Pg: 273-277.

81. Harper, C. R. & D. Zilberman (1992): "Pesticides and worker safety", *American Journal of Agricultural Economics*, Vol. 74, Pg. 68-78.

82. Hoek Van Der, W., F. Konradsen, K. Athukorale and T. Wanigadewa (1997): "Pesticide poisoning: A major health problem in Sri Lanka", *Social Science and Medicine*, Vol. 46, Issue 4-5, February 3, 1998, Pg. 495-504.

Abstract: Acute pesticide poisoning is a major public health problem in Sri Lanka. In several agricultural districts, it precedes all other causes of death in government hospitals. Most of the acute poisoning cases are intentional (suicide) and occur among young adults, mainly males. Poisoning due to occupational exposure is also common, but less well documented. In an irrigation area in Sri Lanka a very high incidence of serious pesticide poisoning was observed, with 68% due to intentional ingestion of liquid pesticides. It is argued that the easy availability and widespread use of highly hazardous pesticides is the most important reason for this high number of poisoning cases. The frequent application of highly hazardous pesticides in high concentrations was often irrational and posed serious health and financial risks to the farmers. Sales promotion activities and credit facilities promoted this excessive pesticide use, which was not counteracted by an agricultural extension service. Hazardous practices when spraying pesticides were due to the impossibility of applying recommended protective measures under the local conditions, rather than to lack of knowledge. Current emphasis on programs that promote the safe use of pesticides through education and training of farmers will be ineffective in Sri Lanka because knowledge is already high and most poisoning cases are intentional. Instead, enforcement of legislation to restrict availability of the most hazardous pesticides would result in an immediate health benefit. Improved agricultural extension services to promote alternative non-chemical methods of pest control is the most important strategy, in the long term, to prevent acute pesticide poisoning.

83. Huanh, J., F. Qiao, L. Zhang and S. Rozelle (2001): "Farm pesticides, rice production, and human health in China," Economy and Environment Program for Southeast Asia (EEPSEA), *Research Report 3*, Singapore.

84. Hurtig, A. K. (2003): "Pesticide use among farmers in the Amazon basin of Ecuador," *Archives of Environmental Health*, April 2003.

85. Igbedioh, S. O. (1991): "Effects of agricultural pesticides on humans, animals, and higher plants in developing countries", *Archives of Environmental Health*, July-August 1991.

86. JAMA, (1996): "Provocative report issued on the use of pesticides",*Medical news and perspectives*, Vol. 275, No.12, Pg. 899 -900.

87. Jeyaratnam, J. (1990): "Acute pesticide poisoning: A major global health problem", *World Health Statistics Quarterly*, Vol. 43, No. 3, Pg. 139-144.

88. Jeyratnam, J.: (1985): "Health problems of pesticide usage in the Third World", *British Journal of Industrial Medicine*, Vol.42, Pg. 505-506.

89. Jeyaratnam, J., K.C. Lun and W.O Phoon (1987): "Survey of acute pesticide poisoning among agricultural workers in four Asian countries", *World Health Bulletin*, Vol. 65, Pg.521-557.

90. Jeyaratnam, J., R. S. Seneviratne, J. F. Copplestone (1982): "Survey of Pesticide Poisoning in Sri Lanka", *Bulletin on World Health Organization*, Vol.60.

91. Jeyaratnam, J. (1992): "Acute pesticide poisoning and developing countries", In: J. Jeyaratnam (Ed.), Occupational Health in Developing Countries, Oxford, UK: Oxford University Press, 1992, Pg. 255-264.

92. Iorio, D.C (1985): "Agricultural worker: Occupational health's neglected client", *Occupational Health Nursing*, Vol. 36, Pg.566-568.

93. Keifer, M., D. I. Murray, R. Amador et al. (1997): "Solving pesticide problems in Latin America: A model for health-sector empowerment", *New Solutions*, Vol.7, No. 2, Pg. 26 – 31.

94. Keyfer, M., R. McConnel, A.F. Pacheco, W. Daniel and L. Rosenstock (1996): "Estimating underreported pesticide poisoning in Nicaragua", *American Journal of Industrial Medicine*, Vol. 30, Pg. 195-201.

95. Kimani, V.N. and M.A Mwanthi (1995): "Agrochemicals exposure and health implications in Githunguri location, Kenya", *East African Medical Journal*, Vol.72, Pg. 531-535.

96. Kishi, M. et al (1995): "Relationship of pesticide spraying to signs and symptoms in Indonesian farmers", *Scandinavian Journal of Work, Environment and Health*, Vol. 21, Pg.124-133.

97. Koch, D. et al (2002): "Temporal association of children's pesticide exposure and agricultural spraying: Report of a longitudinal biological monitoring study", *Environmental Health Perspectives*, Vol. 110, No. 8 Pg. 829-833.

Abstract: Growing evidence exists that chronic exposure to low levels of organophosphate pesticides (OPs), widely used both in agriculture and residential settings, can cause adverse health effects in children. Despite these concerns, few studies have evaluated children's long-term exposure to OPs. A recent study examines year-long fluctuations in OP metabolite concentrations in a group of low-income family children living in an agricultural community. The study found that regardless of the families' proximity to treated orchards or parental work exposure to pesticides, metabolite levels increased in children's urine during the spring and summer spraying months. Because OPs have a relatively short half-life in the body, levels declined (but were still detectable) in fall and winter after agricultural spraying ended. Study findings support the theory that children are continuously exposed to low levels of OPs in the diet, with episodes of higher exposures as a result of residential and agricultural pesticide use.

98. Kurzel, R. B. and C. L. Cetrulo (1981): "The effect of environmental pollutants on human reproduction, including birth defects", *Environmental Science and Technology*, Vol. 15, No. 6, June 1981.

Abstract: in 1969, it was reported that DDT, DDE, lindane, dieldrin and heptachlorepoxide were present in the cord blood (fetal) and tissues of 10stillborn infants, in levels equal to that of adults. This confirms the transplacental transfer of these compounds, which can also reach the

newborn via the breast milk. Measuring DDE levels in fetal whole blood, they found that premature infants had levels elevated three- to fourfold relative to control, term infants. Although these elevations could be explained by the absence of body fat to store the compound, which is common in pre-term infants, a causative role of chlorinated pesticides in inducing premature deliveries cannot be ruled out.

99. Landrigan, P. J. et al. (2002): "Environmental pollutants and disease in American children: Estimates of morbidity, mortality, and costs for lead poisoning, asthma, cancer, and developmental disabilities", *Environmental Health Perspectives*, Vol. 110, No. 7, Pg.721-728.

Abstract: The most serious childhood diseases in the U.S. and other developed countries are chronic conditions with multiple causative factors, including environmental pollution. Although environmental linkages are known or suspected for many diseases, their economic costs to society have not been estimated. A recent study estimates the incidence, prevalence, mortality, and annual costs of four environmentally induced childhood diseases – lead poisoning, asthma, cancer, and developmental disabilities. Using approximations of incidence and prevalence for each of these diseases in the U.S., the researchers estimated the average annual costs attributable to toxic environmental exposures to be $43.4 billion for lead poisoning; $9.2 billion for neurobehavioral disorders; $2.0 billion for asthma; and $300 million for cancer. For these diseases alone, the total annual cost (average) attributable to environmental factors is $54.9 billion, nearly 2.8 percent of the total annual costs for illness in America. By comparison, the cost of all child-related research was only $2 billion (1995 estimate) – a small fraction of federal research spending. Based on the results of the study, the authors recommend increased investment in disease tracking and surveillance, basic research on disease mechanisms, prevention-oriented epidemiologic research, and most importantly, pollution prevention.

100. Lessenger, J. E. and N. Riley (1991): "Neurotoxicities and behavioral changes in a 12-year-old male exposed to dicofol, an organochlorines pesticide", *Journal of Toxicology and Environmental Health*, Vol. 33, Pg.255-261.

101. Levine, R. S. (1986): "Assessment of mortality and morbidity due to unintentional pesticide poisonings", WHO/VBC/86.929, Division of Environmental Health, World Health Organization, 1121 Geneva 27, Switzerland.

102. London, L. and H. A. Rother (2000): "People, pesticides and the environment: who bears the brunt of backward policy in South Africa? ", *New Solutions*, Vol.10, No. 4, Pg. 339 – 350

103. Lohr, L., T. Park and L. Higley (1999): "Farmer risk assessment for voluntary insecticide reduction", *Ecological Economics*, Vol.30, Pg.121 -130.

104. Lu, C., R. A. Fenske, N. J. Simcox and D. Kalman (2000): "Pesticide exposure of children in an agricultural community: evidence of household proximity to farmland and take home exposure pathways", *Environmental Research Section A*, Vol.84, Pg. 290 -302.

105. Ma X. et al. (2002): "Critical windows of exposure to household pesticides and risk of childhood leukemia", *Environmental Health Perspectives*, Vol.110, No.9, Pg. 955-960.

Abstract: Several studies have suggested that household pesticide use is associated with increased risk of childhood leukemia; however, many of these studies are limited by small study size or weaknesses in exposure data. To address these concerns, a more comprehensive study in California recruited 162 children (ages 15 and under) with recent diagnoses of leukemia and 162 matched controls. For each study participant, the primary care giver was interviewed in detail regarding household pesticide use, including the type of product and frequency and timing of use. Pesticide use was examined for five discrete periods: the three months prior to pregnancy, pregnancy, and each of the three years after birth. The researchers found that children who lived in homes professionally treated for pests or where insecticides

had been applied indoors at any time during the five periods had a higher risk of leukemia. The highest risk was seen for indoor pesticide use during pregnancy. No association was found for outdoor pesticide use or for use of herbicides or flea control products. These results provide additional evidence that exposure to insecticides during development and the early years of life is associated with an increased risk of childhood leukemia.

106. Maddy, K. T., S. Edmiston and D. Richmond (1990): "Illness, injuries and deaths from pesticides exposures in California 1949-1988", *Reviews of Environmental Contamination and Toxicology*, Vol.114, Pg. 57-123.

107. Maroni, M. and A. Fait (1993): "Health effects in man from long-term exposure to pesticides. A Review of the 1975-1991 literature", *Toxicology*, Vol. 78, Pg. 1-180.

108. Maramba, N. C. (1988): "Assessment of Adequacy of Protection of Pesticides Handlers II", A Final Project Report, Guagua, Pampanga, Phillipines.

Abstract: Twelve volunteer farmers were divided into two groups: protected and unprotected farmers tested before and after spraying methyl parathion 50EC at a final spray concentration of0.05 to 0.18 kg ai/ha. While there was no significant difference in cholinesterase (ChE) levels before and after exposure in either farmer's group, there was significant red cell ChE depression in 31percent of the sample. Farmers wearing protective clothing had significantly higher hemoglobin levels than those without. In terms of potential dermal exposure, total pesticide residue levels by anatomical locations are 37 to 200 times higher for the unprotected group. Mean levels of urinary metabolite (paranitrophenol) for both groups were higher after exposure. There was a statistically significant lowering in the after-exposure levels of paranitrophenol of the protected group, suggesting some from of protection not only from exposure but also from systemic absorption.

109. Maumbe, B. M. and S. M. Swinton (2003): "Hidden health costs of pesticides use in Zimbabwe's smallholder cotton growers", *Social Science & Medicines*, Vol. 57, Pg. 1559-1571.

110. Meulenbelt, J., I. de Vries (1997): "Acute work-related poisoning by pesticides in the Netherlands: a one year follow-up study", *Przegl Lek*, Pg. 665–70.

111. Moses, M. (1992): "Harvest of sorrows: Farm workers and pesticides", San Francisco, Pesticide Education Center.

112. Moses, M., E. S. Johnson, W. K, Anger, V. W. Burse, S. W. Horstman, R. J. Jackson et al (1993): "Environmental equity and pesticide exposure", *Toxicology and Industrial Health*, Vol. 9, Pg. 913-959.

113. Namba, T. (1971): "Cholinesterase inhibition by organophosphorus compounds and its clinical effects", *Bulletin of World Health Organization*, Vol. 44, Pg. 1735-1749.

114. Nemery, B. (1987): "The lungs as a target for toxicity of some organophosphorous compounds," NATO ASI Series, Vol. H13, *Toxicology of Pesticides: Experimental, Clinical and Regulatory Aspects*, ed. L.G. Costa et. al, 1987.

Abstract: The article mainly dealt with trialkyl phosphorothioates(TP). Human relevance of TP-induced lung injury indicate that lungs are an important site for binding or metabolism of organophosphorus pesticides; exposure by inhalation may occur occupational activites, and respiratory distress is commonly found in acute human poisoning with organophosphate insecticides, the latter being generally attributed to the effects of cholinesterase inhibition leading to bronchospasm and excessive tracheobronchial secretions, respiratory muscle paralysis and cause of pulmonary oedema encountered in India; delayed pulmonary oedema or pneumonitis may also be observed in organophosphate poisoning.

115. Ngatia, J. and A. Y. Mgeni (1980): "The effects of continuous exposure of organophosphorus and carbamate insecticides on cholinesterase (CHE) levels in Humans", *Field worker exposure during pesticide application*, Pg. 98-102, Eds. W.F. Tordoir, EAH van Heemstra, Amsterdam: Elsevier.

Abstract: Employees from a total of six sections from the two institutes (Agricultural Entomology, Physics, Botany and Administration) were examined, these employees handled a variety of chemicals including chlorpyrifos, dimethoate, fenthion, trichlorophon, methomyl, dichlorvos, carbofuran, DNOC, 2,4 –D, atrazine, oxadiazon, carbendazim and endosulfan. There was statistically significant reduction of plasma cholinesterase enzyme at the 0.025 probability level, while there was none in the whole-blood cholinesterase in all persons examined.

116. Ngowi, A. V, (2002): "Health Impact of Exposure to Pesticides in Agriculture in Tanzania", Academic dissertation submitted to the Faculty of Medicine of the University of Tampere, for public discussion in the auditorium of Tampere School of Public Health, Medisiinarinkatu 3, Tampere, on October 18th 2002.

117. Ngowi, A. V., D. N. Maeda and H. Kisso (1992): "Impact of pesticides on human health: A case study of the coffee growing regions of Tanzania", *African Newsletter on Occupational Health and Safety*, Vol.2, Pg. 80-83.

118. Niraula, B. B., F. Neupane, P. L. Shrestha, N. Shrestha and B. Sharma (2001): "Socio economic contexts of pesticides use in Nepal ", A. Hermann and S. Schumann (eds). Extended Abstracts: international workshop on environmental risk assessment of pesticides and integrated pest management in developing countries, Kathmandu, Nepal.

119. Ohayo-Mitoko, G. J.A, D.J.J Heederik, H. Kromhout, B.E.O Omondi and J.S.M. Boleij (1997): "Acetylcholinesterase inhibition as an indicator of organophosphate and carbamate poisoning in Kenya agricultural workers", *International Journal of Occupational and Environmental Health*, Vol.3, Pg.210-220.

120. PAN, North America (1999): "Pesticide Research Updates – A Review of recent research on the health effects of pesticides", No. 1, Oct. 1999, *Pesticide Action Network*, North America.

121. PAN, North America (2000): "Pesticide Research Updates – A Review of recent research on the health effects of pesticides", No. 2, Feb.2000, *Pesticide Action Network*, North America.

122. Pandey, M. R. (1997): "Domestic smoke pollution and chronic bronchitis in a rural community of the hill region of Nepal", *Thorax*, Vol. 29, Pg.337-42.

123. Partanen, T., K. Kurppa K and V. F, Ngowi (1991): "Occupational pesticide hazards in developing countries: epidemiological considerations", *African Newsletter on Occupational Health and Safety*, Vol.1, Pg. 46-51.

124. Pearce, N and J. S. Reif (1990): "Epidemiologic studies of cancer in Agricultural workers," *American Journal of Industrial Medicine*, Vol.18, Pg. 133-148.

125. Perera, D. (1988): "Poisoning with chemicals and hazards of pesticides", *Use of Pesticides and Health Hazards in the Plantation Sector*, Friedrich Ebert Stiftung, Colombo.

126. Perry, M. J., A. Marbell, P. M. Layde(2000): "Association of pesticide safety knowledge with beliefs and intentions among farm pesticide application", *Journal of Occupational and Environmental Medicine*, Vol.42, Pg.187–93.

Abstract: Although a number of health hazards associated with pesticide exposure have been well documented, relatively little is known about the knowledge and health beliefs that may influence pesticide handling. This study measured knowledge levels concerning pesticide safety and precautionary handling among applicators and examined relationships between knowledge scores and intentions to use handling precautions, perceptions of pesticide safety peer norms, and perceived self-efficacy to prevent personal exposure. Telephone interviews were conducted with a randomly selected sample of 164 dairy farmers who were pesticide applicators residing in Wisconsin (response rate = 77.4%). The percentage of correct responses to 18 knowledge items ranged from 100% to 45.7%. Knowledge levels were positively related to intentions, beliefs, and self-efficacy regarding use of personal protective gear but were not significantly related to risk perceptions and peer norms concerning pesticide safety.

127. Pingali, P. L. and P.A. Roger (1995): "Impact of Pesticides on Farmer Health and the Rice Ecosystem", Boston, Massachusetts, Kluwer Academic Publishers.

128. Pingali, P. L., R. V. Gerpacio and A. C. Rola (1995): "Pesticide Pollution and Poison: Evidence from the Philippines' Rice Production", Ecodecision: Environment Policy Magazine, Quebec, Canada. Pp. 61-65.

129. Pingali, P. L. and J. M. Antle (1994): "Health and Productivity Effects of Pesticide Use in Philippine Rice Production", *Resources,* No. 114:16-19.

130. Pingali, P. L. (1995): "Impact of Pesticides on Farmer Health and the Rice Environment: An Overview of Results from a Multidisciplinary Study in the Philippines", P. Pingali, and P. Roger (eds.), *Impact of Pesticides on Farmer Health and the Rice Environment*, Kluwer Academic Publishers, Boston, Massachusetts, U.S.A.

131. Pingali, P. L. and A. C. Rola (1993): "Pesticides, Rice Productivity and Health Impacts in the Philippines", P. Fateh ed, *Agricultural Policy and Sustainability: Case Studies from India, Chile, the Philippines and the United States*, Publishers World Resources Institute, Washington, D.C., U.S.A., pp. 47-62.

132. Pingali, P. L., E. Lichtenberg, R. C. Spear (1991): "Productivity and Environmental Trade-Offs of Pesticide Regulation", *Working Paper No. 91-23*, Department of Agriculture and Resource Economics, University of Maryland, U.S.A. December.

133. Rahmen, S. (2003): "Farm-level pesticides use in Bangladesh: Determinants and Awareness", *Agriculture, Ecosystems and Environment*, Vol. 95, Pg. 241-252.

134. Rama, D. B. and K. Jaga (1992): "Pesticide exposure and cholinesterase levels among farm workers in the Republic of South Africa", *Science of the Total Environment*, Vol. 122, Pg. 315 -319.

135. Reigart, J. R. and J. R. (1999): "Recognition and management of pesticide poisonings", *Office of Pesticide Program*, U. S. Environmental Protection Agency, Washington D. C.

136. Repetto, R. and S. Baliga0 (1996): "Pesticides and the Immune System: The Public Health Risks", World Resources Institutes, Washington, D.C.

137. Richter, E. D. and J. Safi (1997): "Pesticide use, exposure, and risk: a joint Israeli-Palestinian perspective", *Environmental Research*, Vol. 73, Pg. 211-218.

138. Richter, E. D., S. Gasteyer, S. El Haj, M. Jaqhabir and J. Safi (1997): "Agricultural sustainability, pesticide exposure, and health risks: Israel, the Palestinian National Authority, and Jordan", *Ann. N. Y. Acad. Sci*., Vol.837, Pg.269-290.

139. Rojas, M., J. Reid and R. Rincon (1999): "Pesticide Exposure in a Farming Village in Venezuela – a Developing Country," *Archives of Environmental Health*, Vol. 54, No.6, Pg. 430-435.

140. Rola, A.C. (1989): "Pesticides, Health Risks and Farm Productivity: A Philippine Experience", *UPLB – Agricultural Policy Research Program Monograph No.89-01*, Los Banos, Philippines: University of the Philippines at Los Banos.

141. Rola, A. C. and P. L. Pingali (1993): "Pesticides, rice productivity and farmers' health: an economic assessment", IRRI and World Resources Institute, Philippines.

142. Sivayoganathan, C., S. Gnanachandrnn, J. Lewis, *et al*. (1995): "Protective measure use and symptoms among agropesticide applicators in Sri Lanka", *Social Science and Medicine*, Vol. 40, Pg. 431–6.

Abstract: Sri Lankan farmers use large amounts of pesticides to control the pests affecting their vegetable crops. Improper use of pesticides by farmers has resulted in poisoning of occupational origin. This paper examines the use of protective measures by pesticide applicators and its relationship to their illness symptoms. The data were collected by interviewing a stratified random sample of 150 farmers from predominantly vegetable growing areas of the Matale district during 1990/91 using structured questionnaires. These data were supplemented with secondary data and observation of all stages of pesticide application. Scales were constructed to measure the domains of material style of life, awareness and use of protective measures, and illness symptoms experienced by pesticide applicators. It was found that most of the farmers were aware of the protective measures to be used when applying pesticides. There was, however, no significant positive relationship between awareness and use of protective measures. The main reason for not using protective measures was discomfort. The most common symptoms reported by pesticide applicators were faintish feeling, headache and dizziness. A significant negative relationship was observed between use of protective measures and symptoms exhibited within four hours of application. It is recommended that protective materials adapted to the climate and socio-economic conditions of farmers be developed, and that farmers be encouraged to use these protective materials through appropriate educational efforts and incentives.

143. Sack, D., D. Linz, R. Shukla et al. (1993): "Health status of pesticide applicators: postural stability assessments", *Journal of Occupational Medicine*, Vol.35, No.12, Pg. 1196 -1202.

144. Safi, J. M, Y. Z. El-Nahhal, M. G. Kaware, *et al* (2000): "Initiation of a pesticide environmental extension and public awareness program for Palestinian community in Gaza Strip", *Journal of Pest Control and Environmental Science*, Vol. 8, Pg. 75–98.

145. Safi, J. M. (1999): "Special problems associated with pesticides use and its management in Gaza Strip", *Egyptian Journal of Occupational Medicine*, Vol.19, Pg.267–76.

146. Safi, J. M., Y. H. El-Nahhal, S. A. Soliman *et al*. (1999): "Mutagenic and carcinogenic pesticides used in agricultural environment of Gaza Strip", *Science of the Total Environment*, Vol. 132, Pg. 371–80.[Medline]

147. Safi, J. M. (2002): "Association between chronic exposure to pesticides and recorded cases of human malignancy in Gaza Strip (1990–1999)," *The Science of the Total Environment*, Vol. 284,Pg. 75–84.[Medline]

148. Salameh, P. R., I. Baldi, P. Brochard and B. A. Saleh (2004): "Pesticides in Lebanon: A knowledge, attitude and practice study", *Environmental Research*, Vol. 94, Pg. 1-6.

149. Schafer, M. L. (1968): "Pesticides in Blood", Cincinnati, Ohio, USA, in *Residue Reviews*, Vol. 24, 1968, ed F.A. Gunther.

Abstract: Pesticide toxic action is manifested almost entirely though the nervous system. Prominent signs include muscle tremor, incoordination, and convulsions. Levels below that required to produce toxic effects cause vague and nonspecific symptoms like headache, blurred vision, dizziness, and nausea. A study feeding rats with radioactive dieldrin observed that it was absorbed from the GI tract and distributed throughout the body within few hours. After oral administration, maximum concentrations were reached in body organs in one or two days, the highest concentrations appearing in the fat. Some redistribution took place in favor of fat within the next four days. These results indicate that blood levels of dieldrin might reflect both the initial absorption and the redistribution phenomenon. In animals, insecticides such as DDT, deildrin and lindane and/or their metabolites were observed. With a single injection, insecticide level apparently reached a maximum in the blood and then decreased. In fish, studies reported that observed that there were larger concentrations of endrin in the blood of the fist killed by endrin poisoning than in the fist that were exposed but not killed. In human beings, clinical symptoms of intoxication from aldrin and dieldrin include neurophysiological disturbances, such as tremors, with epileptiform convulsions in the more severe cases. Dieldrin has been found in fat biopsies at levels in excess of 100ppm in individuals showing symptoms of intoxication.

150. Sharp, D. S., B. Eskenazi, R. Harrison, P. Callas and A. H. Smith (1986): "Delayed health hazards of pesticide exposure", Annual Review of Public Health, Vol. 7, Pg. 441-471.

151. Sherwood, S., C. Crissman and D. Cole (2002): "Pesticide exposure and poisoning in Ecuador: A call for action", *Pesticides News*, No. 55, March 2002, Pg. 3-6.

152. Shrestha, P. L. and F. P. Neupane (2002): "Socio-economic contexts on pesticide use in Nepal ", in A. Hermann and S. Schumans (Eds.). Proceedings: International workshop on environmental risk assessment of pesticides and integrated pest management in developing countries (page 205 – 223). Kathmandu, Nepal 6-9, November 2001.

153. Sivayoganathan, C., J. Gnanchandran, J. Lewis and M. Fernando (1995): "Protective measure use and symptoms among agropesticide applicators in Sri Lanka", *Social Science and Medicine*, Vol. 40, Pg.431-436.

154. Solomon, G. et al. (2000): "Pesticides and Human Health – A Resource for Health Care Professionals," by Physicians for Social Responsibility and Californians for Pesticide Reform.

155. Sudderudin, K. I. and R. P. Kim (1979): "The effect of pesticides on paddy-field ecosystems", *Proceedings of Trends in Applied Biology*, USM, Penang, October.

156. Sullivan, J. B., M .Gonzales, G. R. Krieger and C. F. Runge (1992): "Health-related hazards of agriculture", in *Hazardous Material Toxicology: Clinical Principles of Environmental Health*, Pg. 46, Eds., J. B. Sullivan and G. R. Krieger, London: Williams & Wilkins.

157. Sunding, D. and J. Zivin (2000): "Insect Population Dynamics, Pesticide Use and Farmworker Health", *American Journal of Agriculture Economics*, Vol.82, Pg.527-540, August 2000.

158. United States Environmental Protection Agency (USEPA): "Protect yourself from pesticides: guide for pesticides handlers", USA: EPA, 1993.

159. WHO (1990): "Public health impact of pesticides used in agriculture", Geneva: World Health Organization.

160. Warburton, H., P. Pingali and F. Palis (1995): "Pesticide Use, Perceptions and Practices: Impact of Pesticides on Farmer Health and the Rice Environment", Boston: Kluwer Academic Press.

161. Water Quality Series: " Pesticides in Ground Water", OSU Extension Facts, No. 7459

162. Warnick, S. L. and J. E. Carter (1972): "Some findings in a study of workers occupationally exposed to pesticides", *Archives of Environmental Health*, Vol.25, Pg. 275-270.

163. Weingner, M. and M. Lyons (1992): "Problem-solving in the fields: an action-oriented approach to farm workers education about pesticides", *American Journal of Industrial Medicine*, Vol. 22, No. 677-690.

164. Wessling, C., L. Castillo and G. C. Elinder (1993): "Pesticides poisoning in Costa Rica", *Scandinavian Journal of Work, Environment and Health*, Vol. 9, Pg. 227-235.

165. Wessling, C., R. McConnell, T. Partanen and C. Hogstedt (1997): "Agricultural pesticide use in developing countries: health effects and research needs",*International Journal of Health Services*, Vol. 27, Pg. 273-308.

166. Wilson, C. and C. Tisdell (2001): "Why farmers continue to use pesticides despite environmental, health and sustainability costs", *Ecological Economics*, Vol. 39, Pg. 449-462.

167. Wilson, C. (2002a): "Pesticide avoidance: Results from a Sri Lankan study with health policy implications", In: D. C. Hall and L. J. Moffitt (Eds.) *Economics of pesticides, sustainable food production, and organic food markets*, Advances in the economics of environmental resources, Vol. 4, Elsevier, Science.

168. World Health Organization, WHO (1990): "Public Health Impact of Pesticides Used in Agriculture", Pg. 79-86, WHO, Geneva.

169. Wesseling, C., R. McConnell, T. Partanen, et al (1997): "Agricultural pesticide use in developing countries: Health effects and research needs", *International Journal of Health Services*, Vol. 27, No.2, Pg. 273-308.

Abstract: Large worker populations in the Third World are exposed to increasing amounts of pesticides, including pesticides severely restricted and banned in industrialized countries. Studies on knowledge, attitudes, and practices indicate that unsafe use of pesticides is the rule in Third World countries. Surveys of acute poisonings show high rates in these countries, despite underregistration. The scarce studies on chronic health outcomes demonstrate neurotoxic, reproductive, and dermatologic effects. Exposure assessment consists mainly of cholinesterase testing, and few studies have quantified dermal and respiratory exposure. The few intervention studies demonstrate the need for evaluation of the impact of preventive measures and policies. There is no evidence that widespread "safe-use" programs have greatly affected exposure and morbidity. It was concluded that research should focus on simple methods for surveillance of exposure and on surveillance of acute illness and its causes in order to develop and evaluate rapid local interventions. Studies on chronic effects should be carried out in selected countries, aiming at long-term and broader interventions. Policies that promote the use of pesticides should be critically evaluated. North-South and South-South research collaborations must be encouraged to address this global health problem.

170. WHO (1991): "Safe use of pesticide", Technical Report Series 813, 1-26, WHO, Geneva.

171. WHO, UNEP (1990): "Public Health Impact of Pesticides Used in Agriculture", WHO, Geneva.

172. Wilson, C. I. (1999): "Pesticide Avoidance: Results from a Sri Lankan Study with Health and Environmental Policy Implications", *Working Paper Series 264*, School of Economics, University of Queensland, Australia.

Abstract: In this paper the contingent valuation method (CVM) is used to elicit bids/values to avoid direct exposure to pesticides and the resulting illnesses among subsistence farmers in a developing country, namely Sri Lanka. Farmers using pesticides on their farms suffer from short-term as well as long-term illnesses. Deaths from direct exposure to pesticides are not uncommon. The CVM is used to determine the yearly value to an average farmer of avoiding the costs of direct exposure to pesticides and to calculate the pesticide cost scenarios for the entire country. The last section of the paper examines the factors that influence the willingness to pay (WTP) to avoid direct exposure to pesticides and the resulting illnesses and discuss the health and environmental policy implications stemming from the regression analysis.

173. Wilson, C. (2000): "Environmental and human costs of commercial agricultural production in South Asia", *International Journal of Social Economics*, Vol.27, Pg. 816 - 846.

174. Wilson, C. and C. Tisdell (2001): "Why Farmers continue to use pesticides despite environmental, health and sustainability costs", *Ecological Economics*, Vol. 39, Pg. 449-462.

175. Woodruff, T., A. Kigle and F. Bois (2002): "Evaluating health risks from occupational exposure to pesticides and the regulatory response", *Environmental Health Perspective*, Vol. 102, Pg.1088-1096.

176. Yassin, M., T. Abu Mourad and J. Safi (2002): "Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farm workers in the Gaza Strip", *Occupational and Environmental Medicine*, Vol.59, Pg.387-394.

Websites

177. **Pesticide Action Network UK, PAN UK**

Pesticide Action Network *UK* (PAN *UK*) promotes healthy food, agriculture and an environment which will provide food and meet public health needs without dependence on toxic chemicals, and without harm to food producers and agricultural workers. PAN *UK* is an independent, non-profit organization that works nationally and internationally with like-minded groups and individuals concerned with health, environment and development to eliminate the hazards of pesticides, reduce dependence on pesticides and prevent unnecessary expansion of use and increase the sustainable and ecological alternatives to chemical pest control.
http://www.pan-uk.org

178. **Environmental Health Action**

EnviroHealthAction is an education and action center that provides an online community for health professionals and others interested in environmental health. It is designed to provide busy professionals with the opportunity to access important resources and deliver valuable input to policymakers.
http://www.envirohealthaction.org

179. **People and the planet**

This site provides a global gateway to the greatest issue of our time: the future health and wellbeing of the human family as it presses ever more heavily on the natural resources of our planet. All 16 sections of our website are now fully on-line in our new format, and we will be building our new Picture Gallery over the coming months. Happy browsing - and please send us your feedback.
http://www.peopleandplanet.net

180. **U. S. Environmental Protection Agency (EPA)**

EPA's Pesticides Program
http://www.epa.gov/pesticides