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EXTERNAL COSTS OF PESTICIDE USE – SUMMARY

Less input-intensive farming is at least as economically viable as high input/high pesticide-intensive farming. See for example, the studies by Mouron et all. (2005) and Reganold et all. (2001). Even from the commercial point of view, if Directive 91/414 removes the most hazardous pesticides from the market and substitutes pesticides by less harmful alternatives and non-chemical methods, that would be an advantage for the society. Industry could rip benefits too, by moving to new, more profitable pesticides.

High input farming has enormous external costs. In a US study, only runoff/leaching accounts for 6% of crop revenues (Färe et all., 2005). In a UK study (Pretty et all., 2000), hidden costs of British intensive agriculture is estimated to be at least 208£/ha. Another US study (Brethour and Weersink, 2001) shows that pesticide reduction in Ontario benefits US households at 166 $ a year.

In Germany, Waibel and Fleischer started to work on a cost-benefit analysis of pesticides in Germany in 1992 and published a comprehensive book in 1998 (Waibel and Fleischer, 1998). The book analyses benefits as well as external costs of pesticide use in the former Western Germany. The total costs amounted to 128.79 Million Euros, given the best scenario. This figure does not include chronic effects of pesticides on human health, long-term effects on the sustainability of agricultural production and soil fertility.

Table 1 – Annual external costs of pesticide use in Germany

Type of costs	Minimum value Million €	Effects identified, but not yet quantifiable
Contamination of drinking water		
Monitoring costs	32.88	Avoidance costs of consumers (e.g. increased consumption of mineral water)
Avoidance costs	20.14	
Costs of pollution prevention	3.48	
Costs of water treatment	8.95	
Production loss		
Damage of honey bees	1.02	Losses in other production areas (fish farming, bird keeping and hunting)
Loss of biodiversity		
Loss due to herbicide use	5.11	Effects of herbicides on animals and of insecticides and fungicides on animals and plants
Residues in food		
Monitoring costs	11.61	Costs of removing contaminated products from the market
Health costs		
Costs of medical treatment	2.97	Costs by chronic health effects (e.g. cancerous diseases)
Opportunity costs of labour	4.86	
Cases of lethal poisoning	4.04	
Government organisations		
Plant protection services of federal states	23.01	Costs of administration (laws, decrees, etc.) Pesticide-related research at universities and environmental agencies
Federal registration authority	10.74	
Total	**128.79**	

In an assessment based on currently available US data, although incomplete, Pimentel et all. (2001) have calculated environmental and economic costs of pesticide use at $8 billion in annual costs.

Table 2 – Estimated environmental and social costs from pesticide use in the United States

Impact	Cost (million $/year)
Public health impacts	**787**
Hospitalisation after poisonings	6.76
Outpatient treatment after poisoning	17.01
Lost work due to poisonings	1.76
Treatment of pesticide induced cancers	707.00
Fatalities	54.00
Domestic animal death and contamination	**30**
Loss of natural enemies	**520**
Cost of pesticide resistance	**1400**
Honeybee and pollination losses	**320**
Colony losses from pesticides	13.3
Honey and wax losses	25.3
Loss of potential honey production	27.0
Bee rental for pollination	4.0
Pollination losses	200.0
Crop losses	**942**
Crop losses	136
Crop applicator insurance	245
Crops destroyed by excess pesticide contamination	550
Public investigation and testing	10
Private investigation and testing	1
Fishery losses	**24**
Bird losses	**2100**
Groundwater contamination	**1800**
Government regulations to prevent damage	**200**
Total	**8123**

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1. Health costs: workers, residents and bystander, in-utero, children

Many negative health effects of pesticides are only known partly because of scarce research and poor and inconsistent record of health effects. Endocrine disrupting pesticides are likely to add to the exposure of mankind of a big pool of potential disrupting (with unknown combination effects) which could (or already have) change the quality of life of generation by introducing morphological changes and affecting reproduction. The example of vinclozolin (Anway, 2005) capable of inheritable changes shows the potential of negative effects.

1.1 Health costs: workers exposure

Concerning poisoning of workers or workers' health, few independent studies on workers' health have been carried out at the European level. In the late 1990s, the European Federation of Agricultural (EFA) workers carried out a survey of pesticide poisoning among its two million members (Pesticide News, 1997). A total of 1,230 questionnaires from individuals and organisations were analysed. The results showed that at least one person in five considers that they have been made ill or poisoned, or adversely affected by pesticides.

The survey revealed that workers are poisoned at different times during their work. Problems of usage represent 73% of incidents, in particular: handling of concentrates (6%); application (39%); preparation and mixing (28%). Nevertheless the proportion of incidents arising after pesticide treatment is noticeable: washing after use (12%), operations involving contaminated equipment (7%) or containers after use (2%), working in areas previously treated (6%) making a total of 27%.

Among those poisoned, 53% informed their employer, but only 27% informed the competent authority. In 46% of cases, poisoning involved medical intervention, either a consultation or visit to a hospital. Symptoms most often reported by pesticide users included: headaches (67%); skin irritation (39%); stomach pains (33%); vomiting (30%); eye irritation (25%); diarrhoea (15%). Some reported more than one symptom. Other symptoms occurred in 10% of cases: notably symptoms linked with the nervous systems such as fatigue, difficulty in concentration, difficulty in muscle control and co-ordination of movement; and the respiratory system.

Besides poisoning, workers frequently exposed to pesticides are known to develop several diseases, including cancer, chronic fatigue and respiratory diseases. In 2004, PAN Europe Annual Conference focused on workers exposure to biocides both in indoor and outdoor use. Some workers in Catalunya who were daily exposed to disinfectants or insecticides have developed cancer, permanent impairment, besides suffering from acute poisoning. This highlighted that certain highly hazardous active ingredients (mainly pyrethroids and organophosphates) must be substituted by safer alternatives, and that controls are necessary whether a product has an approval to be used indoors. Better training on safety for workers is needed, and the situation in the private sphere must be monitored also.

For the US, public health impacts of pesticide use are estimated by Pimentel et all (1992) to cost $787 million each year. These impacts arise from human pesticide poisonings and illnesses, and include costs of hospitalization, outpatient treatment, lost work time, treatment of pesticide induced cancers, and fatalities. Pimentel and colleagues stress that chronic (vs acute) health effects of pesticides are particularly difficult to assess. Deaths of domestic animals (particularly cats and dogs) and contamination of meat, milk and eggs cost at least an additional $30 million annually.

The International Labour Office (ILO) recognises that workers in developing countries are at especially high risk due to inadequate education, training and safety systems. But even in developed countries such as EU countries agriculture ranks consistently among the most hazardous industries. In Italy, for example, although agriculture production employs 9.7% of the workforce it is responsible for 28.7% of accidents. Exposure to pesticides and agrochemicals constitutes one of the major risks faced by farm workers, accounting in some countries for as much as 14% of all occupational injuries in the agricultural sector and 10% of all fatal injuries.

1.2 Health costs: residents and bystander exposure

An important new report by the UK Royal Commission on Environmental Report 'Crop spraying and the health of residents and bystanders' finds that, 'Based on the conclusions from our visits and our understanding of the biological mechanisms with which pesticides interact, it is plausible that there could be a link between residents and bystander pesticide exposure and chronic ill health. We find that we are not able to rule out this possibility. We recommend that a more precautionary approach is taken with passive exposure to pesticides.' The report finds that the assessment of residents and bystander exposure made in the UK is far from satisfactory. It has not been rigorously evaluated under field conditions and has been assessed in relation to non-peer-reviewed experiments conducted on a limited scale and reassessed on the basis of data collected for different purposes in Germany and USA. As such, residents and bystander exposure has been chronically under evaluated. The RCEP commissioned an independent economic analysis that showed no significant costs for the industry if the recommendations of the report were fully implemented.

1.3 Health costs: in utero exposure

Mothers' exposure during pregnancy can also cause birth defects. Mothers can be exposed directly through food, occupational use, gardening and household use, the house being exposed near sprayed fields, and indirectly through partner's professional or amateur use. An extensive literature review divided scientific studies according to their findings in terms of implications for the progeny (Wattiez, 2005). Exposure to pesticides is linked to central nervous system defects, cardiovascular defects, oral cleft, eye anomalies, urogenital defects, limb defects, intrauterine growth retardation and neurodevelopment impairments.

1.4 Health costs: children's exposure

The Commissioner for the Environment, Margot Wallström, asked for a special study from the World Health Organization (WHO) and European Environment Agency (EEA) on environmental impacts on children's health (WHO/EEA, 2002). The section on pesticides notes that fetuses, infants and children can be more vulnerable to pesticides, both quantitatively and occasionally qualitatively, than adults, because their bodies are still developing. Fetuses, infants and children are highly vulnerable to critical windows of exposure, and their systems for protecting the body from toxic chemicals are still immature. They are also more exposed because of childhood patterns of behavior and specific diet.

The WHO/EEA study notes that the core tests to determine the safety of pesticides in use within and outside the EU, including for new EU pesticide authorizations, do not fully assess the hazards posed by specific pesticides to infants and children. Moreover, current risk assessment methodology does not specifically consider these effects on infants and children nor the wide range of exposure patterns that exist within this population. Consequently, variations in dietary and environmental exposure to pesticides (aggregated exposure) and health risks related to age and particular sensitivity are not addressed when establishing ADIs (average daily intake), ArfDs (average reference doses) and MRLs (maximum residue limits).

Possible health effects include immunological effects, endocrine disrupting effects, neurotoxicological disorders and cancer. Susceptibility of this vulnerable group to delayed functional toxicity -- as a result of exposure to apparently sub-toxic doses of pesticides during a critical window – may not become manifest until adulthood.
The authors of the report urge that environmental pollution and residues in food and drinking water be minimized to protect this age group of the population and those IPM methods are implemented.

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2. Loss of biodiversity

Biodiversity and greater species richness is also known to be associated with the least-intensive crop systems (Donald, 2004). Biodiversity, being the basis of life, can never be valued high enough. Some studies have tried to attribute a value using Willingness to Pay (WTP) like Brethour (2001) but the intrinsic value is not calculated by this method.

Wild birds are also subject to pesticide contamination and poisoning. One study cited by Pimentel et all (1992) for the US reports that more than 5000 ducks and geese died in five instances when carbofuran was applied to alfalfa. In 1985 alone, hunters spent $1.1 billion to harvest 5 million game birds ($216 per bird killed). These and other sources of information are used to estimated indirect costs associated with bird losses at an astounding $2.1 billion. Finally, government regulations to prevent damage lead to indirect costs, which are estimated at $200 million annually.

A UK 1997 report (Campbell, 1997) cited pesticide use as a major factor in the decline of many bird species over the last 30 years or so. The main examples were: tree sparrows (-89%), turtle doves (-77%), bullfinches (-76%), song-thrushes (-73%), lapwings (-62%), reed buntings (-61%), skylarks (-58%), linnets (-52%), swallows (-43%), blackbirds (-42%), starlings (-23%).

Several investigations in Germany verify that areas close to organic farms are characterised by a greater biodiversity than areas close to conventional farms. The variability of organisms can be up to 6 times higher in land in organic farming as compared to land in conventional agriculture (Frieben et all , 1997). One investigation found that species listed on the IUCN Red List of Threatened Species could be found in 79% of the agricultural areas sampled where organic farming had been applied for at least 25 years, whereas Red List species could be found on only 29% of land in conventional agriculture (Frieben 1990). In a two-year study in Austrian soils, referred to in the Commission Communication "Towards a Thematic Strategy for Soil Protection", beetles were 94% more abundant in organic fields than in the conventional ones. The number of beetle species was 16% higher. The same study acknowledges that inappropriate use of pesticides, and in particular nematocides, can have very negative effects on soil biodiversity because of their poor selectivity. Some studies suggest that some herbicides considerably suppress soil bacteria and fungi activity.

Of the more than 130 different plants found naturally around Germany's agricultural land, half are currently considered endangered, and some have already disappeared (MURL, 1988). Another German study calculated the cost of the loss of biodiversity in Germany through the use of pesticides at 10 million DM (~5 million Euros) per year (Weibel and Fleisher, 2003).

Danish studies also stress the negative effects of pesticides on biodiversity. According to the Bichel Report, the effects of pesticide use on above-ground arthropods are significant, and a larger insect population could be expected in the event of a phase-out of pesticide use (Bichel Committee, 1999). According to a Danish 2002 report, half and quarter dosages of herbicides and insecticides improve the "natural elements" of the fields with an increased number of weed species, increased proportion of flowering species and increased abundance of insects. Use of half the dose only creates negligible, if any, agricultural problems, especially if supplementary control of particular weed patches is carried out.

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3. Water contamination

According to EUREAU report (EUREAU, 2001), pesticide contamination of raw water is most acute in lowland rivers, particularly in Belgium, France, Netherlands and the UK. In all these countries, a high proportion of the resources contains residues above 0.1µg/l (the legal threshold), often by a significant margin. Removal of pesticide residues, an expensive treatment, is needed in many cases.

Pesticide contamination of groundwater resources affects Belgium, Denmark, France, Germany, Netherlands and UK, where 5 to 10% of resources are found contaminated with levels of pesticide residues above 0.1µg/l. The majority of Europeans (65%) rely on groundwater for their drinking water. This situation also offers a major impact to local communities which depend on groundwater supplies.

Using a ranking system, the substances which appear to most regularly cause problems across Europe as summarised below. The mark # indicates they are in the list of priority substances under the Water Framework Directive.

Groundwater:
- atrazine and related products#,
- simazine#,
- mecoprop,
- bentazone

Rivers:
- diuron#,
- isoproturon#,
- atrazine and related products#,
- simazine#,
- mecoprop,
- MCPA,
- chlortoluron.

The type of pesticide most commonly detected is herbicides, although other types have been identified in localised water resources. The substances are detected regularly, which indicates that best practice measures alone are unlikely to offer a solution.

Pesticides have also been found in European rainwater. Approximately half of the compounds analysed were detected. For those detected, most concentrations were below 100 ng/l, but larger concentrations, up to a few thousand nanogrammes per litre, were detected at most monitoring sites. The most frequently detected compounds were lindane (gamma-HCH) and its related isomer (alpha-HCH), which were detected on 90-100% of sampling occasions at most of the sites where they were monitored. In total, 44 pesticide active ingredients have been found in European rainwater from 1990 onwards. They include: alachlor, atrazine, carbaryl, 2,4-D, diazinon, isoproturon, MCPA, mecoprop, and simazine (IG Dubus, 2000).

Calculation of external costs of water pollution exists for some countries. For many years the Dutch drinking water industry is confronted with the occurrence of pesticides in drinking water resources. To get an estimation of these costs for the drinking water industry VEWIN has asked Kiwa Water Research to set up an inquiry into these costs under all of the water companies in the Netherlands during the last ten years. The inquiry shows that the total costs amount about 240 million in the period of 1991 – 2000 (KIWA, 2001).

Table 3 – Costs for Dutch water industry 1991-2000 due to pesticide contamination

Investigated Cost	Million Euro
Cost for analysis	50.5
Monitoring of resources (inventorial studies)	11.6
Protection of the water resources	12.6
Replacing or abandoning of well fields and/or water treatment processes	5.0
Research on water treatment processes and pesticide removal	13.3
Purification/water treatment (also temporary measures)	146.0
Meetings, training and public relations (costs for personnel)	4.6
Total costs	**244**

In the US, monitoring and cleaning up contamination costs $1.8 billion annually. As groundwater contamination illustrates, pesticides find their way into aquatic ecosystems all too frequently, where they directly kill fish and fish fry, and indirectly harm fish by eliminating essential foods such as insects. An additional indirect cost arises when fish are unmarketable because of high pesticide residues. Fishery losses are estimated at $24 million annually.

Danish drinking water policy is based on the assumption that the public prefers clean groundwater to water that has been treated. The Danish Environmental Protection Agency (DEPA, 2005) has carried out a study to evaluate the benefits of groundwater protection in order to measure whether there are welfare gains associated with increased protection of the groundwater resource, as compared to purification of groundwater for drinking water purposes. Willingness to pay for naturally clean groundwater was estimated at 1,899 DKK/Year per household and for very good conditions for plant and animal life ar 1,204 DKK/Year per household (total 3,104 DKK/Year per household).

Pretty et all (2000) estimate that UK uses 25 million kg of pesticides each year in farming – and some of these get into water. It costs water companies £120 million each year to remove pesticides – not completely, but to a level stipulated in law as acceptable (0.1 µg/litre for a single product and 0.5 µg/l for total pesticides). Water companies do not pay this cost –they pass it on to those who pay water bills. And so this also represents a hidden subsidy to those who pollute. Equally, those who do not pollute do not receive this hidden subsidy.

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