

General Situation

Pesticide use in Germany presently amounts to ca. 35,000 tons active ingredients per year. Pesticide application by the agricultural sector and from non agriculture areas have led to inputs to the rivers and the sea via runoff from the fields, spray drift, contaminated ground water, and contaminated atmospheric deposition (rain), plus inputs via sewage plant effluents and production plant effluents. Improper cleaning of spraying equipment at the farmyard is one of the main reasons for pesticide pollution of surface water (UBA, 1997).

In Germany 17 pesticides were detected in the river Rhine in 1995, while 10, 14 and 8 were found in the rivers Elbe, Weser and Ems respectively. Many of these pesticides exceeded the drinking water limits (100ng/l each compound) - 5 pesticides in the Rhine, and 3,12 and 9 in each of the Elbe, Weser and Ems. The overall concentrations in Rhine, Elbe, Weser and Ems were 2000, 870, 3200 and 2300 ng/l respectively. This is significantly higher than the overall drinking water limit set by the EU of 500 ng/l for the sum of all pesticides (WWF, 1998). Most modern pesticide compounds that dominate the market today (such as glyphosate/gluphosinate) are not yet included in the monitoring programmes. In the cases where they were monitored concentrations such as 200 ng/l glyphosate and 800 ng/l AMPA (metabolite of glyphosate) were reported.

An Inventory of Pesticides in German Surface and Coastal Waters

Trends
Though levels of notorious organochlorines such as gamma-HCH (lindane), MCP (mecoprop) and organophosphates such as parathion and dimethoate are declining, especially in the river Elbe, the situation is



different for other compounds. Levels of most modern pesticides show a dramatic increase in concentration during the application period (May to June and autumn) - thus the maximum concentration is reached in early summer. The peak concentration for atrazine in the river Rhine, though banned in Germany since 1991, is continuously about 200 ng/l each year between 1989 - 1996. Additionally, the peak concentration for isoproturon has increased from about 100 ng/l in 1990 to 250 ng/l in 1996 (Figure 1).

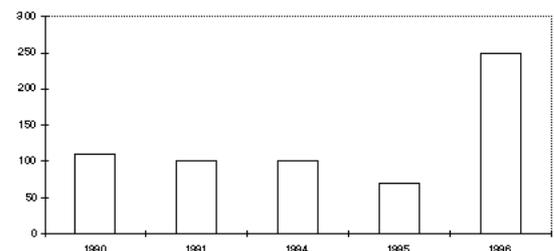


Figure 1: Development of isoproturon concentrations [ng/l] in the river Rhine (WWF, 1998)

Inputs to the Marine Environment

Most of the pesticides that are present in the rivers are also detected in the coastal waters of the North Sea or even in the North Sea itself. Some data on inputs to the North Sea are given in Table 1. For some of the compounds, eg. terbutylazine, about 800 t/yr are applied in Germany. Of this amount about two tons (about 0.25%) reach the German Bight via the river Elbe (Bester, 1996, Hühnerfuss et al., 1997). Additionally, significant amounts of pesticides are transported via the

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atmosphere to the sea. An estimated overall input for triazines (simazine, atrazine, terbutylazine) to the North Sea is about 40 t/yr via the rivers and about 50 t/yr via the atmosphere (Bester, 1996). Action to reduce pesticides inputs to the North Sea, especially modern substances such as phenylureas and triazines, is required particularly since triazine compounds are present in estuaries and coastal waters at higher than No Observable Effect Levels (NOEL) for marine phytoplankton (WWF, 1998).

Compound	Concentration (ng/l)	Location	Year	Estimated Input (t/yr)	
				River	Atm
Atrazine	2,100	Sas v. Gent	1992		
	94	Elbe	1990	2.8	0.2
Bentazon	1,900	Sas v. Gent	1992		
Cyanazine	540	Sas v. Gent	1992		
2,4-D	400	Massluis	1992		
DDT	0.11-	Schnackenburg/Elbe	1992	0.03	
	0.77				
1,2-dichloropropan	7,200	Harlingen	1992		
Dimethoate	3,400	Elbe estuary	1992	2.4	
Diuron	1,100	Sas v. Gent	1991		
2,4-DP	400	Maassluis	1992		
Lindane		Schnackenburg/Elbe	1992	0.2	0.3
Isoproturon	180	Sas v. Gent	1991		
Linuron	470	Maassluis	1992		
MCPA	500	Sas v. Gent	1992		
MCPP	3,400	Sas v. Gent	1992		
Metabenzthiazuron	1,300	Sas v. Gent	1991		
Simazine	1,000	Elbe	1991	16	0.2
Terbutylazine	160	Elbe	1991	2	0.2
2,4,5-TP	1,000	Sas v. Gent	1992		

Table 1: Concentrations of pesticides in the estuaries exceeding 150 ng/l or situations where inputs by river or atmosphere (atm.) were calculated (WWF, 1998)

Comparison to Toxicity Data

Several pesticides that are detectable in German waters are "possible and/or probable carcinogens". Some of these pesticides are present at considerable concentrations. It is recommended that carcinogenic compounds should not be released into the environment. Between 1990 - 1995 the following pesticides were found in German rivers (maximum concentrations throughout the years in [ng/l]): simazine (2400 Elbe; 160 Rhine), 2,4-D (2000 Elbe; 750 Rhine), propazine (700 Elbe), amitrol (700 Weser), atrazine (600 Elbe; 260 Rhine), pentachlorophenol (PCP) (370 Elbe; 20 Rhine), isoproturon (250 Rhine), linuron (130 Elbe; 70 Rhine), alachlor (80 Rhine), gamma-HCH (37 Elbe; 10 Rhine), HCB (10 Elbe), DDT (3 Elbe). Most pesticides that are found in the water exceed either the NOEL for the respective compound or for a compound of the same mode of action, or the concentrations were not significantly beyond a security margin of x100 of the NOEL (WWF, 1998).



Conclusions

- The concentration of pesticides in German rivers and coastal waters is still high, though the pattern varies with time as well as from one river to another.

- For some pesticides the temporal trend in concentration is upward rather than downward.

- Inputs of triazines into the North Sea amount to about a tenth of the level applied in Germany.

- A critical review of data shows that for about half of the compounds it should be assumed that they can have an effect on the biodiversity of river ecosystems, for at least some weeks of the year. Effects should also not be discounted for the rest of the active ingredients.

- There is evidence that farmers' pesticide application does not comply with "good farming practise". Up to 90% of pesticide applications contravene existing legal requirements.

- Action to reduce the load of pesticides in the rivers and coastal waters is urgently required. A tax on pesticides should be introduced and be used to support organic farming systems, the training of farmers in the correct use of pesticides in line with the principles of "Best Environmental Practice" (BEP), and proper recycling and cleaning systems for the disposal of unused pesticides.

Text prepared by Ulf Jacob

References/Further Reading

This briefing is a summary of the report: WWF (1998) A Pesticide Inventory in German Surface and Coastal Waters (1998) by Dr. Kai Bester, University of Hamburg.

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