THE DANUBE REGIONAL PESTICIDE STUDY PROJECT 1995-1997: A BRIEF SYNTHESIS OF THE RESULTS

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Abstract. The chapter is a continuation of the previous chapter in this book and provides a description of the objectives in respect to the synthesis of the results of the Danube Regional Pesticide Study Project, initiated during 1995-1997 under the frame of the Danube Applied Research Programme, which is managed by the Danube Programme Coordination Unit in Vienna. The ultimate goal of the project was to achieve an agreement between the Danube countries on the list of pesticides that are allowed, conditions under which pesticides may be applied especially related to protection of ground and surface water, criteria for allowance of pesticide use with regard to ecotoxicological aspects. The main issues under discussion include: Qualitative and quantitative inventory of pesticide application, transport, and storage; Inventory of pesticide production, formulation, import, export, and supply; Responsible authorities for pesticide regulation and laws; Economic parameters underlying the use of pesticides; Current legislative procedures and criteria related to pesticide registration; Overview of the most significant emission routes; Soil resources in the Danube river catchment area and problems of pesticide pollution; Inventory of existing laboratory data for pesticide concentrations in Danube and tributaries; Overview of existing and proposed international water quality standards for pesticides; National water quality standards of pesticides in Danube river countries; Estimating environmental concentrations of pesticides, using exposure models. This chapter is made with educational purposes to generally

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assist young scientific researchers, who intend to formulate future project applications in the field of environmental sciences.

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1. Qualitative and Quantitative Inventory of Pesticide Application, Transport, and Storage

The climatic conditions in the Danube river countries do not differ drastically from country to country. There are few differences in the types of cultivated crops depending mostly on the nutritional habits in each particular country. The most important cultivated crops are wheat, maize, sugar beet, potatoes and sunflower. Fruit and vegetables represent also an important part of cultivated crops.

The existing pests (insects, diseases, and weeds) are almost similar, in particular, weeds being the same in all Danube countries.

Pesticides are mainly used in agriculture. The control of economically significant pests covers the biggest part of their use. A limited part of insecticides and rodenticides is also used in public health for vector control of human diseases.

A cumulative list of the existing pesticides in all 11 Danube countries has been prepared. The total number of pesticide active substances used in the region is 452 (1995).

The active ingredients from the following chemical groups are mostly used:

- Organophosphorous – 62;
- Carbamates and thiocarbamates - 38;
- Synthetic pyrethroids – 24;
- Urea compouds – 35;
- Triaines -18;
- Anilides and amide derivates- 37;
- Chlophenoxy compounds;
- Dithiocarbamates – 10;
- Triazoles - 27;
- Copper compounds – 10;

- Others -178.

The total quantity of pesticides used in the basin to control the pests on principal crops is approximately 118 828 tons of formulated product per year (data valid for the period 1993-1995). The use of herbicides (in tons) in the region is considerably higher than the total amount of both insecticides and fungicides.

Integrated Pest Management (IPM) was partly introduced in the region (data is for 1997). Alternative biological pesticide had still a limited use in according to data in the period 1995-1997.

The major application method is spraying with ground equipment. Seed treatment with fungicides and/or insecticides is also applied. Aerial spraying by aircraft had limited significance in the Danube river basin region during 1995-1997.

Storage of pesticides has been regulated in all Danube basin countries. Requirements and control of storehouses are almost similar in the particular countries. Disposal of pesticides, even regulated, creates problems in som of the countries. Thermal destruction is a method of choice in n most countries but still not available in some of them.

The economic reforms and new agricultural structures in down-stream Danube countries lead to a considerable decline in pesticide use after 1989. The decline during this 5-6 year period (until 1995-1997) was approximately 3.5-fold in Hungary, 2.5-fold in Slovakia, 2.6-fold in Bulgaria, 3.9-fold in Moldova and 2.9-fold in Ukraine. Some increase of the pesticide use for the next several years was expected in 1997, but the long-term trends are to reduce the agrochemicals, to increase the use of biopesticides, to introduce new technologies including pest-resistant crops.

The 1997 forecast was that less toxic and less persistent com[ounds are more likely to be used as chemical pesticides.

2. Inventory of Pesticide Production, Formulation, Import, Export, and Supply

Most of the Danube countries produce and/or formulate pesticides. Germany is one of the leading countries in pesticide production. In the other 10 Danube countries the production is limited and they rely mostly on import of pesticide active ingredients or formulations.

The pesticide registration is a primary requirement for import, production and distribution. During the period of centralized economy in Central and Eastern Europe, the import was monopolized by the relevant state organization. By the end of the 80s many private companies and minor distributors were

involved in import and distribution of pesticides. This provoked changes in regulations and required the training of much more persons, handling pesticides.

In all Danube countries packing and labeling of pesticides are approved by respective responsible authorities. The primary requirement is the product to be distributed in original packages with labels in the language of the country user.

Most of non-EU member countries in the region have already introduced the requirements for labeling and packaging covered by the Counsel Directives No.92/32/EEC (Counsel Directive, 1992).

3. Responsible Authorities for Pesticide Regulation and Laws

Multiagency preparation in the registration procedures is the usual practice with the leading role of the Ministries of Agriculture, Health, Environment or equivalent organizations. In most cases interministerial committees evaluate information supplied by the producer. A full data package is required for assessment of the risks for human health and environment. The list of approved pesticides is published annually.

Interagency collaboration exists also in the elaboration and enforcement of the regulations and laws concerning pesticides. The collaboration with the international organizations dealing with pesticides, such as FAO, WHO, IRPTC, CCPR, OECD, IUPAC, ECPA, supports the development of the legislative basis of pesticide production, sale, transport and use. The main trend nowadays is the harmonization of non-EU member counties legislation to that of EU.

4. Economic Parameters Underlying the Use of Pesticides

Analysis of data presented by the Danube countries showed that the production of principal crops in tons/ha differs from country to country. Pesticide use is not the principal reason for these differences. Obviously the agricultural practice, the climatic conditions, fertilizers use, soil types, and many other social and economic factors may influence the production. Nevertheless the pesticide use support the quality and quantity of yield. The losses due to pests and diseases vary from 3 to 100% with the most common figures about 20-50%. They are comparable to the most common figure of 40%.

Rough cost/benefit analyses in Danube countries show that pesticide use is profitable for the principle crops. The positive effect of pesticides on crop yield and quality of production is obvious and there are no effective alternatives available to replace them in a short-term period.

5. Current Legislative Procedures and Criteria Related to Pesticide Registration

Data requirements for registration of pesticides are more or less similar in Danube countries. They are in accordance with internationally agreed guidelines such as FAO Guidelines on basic registration criteria and requirements as well as registration procedures.

Nine of 11 participating in the study Danube countries in 1995-1997 were not members of the European Union. They develop new legislation instruments concerning pesticides, harmonized with the EU directives. The leading principle in pesticide regulations in all Danube river basin countries is that regulatory decisions should be based on high protection for humans and environment.

6. Overview of the Most Significant Emission Routes

The most significant source of pesticide pollution of soil and water is the agricultural use of pesticides. Production and formulation factories, aircraft landing places, big storehouses, incinerators, etc. are also potential sources of pollution especially in emergency situations. Charts for the most important of the above mentioned point sources have been prepared for each country.

7. Soil Resources in the Danube River Catchment Area and Problems of Pesticide Pollution

Soils are of importance for the environmental fate of pesticides and in particular for the movement and deposition in ground water as well as for runoff and pollution of surface water. Soil resources in the Danube river catchment area are assessed based on the soil map of the world of FAO/UNESCO.

Bearing in mind the combined effect of pH, texture, organic matter content and temperature regimes on the biological activity in soils, a conclusion can be drawn that the region of Mollic soils provides the most intensive processes of chemical product decomposition and lowest hazard of pollution. The hazard increases in the following order: Luvisols, Heavy Textured soils and Acid soils.

Additional degradation processes like salinization, alkalinisation, gleyification, water-lodging, acidification, soil crusting and compaction contribute to the detoxification of pesticides.

Washing of chemical products from the surface horizons and their depositing in deeper horizons and ground water is a typical process for Gleyic soils, Saline-Alkaline soils and Fluvisols.

Washing of pesticides from the surface by runoff water takes place most intensively in soils with high water-erosion index. These are arable soils of

medium texture, scanty in humus, low permeability and occurring on sloping grounds with frequent intensive rainfalls. This process is characteristic of the grounds with frequent intensive rainfalls and in the region of Luvisols, Acid and Weakly Developed soils, but is observed also in regions with steeper ground.

8. Inventory of the Existing Laboratory Data for Pesticides Concentrations in Danube and Tributaries

Pesticide concentrations in Danube river and its tributaries show significant differences between countries in the number and the types of pesticide analyzed. The cumulative number of analyzed pesticides is 76. Residues of only 36 pesticides and metabolites have been detected. The most frequently detected pesticides are organochlorine compounds and triazines. Organophosphorous pesticides are also occasionally detected. Only DDT and metabolites, HCH and isomers and atrazine and metabolites are found in more than 50% of samples.

It appeared that Danube river at the middle and down stream part, if compared with the upper stream, is more polluted by:

- Atrazine and metabolites;
- Lindane;
- Simazine;
- DDT.

9. Overview of Existing and Proposed International Water Quality Standards for Pesticides

The EC Drinking Water Directive 80/778/EEC requires the Member States to ensure compliance with the Directive by 1985 (Counsel Directive, 1980). The Maximum admissible concentrations (MACs) in drinking water are required to be 0.1 µg/l for individual pesticide and 0.5 µg/l for total pesticides.

Counsel Directive 75/440 EEC provides limits of 1 µg/l for individual and 5 µg/l for total pesticide contents in surface waters intended to use as drinking water (Counsel Directive, 1975).

Although the criticism expressed for unscientific considerations, the EC Drinking Water Directive is incorporated in EU member states legislation.

The USA Health Advisory Levels (HALs) for individual pesticides in water are calculated based on ADI and assumption of 2 l consumptions of water per day.

10. National Water Quality Standards of Pesticides in Danube River Countries.

Regulatory documents for drinking and/or surface water exist in all Danube countries. They differ significantly in relation to number of pesticides regulated and the accepted limits. Some of the countries use levels for drinking water accepted by EU directives (Croatia, Germany, Romania) or WHO guidelines. Extensive list of pesticide limits in fish-household reservoirs is used in Ukraine.

11. Estimating Environmental Concentrations of Pesticides, Using Exposure Models

Predicted Environmental Concentrations (PEC) were calculated by USES model - Uniform System for the Evaluation of Substances (Van der Poel, 1994) for 275 pesticides and by HESP model - Human Exposure to Soil Pollutants (Poels et al, 1992) for 99 of them. Due to the specific approaches of these models the results differ considerably. HESP model gives higher concentrations corresponding to the more polluted soil, just after the spraying. The results from USES have been only evaluated in the risk assessment.

Comparison of PEC and real concentration of detected pesticides demonstrated that PEC exceeded measured concentration of almost all pesticides detected in Danube and tributaries.

The results from PED (Predicted Exposure Distribution) calculation programme present more interest for accident situations, when the immediate distribution of pesticides in environmental media is of great importance (Mackay and Patterson, 1990). Calculation of PED was performed for 307 pesticides (123 herbicides, 72 fungicides and 112 insecticides). It may be concluded from the data that 80% of herbicides have the potential to be present in water in more than 50% of applied dose, as well as 76% of fungicides and 52% of insecticides.

Similarly pesticides may have an air polluting potential due to their volatility properties estimated according to the distribution to air exceeding 2% of applied quantity. In such a comparison 2 fungicides, 25 insecticides and 132 herbicides of 307 total investigated pesticides have a tendency to be present in the air for a time.

Such kind of initial exposure assessment of pesticides can be used for a categorization of pesticides, whether or not they are of concern for further investigation and the acceptability of a pesticide use at a large regional level on the base of potential exposure.

12. Conclusions

The purpose or this chapter is educational with the intention to assist young scientific researchers, who intend to formulate future project applications in the field of environmental sciences.

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