SECTION 7

Further analysis on presence of residues and impact of plant protection products in the E.U.

(Sub-Report prepared by Soil Survey and Land Research Centre ('SSLRC'))

7.1 INTRODUCTION/SUB-REPORT OBJECTIVES

Given that a synthesis Report of 100 pages does not allow for inclusion of a detailed breakdown of results for this sub-Report (which appear in the full text by region as well as by Member State) reference should be made to the full text for information addressing specific factors such as climate, geology, soil, relief, water use/quality and agricultural use generally. Monitoring strategy and sources of data must also be found in the full text. The following pages seek only to draw out the most salient findings, conclusions and recommendations to this sub-Report. It is accepted that the results presented for individual Member States differ in length. This is largely to differences in availability of data.

The objectives of the sub-Report were identified as follows:

- to provide a more detailed overview of monitoring data on pesticides in the environment related to use patterns;

- to describe qualitatively various routes of the emission of pesticides into the environment and their importance, as well as to provide quantitative information on these emissions;

- to generate as far as possible data on effects of pesticides in the environment. If such data were only limited, reasons and implications should be addressed;

- to make recommendations with priorities for future monitoring strategies designed to protect environment.

7.2 METHODOLOGY/INITIAL REMARKS

7.2.1 Use of Plant Protection Products

Each collaborating country confirmed the registration status of the 12 active substances, and usage data from the draft Landell Mills sub-Report summarised for each crop and country. No active substance chosen for this study was applied at similar rates in the different regions, nor was the area of land treated consistent between the regions. Interpretation of environmental monitoring data to derive specific fate pathways was further complicated by the fact that many plant protection products are not crop specific.

It was concluded by the authors of the sub-Report that the original objectives of the study could not be met, for several reasons:

- studies to determine presence and impact of PPPs at regional level are too large if the objective is to understand processes, quantify losses and determine potential impacts, but should rather be conducted at a field or catchment scale;

- some regions had no available residue monitoring in place, and therefore no data were available;

- monitoring data was on several occasions classified as confidential;

- time and budgetary conditions prevented a study of all regions studied in the sub-Report prepared by Landell Mills.

7.2.2 Monitoring Data[1]

The EU pesticide monitoring database is held at Silsoe, UK, and currently contains 73,000 records from five countries. Time and budgetary constraints within this sub-Report have precluded further analysis of data but the structure and information within the database will allow future users to benefit from the considerable effort required to develop this information set. The monitoring data presented in this document cannot therefore provide a true indication of real environmental concentrations for any given active substance and hence the amount of exposure to non-target organisms, but simply provide 'snapshots' in time which must be related to previous and prevailing agroclimatic conditions for interpretation.[2] Until sampling strategies are designed to assess environmental impact it is considered to be dangerous to make evaluations on only a restricted number of detections.

7.2.3 Field Monitoring

Impacts of plant protection products on non-target organisms were divided into different categories according to the dose and severity of damage (Sheehan et al (1984)): acute toxicity causing mortality; chronically accumulating damage causing death; sub-lethal impairment of various aspects of physiology and morphology; sub-lethal behavioural effects; measurable biochemical changes. These impacts can all be ecologically significant since they can all have cascading impacts on communities and ecosystems. To determine whether a plant protection product has an impact on the ecosystem it is necessary to know a great deal about the functioning of the ecosystem. Such knowledge is scarce and many ecotoxicological studies

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1 Data were also provided by the agrochemical companies on fate and behaviour in the environment. Basic information like laboratory degradation, sorption and mobility were made available to the project. The authors of this sub-Report have not, however, presented any of this information as the project investigations demonstrated that there was in fact insufficient field monitoring data available. The review did, however, demonstrate that it is company dossiers which provide the most comprehensive source of information available.

2 For the purposes of this project the *maximum* detected levels in any crop or region for each country for all surface water types and groundwater were assessed. It is accepted by the authors of the sub-Report that summaries of this kind may be biased in that little detail is available on the origin of the detection, dilution, duration or frequency. Data do however provide a worst/extreme case for assessing potential exposure to non-target organisms.

only provide rudimentary knowledge of basic structure and function.[3] It can be concluded from the sub-Report that the impact of a specific active substance or even plant protection products *per se*, could not be easily assessed because of the multitude of factors influencing the ecosystem.

7.2.4 Quality Standards

The health and environmental quality standards for a large number of active substances have been tabulated and are not reproduced here due to considerations of space. These may be therefore be found in the full sub-Report.

7.2.5 Impacts on Non-target Organisms

Potential impacts on non-target organisms are commonly assessed by calculating toxicity exposure ratios (TERs) or comparing toxicity with health or environmental quality standards or advisory limits *e.g*. EQSs or MTRs. This type of assessment often uses the lowest effect level for the most sensitive species. Maximum detected concentrations are reported in this sub-Report. A summary of this kind is biased in that the most sensitive species is quoted regardless of its potential exposure and some dossiers presented a wider range of non-target organism studies and a range of effect levels. Further breakdown of these results may be found in the full text of the sub-Report.

The Sections below set out in brief form the operation of pesticides policy and practice in selected Member States, and summarises the main conclusions and recommendations drawn from the sub-Report.

7.3 FRANCE - RÈGION CENTRE[4]

7.3.1 Summary Findings

The tonnage of active ingredients applied (95,000 tons in 1995) makes France the heaviest user (by quantity) of PPPs in the EU, although this may be partially explained by the importance in France of arable land use.

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3 A literature search in preparation of the sub-Report showed that numerous studies have been carried out to determine impacts of specific pesticides on non-target organisms in restricted situations, although the number of studies which actually occurred in the regions investigated was limited, and not necessarily related to the normal use of the product in a defined usage area. The origin of the contamination, pathways, quantification and relationship to environmental concentrations could therefore not be derived within the scope of this study.

4 For the Règion Nord-pas-de-Calais and the Règion de Bordeaux permission to publish confidential information was denied. For the Languedoc Règion as yet there is no information available on pesticide applications on apples. In addition, for both soil and water no research of residues was been executed in the Languedoc region.

Since the end of the 1980s France has engaged in monitoring of pesticides occurrences in water, and in creating the administrative, scientific and financial means required for this research. Regional organisations such as the GREPPES in the Règion centre have also been established to improve monitoring.[5]

From this study of the pollution of water and soils by wheat pesticides in the Région Centre, a region in which groundwater is the most important system, it was concluded that pesticide residues are indeed present in water, although their presence seems to be more important in surface water than in groundwater. It should be noted, however, that the monitoring in surface water took place <u>after</u> application periods, when the risk is particularly high. Interpretation of surface water residues therefore seems particularly complex.

The occurrence of pesticide residues in water appears to depend on several factors, including the geographical region and the intensity of wheat production. In addition, it became evident that results have to be viewed in their annual meteorological context, especially for surface water. Similarly, the results of groundwater sampling must be considered in their hydrogeological context, the depth of the water table, the direction and velocity of its flow and the location of the boreholes in the watertable.

It can be seen that groundwaters are particularly important resources for consumption in the region studied. The occurrences of pesticide residues in surface water seem more frequent than in groundwater, but rapid variations and the choice of particular sampling periods must be taken into account. The lack of information is one limit of the study. Although data are available about soil residues at present, ecotoxicological impact of plant protection products may only be taken into account in the future, when water quality monitoring is available.

From a methodological point of view, if the evaluation of the risk of pesticide occurrence in water mainly by using index is left aside, this sub-Report demonstrates the necessity of an analytical approach, integrating the different and interdependent layers of information in order to residues in water. A very precise and dynamic hydrogeology knowledge is, however, considered necessary to explain pesticide occurrences in groundwaters (variation of transfer between different stratigraphic layers).

In relation to other crops, cereals - especially wheat - chosen for the Région Centre study, it appears that neither the administrative region nor the wheat area can be considered a whole, while a small catchment areas risks being insufficiently representative, leading to the conclusion that one should distinguish in a region several subzones in which crop extension, climate, soil and subsoil can be considered as homogeneous.

The author of the sub-Report accordingly concludes (see below) from this a need to continue the study, and to adapt the soil and water monitoring for a more scientific knowledge of the pathways.

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[5] It should be noted that the majority of the results of detailed studies for the Règion centre had not yet been published when this sub-Report was prepared.

7.4 GERMANY

7.4.1 Background

The total inland sales of pesticides are notified to the 'BBA' and published annually. Although the overall amount of different categories can be obtained, data for single pesticides or active ingredients are confidential. Herbicides have for many years been the main portion of all plant protectants used in Germany, followed by fungicides. Because of the cool climate, insecticides play only a minor role.

About 50% of a total area of 35.7 million ha is under agricultural use. Cereals, maize, sugar beet and rape are treated to about 80 to 95% with herbicides, potatoes to about 50% (Hanf 1987 in Pestemer 1991). Fungicides are used mainly in potatoes (about 70% of the area), cereals and rape (about 40). About 95% of the rape area is treated with insecticides and about 50% of the sugar beet. In the other crops the percentage is about 20% or even less.

Authorisation is given in Germany not for an active ingredient, but for each formulation, as the permission to sell a PPP for use in agriculture. Residue behaviour is a very important aspect during the evaluation procedure and is covered in many parts of the procedure, such as behaviour in soil, water/sediment systems and air (BBA 1993). In relation to ground water, if average leachate concentrations > 0.1µg/l in lysimeter studies authorisation is not given. For active ingredients showing slow degradation in soil (10% active ingredients. or metabolites left in the field after 1 year) authorisation may only be given after comprehensive risk-benefit analysis. Insufficient degradation in air (DT_{50} in air > 2d) in combination with bioaccumulation potential or adverse use pattern and slow degradation in the other compartments leads to a negative assessment and a comprehensive risk-benefit analysis.

In Germany no nation-wide monitoring programme for drinking, ground or surface water has been established so far. Supervision of water quality is a responsibility of the 'Länder' (states), but not all have water monitoring programmes. Since 1985 several states have carried out investigations to determine water quality regarding pesticide contamination. Most of these however have been single investigation programmes, and in most cases samples were not taken on the basis of a fixed schedule which could give an overview of the situation in the whole area. Most programmes concentrate only on specific problem areas, such as surroundings of storage dams or regions of intensive agriculture. The results of the data should therefore be used only to provide an impression.

Recommendations and target values are published by several organisations, such as the International Commission for Protection of the River Rhine in 1993 (IKSR 1993, as cited in Irmer, 1994). For the risk assessment for aquatic life standard test results for four categories of organisms are included green algae, daphnia *etc.*, fish and degrading bacteria.

To protect fishery, bioconcentration factors are used to estimate the potential concentration of the chemical in fish, which should not exceed the limit for the pesticide as stated in the German regulation on maximum residue limits for nutritional products. For the abstraction of drinking water, the EU-drinking water limit of 0.1 µg/l is used.

Although limits for pesticides in soil have been established by several communities, they are used mainly to assess contaminated former production sites within urban areas. Therefore the

approach is usually to define limits for different use patterns, such as sensible uses (home gardens, children's playgrounds, ground water protection areas), or restricted use (industrial areas). These guidelines are not applicable for agricultural soils, since the limits go down to 0.25 mg/kg soil and no guidelines are given concerning the time between soil sampling and application of pesticides.

Since 1989, the results of all investigations on pesticides in drinking, ground and surface waters should be reported to the Umweltbundesamt ((Federal Environmental Office - 'UBA') by water companies and the states. The latest statistics available from the UBA however contain data only up to the end of 1994. During this time, about 331,000 analyses have been reported for about 250 actives and metabolites. Although not all states report their results every year, about 70,000 single values are collected every year (Wolter 1995). These data are in most cases separated into the categories drinking water, ground/well water and surface water including bank filtrates and groundwater enriched with surface water.

Of all reported analyses, 91.3% were not contaminated by pesticides although this figure is decreasing since the beginning of data collection (end of 1990: 87.1%). In 2.4% of the reported analyses single pesticide concentration exceeded 0.1 µg/l. This figure has decreased from 5.1% in 1990. 74% of all analyses alone contribute to about 23% of the analyses and to about 70% of all findings, although the use of atrazine was banned in Germany in 1991.

By the end of 1992, 38.6% of the reported findings were from ground and well water, 23.4% from surface water and 38.7% from drinking water. Since only the positive findings were classified according to their origin, it is not known how all analyses were distributed over the water sources. Atrazine, simazine and desethylatrazine were still the most frequently analysed compounds with about two thirds of all findings, in ground as well as in surface water.

It is very difficult to identify any pathways or explain the occurrence or non-occurrence of certain chemicals in water, because no information upon location of the findings and upon use in Germany overall is given. Monitoring programmes often seem not to be adapted to the frequency and amount of chemical use and therefore results and conclusions may be biased.

7.4.2 Conclusions

The collated data are based on an annual pesticide usage in Germany of about 30,000 t. The investigations revealed that monitoring programmes for pesticides in water exist, but that it is very difficult to obtain data for the analysis of pathways and problem areas. Many findings, especially in rivers, are not related to agricultural use, but to industrial production.

The most comprehensive data base existing in Germany, set up by the UBA contains data from the whole country, but exact locations or time of sampling are not supplied. It is not therefore possible to further define problem areas.

Several monitoring programmes were single projects, sometimes running over two years, sometimes samples were taken just once. For detailed investigations trends in water contamination would be valuable which cannot be found without continuous programmes.

Water quality is the responsibility of the states of Germany and therefore regional differences occur in data availability, although a need is identified for coordination of the monitoring programmes which are conducted.

Detailed information about cropping in the different areas is probably available but within the short duration of the project it was not possible to get data other than for a greater area than those selected. It is even more difficult to find data about pesticide use. All such data are collected by agricultural offices not related to water quality monitoring at all. Therefore a joint evaluation of statistical records upon cropping, agricultural use of pesticides, soil and climate is necessary on a regional basis.

The compounds monitored are not always those used most frequently. Often it seems as if water authorities set up monitoring programmes rather by the number of pesticides analysed than by their agricultural importance. Therefore findings may reflect a biased picture, and monitoring programmes should be oriented more towards pesticide use patterns.

7.5 ITALY

7.5.1 Background

The analysis of data relating to agricultural use of chemical products in agriculture over the last twenty years shows a large increase in the intensity of use, even though in the second half of the nineteen eighties a reduction began to appear. This overall trend towards rationalisation seems to follow different paths according to the predominant land use and the extent of technical innovation. On a regional basis the intensity of use both of pesticides and fertilisers are on average higher in the North compared with Central and Southern Italy (between 50 and 100% higher) because there are better weather and economic conditions.

Drinking water is the only environmental compartment to be monitored by law (Article 12 of D.P.R. 236/88) for pesticides contamination, with a frequency that depends on the population number that draw from wells. For a single pesticide the limit is 0,1 µg/l, and for a total of pesticides the limit is 0,5 µg/l.[6]

At the time the sub-Report was prepared, there were no national laws or regulations concerning the control of residues of pesticides in soils, and the only normative regulations in force in Italy were those of the Toscana Region. This plan considers soil standards as well as water (ground and surface) standards. During 1993, however, there was no lack of initiatives for controlling the use of chemical products in agriculture. In application of the Directive 676/91 on the protection of waters from pollution due to nitrates of agricultural origin, the first ‘Code of correct agricultural practice’ was prepared.

An important initiative was also taken by the Ministry for Agriculture concerning control of the effects of the use of chemical products in agriculture through the establishment of a national network for monitoring residuals of chemical products for agriculture. The lack of a

[6] Greater detail concerning specific Italian legislation relating to water quality, pollution by dangerous substances, use of slurry agriculture *etc*. may be found in the full sub-Report (see, *inter alia*, pp. 5.3-6). It should be noted, however, that in a number of instances, parameters used in monitoring areas such as fresh water quality and slurry use, do not include pesticides.

systematic national monitoring programme has been overcome by decree D. lgs. 17 March 1995, n. 194, applying the principles of pesticides registration of Directive 91/414. In particular, Article 17 provides for official controls on trade and use of pesticides and their impact on human health and on environmental compartments. Moreover, paragraph 21 of article 5 of the same law, provides for the identification of ‘vulnerable areas’.

Italian pesticide policy concentrates exclusively on the quality of drinking water. The most contaminated area are those in the rice-crop areas in Piemonte and Lombardia regions (Vercelli, Novara and Lomellina), and some areas near the Po delta (in addition to some more localised areas).

7.5.2 Conclusions

In preparation of its sub-Report, Landell Mills selected three Italian Regions (Piemonte, Veneto and Trentino Alto Adige) on the basis of pesticides use and on the dominance of wheat, vine and apple growing respectively. Nevertheless, for Piemonte and Veneto regions smaller and more homogeneous areas (Provinces of Alessandria and Treviso) were studied as they cover more than 50% of the whole regional cultivated area with respective corps. On the basis of data on farm management, it is apparent that it is impossible to characterise a ‘specific’ apple crop area, as apple and vine crops are nearly equally widespread on all regional territory.

Statistical data from a draft version of the Landell Mills sub-Report were the starting point to provide the relation between the use and the presence of plant protection products. However, in the opinion of the authors of the present sub-Report, these did not suit those utilised in the study areas. Moreover, some active ingredients reported in Landell Mills list did not reflect real use. For these reasons the average AI gr per ha was calculated with reference to the whole crop area. These values are obtained from multiplying the base active area treated (ha) by the average number of treatments, and by the crop area grown. This rough estimate represents more efficaciously the real active ingredients distribution in the whole area.

A national authority for pesticides use in agriculture, horticulture and non-cropped land is lacking, as well as a national up-to-date database on monitoring results for the different environmental compartments. Statistics on the total sale of pesticides in Italy are available but they are not indicative for a toxicological and ecotoxicological assessment because they relate to the entire Italian territory and they are not specific for single active ingredients. Statistics on farm pesticides use are completely absent. On a regional basis the intensity of use both of pesticides and fertilisers are on average higher in the North compared with Central and Southern Italy (between 50 and 100% higher) because there are better agronomic conditions.

Climate, soil, geology and agriculture conditions are very different within Italian regions. In general there are no specific studies on geological and hydrogeological characterisation of the selected areas and generic information only can be extrapolated from national or regional maps.

The collection of data is not centrally co-ordinated, and there are no national laws relating to the control of residues of pesticides in soil. Surface and groundwater are the only environmental compartments to be monitored for pesticides contamination for drinking purposes, although data on pesticide detection in water is scattered among the local health authorities. In Italy there is a lot of data available but they are very difficult to compare because they are not homogeneous. In particular, it is evident that herbicides are researched more than fungicides and insecticides, and monitoring programmes are mainly concerned with quality only of potable water. The number of pesticides researched also varies significantly from region to region.

In the apple region examined, insecticides are more often detected (20) than fungicides (13). Only three herbicides were detected (although given that 8 of these insecticides are not used for agricultural purposes, the impact of the insecticides and fungicides is the same). In vines and wheat regions only herbicides (mainly for maize and rice) are monitored and detected. It was noted that vines and wheat regions have few data on pesticides included in the list identified in the Landell Mills sub-Report (3 of 42 pesticides for vines; 3 of 39 for wheat; whilst in apple region 36 of 45.

Of those 3, one insecticide was never detected and just two herbicides are found: metolachlor (3.7% of samples over the detection limit) and terbuthylazine (5.3% of samples over the detection limit). In the wheat region studied none of the 3 pesticides were detected. Of the 36 pesticides for the apple region studied, 13 (31%) were detected.

The vines region had only 9 pesticides comprehensively researched but a notable 25% of samples over the detection limit. In other regions ground water samples are frequently without pesticide residues whilst in surface samples there are a maximum of 5% of samples higher than the detection limit. This limit value of contamination of surface samples is confirmed from Ferrari data, which also analyses Po river samples. In the apple region the Landell Mills-selected pesticides detected are 0.5% of total samples and 0.09% is more than 0.1 µg/l.

Of the 12 ecotox pesticides, 9 are researched in the apple region and one (isoproturon) in the wheat region (none in vine region). Of the 9 ecotox pesticides, 5 are detected in surface water and sediment and often with concentration <u>more than 0.1 µg/l</u>. Azinphos-methyl (3.8%), pirimicarb (5%), chlorothalonil and dimehoate (7.3%), methaloxyl (1.3%) are frequently detected in surface water. MCPA, aldicarb and propiconazole were never detected and mancozeb only in sediment samples (32.5% of samples). In addition, azinphos methyl was on one occasion detected in sediment samples (8.4 µg/kg). None of these pesticides, however, were detected in ground water samples. In the wheat region, isoproturon appears not to be detected at all. These data were therefore felt not to demonstrate evidence of any systematic contamination of surface water or sediment samples.

The main pathway for the movement of residues to surface waters was identified as the rapid movement following rainfall (*via* runoff, drains and subsurface lateral flow through the soil).

This occurs for the most part immediately after treatments between May and July. Ground waters are contaminated mainly in spring area and the main pathway could be leaching through sand or gravel zones, although probably contamination of ground waters is a slower process. It is also easier to find metabolites than parent compounds.

7.6 THE NETHERLANDS

7.6.1 Background

Until the period 1984 - 1988 (the reference period for the Dutch long term crop protection plan) there was an increase in the use of PPPs in the Netherlands. Since that period the amounts used are declining drastically (largely attributable to a reduction in use of soil disinfectants dichloropropene and metamsodium).

Figure 1 - Estimated overall use (kg * 1000) of plant protection products

Pesticide	1984 - 1988	1995
soil disinfectants	12,700	2,500
other pesticides	10,000	10,800
Total	**22,700**	**13,300**

Source: Anonymous, 1995

Figure 2 - Sales of pesticides for 1991 by product group

Product Group	Sales
herbicides	3,312
fungicides	4,281
insecticides and acaricides	594
nematicides	7,679
other	1,440
TOTAL	**17,306**

Source: ISBEST (Merkelbach, et al. 1993)

Figure 3 - Average use of active ingredients in the main crops for 1992 (excluding the soil disinfectants)[7]

crop	kg active ingredient
winter wheat	6.0
barley	2.7
seed potato	24.6
ware potato	23.5
starch potato	11.7
sugarbeet	7.0
fodder maize	3.3

Source: Poppe et al., 1994

Pesticide registration has been regulated in the Netherlands since 1962. Since 1993, an independent board (Board for the Registration of Pesticides (in Dutch: College voor Toelating van Bestrijdingsmiddelen)) is responsible for the registration of pesticides, subject to national policy by using evaluation procedures and decision criteria laid down by the Ministries. Environmental monitoring in the Netherlands is spread over a large number of institutions and (private) companies (including drinking water pumping stations).

Dutch national policy in relation to general Pesticide Policy is laid down in the so-called 'Multi-year Crop Protection Plan' (LNV, 1991), which established the targets[8] of: reduction of the structural dependency of agriculture on chemical agents for crop protection; substantial reduction of the use of chemical agents in crop protection; reduction of the emissions of chemical plant protection products to environmental compartments by more than 50% for air, more than 75% for soil and groundwater and more than 90% for surface water.

Environmental quality standards had not yet been set for all registered pesticides at the time this sub-Report was prepared. Crucial elements in setting the quality standards are the Maximum Tolerable Risk Levels[9] (MTR) for the soil and surface water environment, and the 0.1 mg m^{-3} concentration level for the groundwater. 110 indicative MTR values (iMTR-values) for surface water given by Teunissen-Ordelmann and Schrap (1996) are currently under review.

Pesticide registration procedures follow closely the principles laid down in Directive 91/414. Pesticides are widespread in the Netherlands. Tabular breakdowns of measured concentrations of pesticides (active ingredients) found in soil, groundwater, drainwater, surface water and sediments may be found in the full sub-Report.

7 The use in some bulb and flower crops may be somewhat higher, however. If the soil is disinfected, an additional 30 - 40 kg per ha should be envisaged (while soil disinfestation takes place once each four years at a rate of approximately 150 kg per ha).

8 Target values mentioned are for the year 2000, while the reference period is 1984 - 1988.

9 MTR are concentration levels in the environment that supposedly have little effect on the integrity of the ecosystems. MTR values are calculated from (No Observed) Effect Concentration of plant protection products on environmental species (mostly fish, algae and daphnids).

Apart from diffuse emissions to groundwater and surface water (which have repeatedly drawn the attention of the authorities) some illustrative examples of pollution problems which have occurred in the recent past, and which forced companies to take corrective action include:

- the occurrence of pesticides in the river Rhine (to some extent due to the production of the pesticides), which forced drinking water companies to install additional filtering capacity;
- the occurrence of successively atrazin, diuron and glyphosate in the river Meuse (to some extent due to the use of these compounds in public green areas and on pavements), which caused temporal cessation of the intake of surface water;
- the occurrence of 1,2-dichloropropane in raw water (groundwater) of a drinking water pumping station in the province of Drenthe, which caused the closing down of several wells of this pumping station;
- the occurrence of ETU in raw water of a pumping station near the Hague, which was one of the reasons for the prohibition of bis-dithio-carbamate-fungicides in the area around this pumping station.

Few studies exist which relate effects (impacts) to occurrences of pesticides in environmental compartments, and most such studies refer only to illegal use, spillage or improper cleansing of equipment. Chronic exposure cannot therefore be inferred from the monitoring measurement performed and more dedicated monitoring is therefore recommended.

7.6.2 Conclusions

Pesticides can be found regularly in all environmental compartments. Leeching, spray drift and drainage are the most dominant processes that are responsible for the contamination. Spraydrift is dependent on the crop and the application techniques and may be related to the use of pesticides. In sandy areas, presumably chromatographic transport to the groundwater occurs, and this may lead to leaching of, for instance altrazine, bentazone and dichloropropene. In clayey areas additionally transport may occur due to preferential flow. As artificial drainage is more frequent in the clayey areas as compared to the sandy areas, drain water in these areas might contribute to the load of the surface water. In general, however, concentrations will be lower that those resulting from spray drift. Run-off might also occur occasionally in the Netherlands. More research is necessary on the transport routes to groundwater and surface water.

A national up-to-date database on monitoring results for the different environmental compartments is lacking, and it is recommended to establish such a database.

Impacts of pesticides in environmental compartments might be inferred from the comparison of monitoring data with MTR values. MTR values may be calculated from data enclosed in the registration dossier. A national view combining monitoring data with associated impacts is also absent, although the conclusion is drawn that current Dutch pesticide policy is in line with the European policy as laid down in Directive 91/414.

7.7 SPAIN

7.7.1 Background

The use of pesticides in Spain has increased since the 1950s, particularly since the 1980s. From the historical series of consumption per class of pesticide it can be seen that the increased use of insecticides matches the use of herbicides in recent years. Waste per unit of surface is very variable, there being a clear difference between the wet regions (the littoral and the river basins) and the dry lands (the Meseta, Aragon, and Extremadura). Valencia, La Rioja and Murcia, are the communities which use higher doses per unit of surface.

There are few studies on pollution by pesticides in groundwaters in Spain. This lack of systematic information has therefore hindered a complete characterisation of this type of pollution, although a breakdown of the total use of pesticides and herbicides in Spain (by millions of pesetas) is provided in the full sub-Report.

Problems appear in the zones of greater consumption of these products. When these zones coincide with vulnerable hydrologic areas - as happens in Valencia - the potential risk of pollution in the aquifers site is considerable. In spite of apparent discrepancies concerning the location of responsibilities for the environment, and with regards to the use of pesticides, there appears to be good co-ordination within the National Working Groups on Pesticides, which hold periodical meetings attended by specialists of the official agencies of each Autonomous (Regional) Government. The records of the pesticide products are regulated by the Ministry of Agriculture, Fisheries and Food, and as their staff attend all the meetings of the various Working Groups, they appear entirely conscious of the potential incidences about pesticides, as well as the advances in pest and weed control.

Working Groups are composed by public officials that advise on the integrated control of pests, and cast light on works on plant material residues; *i.e.*: in recent years, and due to the characteristics of exports of part of the Spanish agriculture, emphasis has been put on the analysis and control of pesticide products residues on fruit and vegetables, either for export or for domestic consumption. However, in these Groups, the impacts on soils and waters of the pesticides have not yet been studied in depth. Other research institutions as the CSIC (Upper Council for Scientific Research); I.N.I.A. (National Institute for Agricultural Research); and Universities are now also studying specific problems of environmental impact of pesticides.

The pesticide industry has a common organisation named Spanish Pesticide Association (AEPLA), while growers associations are of crucial importance in Spain, due to their control over the quality of their produce, and because they have technicians trained in various topics such as integrated pest control, in minimising the environmental impact and quantity of PPP use.

The waste per unit of surface is also very reliable. The highest inputs occur in Almeria (where use of green houses is widespread). Valencia, La Rioja and Murcia also use higher doses per unit of surface. The impacts on soils and waters of the pesticides have not yet been studied in depth.

By way of illustration, the Valencian Community (C.V.), in the East of Spain has an extension of 23,305 km^2 and an intensive agriculture with high commercial value. This region

is formed by the provinces of Alicante, Castellón and Valencia. Valencian agriculture is notable for its important system of irrigation, mainly in citrus, winter vegetables, summer vegetables. Vineyards, almonds, olive trees and carob trees, prevail in the dry lands. Farm size is very small, and almost 50% of all farms are smaller than 1 ha. More than 80% are smaller than 5 ha. Sixty five percent of farms grow citrus or fruit trees. In citrus the use of residual and post-emergence-applied herbicides as well as insecticide treatment during spring and summers are very common. The irrigation period takes place from March to October and is done by using surface and groundwater. The frequency of irrigation is about 15 to 20 days during summer and doses employed range from 6,000 to 7,000m3/ha year.

An intensive agriculture is practised in the C.V., and the use of residual herbicides in citrus is a widespread practice due to their effectiveness and low cost. They are also used in the vegetable and rice fields. The CV is one of the first to actively research pesticide pollution. Herbicides above the maximum allowable concentration of the EU drinking water directive (EU 1980) are detected in shallow irrigation wells in citrus orchards with loam soils and old record of herbicide use. The samples of both soil and well water studies, have, however, been selected as worst situation. It is estimated that diffuse ground water contamination in Spain to date is not therefore considered a significant problem.

7.8 SWEDEN

7.8.1 Background

There are two different kinds of statistics concerning pesticide usage in Sweden. One is based on sales figures of active ingredients reported yearly by manufacturers to the Swedish National Chemicals Inspectorate. The other is based on interviews, carried out every second year, of about 4% of Swedish farmers and reflects the use of pesticides, the distribution between different crops, and the use of herbicides, fungicides and insecticides.

The total sale of pesticides to agriculture in Sweden during 1994 was 1, 961 tons of active ingredient, distributed between herbicides (1,551 tons), fungicides (280 tons), insecticides (41 tons) and seed dressings (90 tons). The total number of AIs registered in Sweden is ca 240, distributed among around 500 different products. About 35% of the AIs are registered for use within agriculture (35 herbicides, 16 fungicides and 13 insecticides, with an additional 10 pesticides used for seed dressing only). Some pesticides are also registered for use in other sectors of society (*e.g*. horticulture, forestry and/or industry), and this use is included in the sales figures.

The total use of pesticides within agriculture in Sweden during 1994 was about 1,150 tons of active ingredient, distributed between herbicides (880 tons), fungicides (225 tons), insecticides (25 tons), growth regulators (15 tons) and top killers (5 tons). The total crop area treated with herbicides was 45%, with fungicides 7% and with insecticides 14%. The average dose of active ingredient is 0.8 kg/ha for herbicides, 1.2 kg/ha for fungicides and 0.07 kg/ha for insecticides. Low-dose herbicides were used on nearly 50% of the total arable area, with a per hectare-dose of 0.004 kg/ha, whereas the average fungicide dose in potatoes was 7.5 kg/ha. About 50% of Swedish farmers use herbicides, fungicides or insecticides (as a mean for the whole country).

There are large differences between different regions, different crops and different sizes of farms. On farms with more than 100 ha of arable land, 85% of the farmers used pesticides. In the northern part of Sweden very little pesticides are used (less than 2% of the total use of pesticides), whereas 44% of the total use of pesticides can be found in the intensively cultivated two southernmost counties of Sweden.

There is no organised collection of data at a national level of detections of pesticide residues in water or sediment. The National Food Administration has the responsibility for food and drinking water in Sweden and there is an obligation for local authorities to report to them findings of pesticides in water intended for human consumption. However, reported findings are not accessible in a single database. The Swedish Environmental Protection Agency has overall responsibility for monitoring and surveying the environmental conditions of Sweden, but for the moment only persistent organic pollutants (*e.g*. PCB, DDT and HCH) are part of national monitoring programs. During 1988 - 1991 central Government money was allocated to enable the inclusion of pesticides into regional monitoring programmes, and was utilised in certain regions for monitoring surface waters. There were large discrepancies, though, between the different programmes. Since 1995 authorities responsible for monitoring at a regional level can apply for money to include pesticides into their programmes, but so far this has been done in just two cases.

The aims of the present pesticide policy in Sweden are to reduce the potential risks for the farmer/sprayer/operator, consumer and the environment and also to reduce the total quantity of pesticides used. During the five year period from 1986 to 1990 the overall tonnage of agricultural pesticides used in Sweden decreased by 47% compared to the 1980-1985 average. In June 1990, a governmental Bill was accepted by the Swedish Parliament with the aim of a further reduction of the risks and another 50% reduction of pesticides used in agriculture. This means that the overall result of the risk reduction programme in quantitative terms should be a maximum allowable use at 25% of the mean 1981-1985 quantity to be reached by 1996 (Bernson & Ekström, 1991). According to the latest information, the total use in 1995 was 29% compared to the 1980-1985 average, which means that the overall goal of a 75% reduction over a 10-year period may well be achieved (Bernson, pers. comm.)

Apart from a reduction of the quantities used, the implementation of the risk reduction policy also includes several other elements such as stricter routines for approval of new pesticides and reapproval of pesticides already used, improved spraying equipment and spraying techniques, improved and extended education and training of sprayers and extended control of pesticides residues in food and drinking water (Bernson & Ekström, 1991).

Significantly, the reduction of quantities used achieved so far has not been shown to be critical in terms of crop production, *e.g*. there has been no drop in cereal yields during the same period. The overall cost to the farmers has in addition been small, in some cases even economically beneficial when adopting reduced herbicide dose rates. Importantly, the ongoing governmental risk reduction program has also been adopted by the Federation of Swedish Farmers. Since Sweden is a small market there is only limited interest shown by the chemical industry to apply for approval of new pesticides as well as in maintaining old pesticides on the Swedish market in minor corps. (Bernson, pers. comm.)

The National Food Administration has adopted the view that pesticides should not be present at detectable levels in drinking water (National Food Administration Ordinance on Drinking

Water SLV FS 1989:30, 1993:35), but no specific guidelines have been laid down. The term ‘drinking water’ refers to raw drinking water, *i.e*. surface as well as groundwater intended for drinking water consumption. Assessment of health risks is carried out according to WHO guidelines as no Swedish guidelines exist for irrigation water or the protection of freshwater aquatic life.

Until the mid-1980s, little information within Sweden on exposure data for current-generation pesticides in surface waters was available. In addition, no specific water quality standards for either surface water, irrigation water or drinking water were established for commonly-used pesticides. During the late 1980’s various programs, with somewhat varying objectives, were set up to improve knowledge of pesticide residues in surface waters. There are, however, large differences between the programs in the number of sampling sites selected, the number of samples collected and the number of pesticides included in the analyses of the water samples. A summary of the results of the different studies is provided in the full sub-Report.

7.8.2 Conclusions

There are large differences in pesticide usage between different regions in Sweden, different crops and different sizes of farms. In the northern part of Sweden very little pesticides are used, whereas almost 60% of the total use of pesticides can be found in the intensively cultivated two southernmost counties of Sweden. Apart from a reduction of the quantities used, the implementation of the risk reduction policy also includes several other elements such as stricter routines for approval of new and reapproval of pesticides already used, improved spraying equipment and spraying techniques, improved and extended education and training of sprayers and extended control of pesticide residues in food and drinking water.

The most frequently found pesticides in surface water are the commonly used phenoxy acid herbicides dichloroprop, MCPA and mecoprop, and the herbicide bentazone (with peak appearances at time of spraying). Findings are more obvious in areas of intensive agriculture, but were found to be dependent on rainfall events during and after application. Strong correlation was found between amounts used and frequency of detection and concentrations found (with the notable exception of Atrazine, which is found even more frequently than might be expected, due to non-agricultural uses).

The sub-Report makes clear that good quality data on pesticide exposure patterns and characteristics are lacking. Continuous (as opposed to one off) testing is therefore recommended. In addition, the sub-Report identifies ceratin minimum background data for adequate evaluation of findings, namely: catchment size; land-use patter; soil type; precipitation; water-flow rate; amount and type of pesticides used and spraying season. A lack of knowledge in relation to other transport pathways is also identified, including in relation to spills, run-offs, leaching, wind drift *etc*.
In the future, efforts must be made by the authorities responsible for monitoring to improve procedures for the selection of pesticides to include in monitoring programmes and at adequate detection limits. To facilitate comparison between monitoring programmes within the EU intercalibration activities between pesticide laboratories at an international level are needed for water samples and for the more complicated soil and sediment analyses. Internationally co-ordinated efforts regarding quality assurance and quality control

measurements are also required, both for laboratory and field activities, when collecting and analysing the monitoring data.

7.9 UNITED KINGDOM

7.9.1 Background

Approximately 450 active substances are approved for use.[10] Unpublished data from PUSG (Thomas pers comm.) for 1994/1995 indicate that a total of 33,705 tonnes of active substance was applied to all crops in Great Britain, the majority of which was applied to arable crops (29,201 tonnes). The amount of active substance applied has decreased over the last few years but area treated has increased (a total area of 48,099,330 hectares were treated of which 43,422,390 were arable crops). Under arable cropping, herbicides were applied in the greatest amounts (7,362 tonnes), followed by fungicides (5,594 tonnes), growth regulators (2,558 tonnes), insecticides (653 tonnes) and molluscicides (251 tonnes). Other applications total 12,883 tonnes but this refers primarily to sulphuric acid (used as a desiccant on potatoes). Fungicides were applied to 21,509,760 ha, herbicides to 13,929,960 ha, insecticides to 3,819,890 ha, growth regulators to 2,938,260 ha and molluscicides to 998,670 ha.

Cereals hectarage treated was 32,586,250 with a total of 11,508 tonnes applied. Potato hectarage treated was 2,760,360 with 1,642 tonnes applied (excluding sulphuric acid). Detailed surveys for a wide range of agricultural and horticultural commodities are carried out, and information on crop or active substance by month, region or county may be easily accessed *via* the databases.

Pesticides approvals are normally granted in relation to individual products and for specific uses. The competent authority for use in agriculture, horticulture, forestry and non-cropped land in the UK is the Pesticides Safety Directorate (PSD), an executive agency of MAFF. The Environment Agency (formerly the National Rivers Authority) has statutory duties and powders under the Water Resources Act 1991 to protect the aquatic environment from pollution, and is required to monitor water quality, investigate pollution incidents, control discharges by consents and maintain and improve the quality of all inland, coastal and groundwaters.

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[10] Tonnage data should not, however, be considered in isolation, as no indication of application rates/frequency or potential biological activity is included in these figures.

A national (England and Wales only) centre for toxic and persistent substances (TAPS) is dedicated to collecting and collating monitoring data on pesticides whilst other departments are responsible for monitoring the quality of waters with regard to biological diversity and health. A large pesticide monitoring programme is in place and regional results are supplied to the TAPS Centre where the data (currently over 250,000 pesticide measurements per year) is collated and summarised nationally. A GIS (Geographical Information System) has been developed to improve targeting of pesticide monitoring by predicting potential for contamination of surface and groundwaters.

Water companies which supply drinking water also analyse source water, monitoring data from which are reported annually to the Drinking Water Inspectorate (*e.g*. DWI 1995). In addition, the TAPS Centre provides a national advisory service on the potential environmental impact of plant protection products. Environmental Quality Standards (EQSs) have been developed for selected active substances, which are used in addition to the statutory EQSs to assess potential impact on non-target aquatic organisms. EQS concentration must not be exceeded within the aquatic environment. The values are derived from ecotoxicological data obtained from a variety of sources and are based on effects on the most sensitive species. Two values are provided, an annual average figure (to assess chronic impacts) and a maximum absolute value (to assess acute impacts). No environmental standards have been established in the UK for soil or sediments.

A recently published report (NRA 1995) indicates that 120 different active substances have been monitored, and 450,000 results reported from about 3,500 sites (Eke 1996). In general compliance with the EQS standards was very high. In 1993, over 99% of List 1 pesticides and 96% of all pesticides passed for all EQSs. Lindane (HCH) was the most frequent failure for List 1 pesticides. Just over 1% failed for List II substances, with moth proofing agents PSCDs/eulan and permethrin most frequently detected and associated with the textile industry. Most EQS failures were associated with sheep dip insecticide. Other pesticides detected included substances used in non-cropped land situations, the triazine herbicides atrazine and simazine (used until 1993) and diuron. Contamination of water sources is generally considered to be at a low level, suggesting minimal impact but it is acknowledged that much of the monitoring is not targeted to determine potential impacts of plant protection products on non-target organisms.

A very large amount of routine monitoring data has been collated by the Environment Agency and private water utilities/companies for the wheat- and potato- growing regions of the UK. Almost all of these data were for surface waters, possibly reflecting that much of the underlying aquifers is concealed by overlying impermeable layers.

Wheat and potato cultivation in the Anglian region was subjected to particular study. Over 120 compounds have been monitored in the Anglian region, but many are not registered for use on wheat or potatoes. Of the 86 individual compounds identified by the sub-Report prepared by Landell-Mills as being applied to wheat or potatoes in the UK, only 36 (42%) have been monitored, with fungicides monitored least. Intensity of monitoring decreases in the order herbicides > insecticides > fungicides.

Of the 36 wheat or potato pesticides monitored, only one herbicide and five fungicides have never been detected in water bodies in the region. Between 1991 and 1994, herbicides were detected at concentrations >0. I @g/1 in 7.2% of samples with the equivalent value for

insecticides and fungicides being 0. 2 and 0. I% of samples. It is, however, very difficult to attribute the appearance of a given residue in water bodies to applications to a single crop.

Of twelve pesticides chosen for further ecotoxicological assessments, the two herbicides were by far the most commonly detected in surface waters. This was attributed to their widespread use, high application rates, physico-chemical properties and timing of application. Clear peaks in the proportion of surface water samples containing residues of these herbicides occurred in the months immediately after application to cereals in the region. The four insecticides and four fungicides selected were detected only very rarely and at lower concentrations than the herbicides.

7.9.2 Conclusions

The main pathway for movement of pesticide residues to surface water sources is rapid transport in response to rainfall either in drainflow or in sub-lateral flow through the upper soil across a relatively impermeable subsoil horizon. This rapid movement means that much of the potential for absorption or degradation in the soil is bypassed.

There are very few data for presence of the twelve pesticides in groundwaters. There is no evidence for any systematic contamination of groundwaters in the region with four of the eight pesticides monitored detected only very infrequently and at low concentrations. These residues might be attributed to point source contamination or to local hydrogeological conditions where fissuring causes rapid movement of surface-applied pesticides to depth.

Seven pesticides failed environmental quality standards for water in Anglian region in 1993. Lindane was the only one with extensive diffuse agricultural uses (although its detection may also have derived from use in wood treatment). Residues of the other six compounds were likely to have resulted from non-agricultural applications or industrial usage or were historical residues from persistent compounds which are no longer in use.

7.10 OVERALL SUB-REPORT CONCLUSIONS

The uncoordinated monitoring and data collection for all environmental parameters at the EU level prevents systematic interpretation of information with respect to determining the presence and impact of plant protection products. Regulation of plant protection products is by necessity largely based on the results of laboratory data generated by the agrochemical companies. Impacts on non-target organisms are assessed by calculating toxicity exposure ratios and, if appropriate, risk reduction management strategies are required *e.g.* without spray/buffer zones. Few field monitoring data exist in the regions studied to determine whether exposure to real environmental concentrations was likely to have any chronic or acute impact. The specific objectives of this sub-Report were therefore only partially met.

7.10.1 Scale of Study

Studies to determine the presence and impact of plant protection products at the regional level are too large if the objective is to understand processes, quantify losses and determine potential impacts. Detailed studies at the field or catchment level are required to provide the necessary information. Upscaling from this detailed information, (using mathematical models for extrapolation of data, for example), to the regional or national level could possibly be achieved provided detailed information is available on pesticide usage, cropping, climate, soils, hydrogeology *etc*.

The process of collating the dispersed or confidential data was more time consuming and demanding of resources than originally envisaged. This precluded the investigation of all regions chosen for the sub-Report prepared by Landell Mills and prevented further analysis and investigation within the resources allocated. Consequently, further evaluation of the collated data will be necessary to derive maximum benefit from the investigations.

7.10.2 Usage Data

Plant protection products are rarely crop specific. In a given region they may be used on a variety of crops (or even used in non-cropped land situations) at different application rates and at different times of the year. Qualitative or quantitative assessments need to take into account the full usage spectrum across a number of years to incorporate crop rotations. This information was not available in preparation of this sub-Report.

Several countries reported detections of active substances arising from use in industrial applications, food processing and non-cropped land. These uses can potentially have more impact on non-target organisms as they originate from a point source and concentrations in discharges can be significantly higher than those originating from diffuse agricultural contamination. Spillages, washings and other misuses were also known to be responsible for contamination events. Information is therefore also required on usage in non-agricultural situations.

Comparison of the fate of specific active substances in different Member States was found to be difficult since availability of the active substance and product type can vary, method of application and treatment rates and timing may also differ. Consequently, their fate and behaviour is expected to differ.

7.10.3 Monitoring and Strategies

Some regions did not have any pesticide residue monitoring programmes in place and therefore no data were available. Some regions did not have good characterisation data (for example, in relation to hydrogeology) and as a result definition of pathways was impossible. All regions were able to provide meteorological data, but not all could provide specific detail like average storm intensity and duration.

Monitoring data from some regions was classified as confidential or was presented in a summary format inappropriate for this project. Some of the regions incorporated several administrative authorities. Since data was not centrally co-ordinated in these countries it was difficult to access and collate comparable information.

Much of the data collected related to statutory monitoring of older, more persistent, active substances, many of which are no longer registered but are required by EU Directives such as those for Groundwater and Drinking Water. It is argued that this requirement uses key resources which could be better used to identify and characterise current problems.

No regional or national soil quality monitoring programmes appear to exist for the seven countries contributing to this sub-Report. The data evaluated for the 12 active substances suggest that there are no long term effects on soil quality. Further evaluation of the literature and other active substances would be required to determine whether effects from other plant protection products may occur in the field situation. No regional or national data were obtained for the routine monitoring of sediments though some analyses were located which were confined to specialist surveys.

Water quality monitoring was not usually targeted for location, timing or for a specific active substance with respect to impacts on non-target organisms. Most monitoring appeared to be in relation to drinking water intakes and was not designed to determine the magnitude and frequency of contamination events and their potential impact. Drinking water intakes are usually large water bodies and any upstream contamination event will consequently become diluted by other uncontaminated waters. Impacts on non-target organisms are more likely to occur upstream (where monitoring has not taken place). Some monitoring schemes appeared to exist because of particular local interest in a specific contamination problem and not because of a strategic monitoring plan. Other monitoring schemes were found to base the selection of determinands on usage data or on evaluation of cropping and then assumed use. In some cases determinands were further selected by assessing basic physico-chemical properties which characterise leaching and persistence. Only England and Wales had a designated authority responsible for the co-ordination and collation of monitoring data.

Herbicides were the most frequently monitored group of pesticides. The tonnage applied was generally greater than for other groups and the timing of application and physicochemical properties suggest that some may be more prone to leaching. The drinking water limit of 0. 1 pg/1 was more frequently exceeded in the water resources monitored by herbicides (although proportionately fewer fungicides or insecticides were monitored for). Analytical techniques were not available for routine determination of many active substances.

7.10.4 Pathways and Processes

Since monitoring was not targeted to the relevant environmental compartments no comparative assessments were made in the sub-Report. It is generally assumed that agricultural spray drift is the main source of contamination of surface waters yet little monitoring data is available to determine the post application concentrations or their impact. Subsequent contamination can occur via drainflow, lateral seepage, leaching, overland flow and atmospheric deposition. Only in intensively instrumented catchment based studies could these begin to be identified and quantified and the processes responsible understood.

Large amounts of historical monitoring data (mainly statutory) were collated during preparation of the sub-Report. In order that this could be effectively evaluated an EU

database on pesticides[11] water, soil and sediment was compiled. The database allows summaries to be retrieved for active substance, water source type, country *etc*. Supporting data on location, source type, sampling date and contact organisation are essential components of the database as comparison of concentrations detected in isolation are meaningless. Interpretation of the data and an initial assessment of pathways and processes can be made.

7.10.5 Health and Environmental Quality Standards

A database of health and environmental water quality standards was compiled. This showed that for some active substances there are several orders of magnitude difference between values of different countries. The development of different environmental quality limits/standards in different countries was considered confusing and could be seen a duplication of effort at the European level. The basis for calculation of each needs to be available, as theoretically they are all based on available data yet different values are apparent. The process requires EU co-ordination.

Incidences of pesticide contamination of water were found to occur and comparisons of concentrations were made with health and environmental standards or limits. However, the sampling strategies which provided the data reviewed were not usually designed to fully characterise a contamination incident. This project used maximum detected levels to make the comparisons (although it is accepted that this method is not necessarily considered a valid approach). However, the use of 'means' is also problematic. The database retrievals allow a better comparison since they provide information on the total number of analyses, those below the detection limit and those above 0.1 μ/1. Until comprehensive databases are available showing the origin, magnitude, duration and frequency of events, quality standards cannot be scientifically compared with field monitoring data. Only continuous, frequent or carefully targeted monitoring can supply this detail.

Environmental standards from the UK and the Netherlands (EQS's or MTR's respectively) are based on the lowest effect level regardless of species tested. This may trigger regulatory action whether it is fish or algae at risk. In the regulatory assessment of data for inclusion on Annex I testing of a specific range of non-target species is required, where this data is absent it will be required as a condition of approval. The species range is then always comparable.

It was also noted that there is concern over the status of environmental standards in relation to the toxicity exposure ratios (TER's) calculated for regulatory compliance with Directive 91/414. It was considered that the purpose and need for each value should be clearly defined and the information made widely available.

No soil or sediment standards were located which were relevant to the agricultural use of pesticides. The need for and feasibility of creating such standards and monitoring for their compliance should be carefully considered if resources were to be allocated for this task. For example problems of monitoring strategy, timing, soil type influences, water status and cropping would all need to be considered.

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[11] The European Pesticide Database can be obtained by initially contacting Dr Carter at Soil Survey and Land Research Centre, Cranfield University, Shardlow Hall, Derby, DE72 2GN. England. Tel: 00 44 1332 799000, Fax: 00 44 1332 79916 1.

7.10.6 Impacts of Plant Protection Products

Summary data on environmental fate and ecotoxicology are essential for determination of the impact of residues of PPPs. Two databases, PETE and Pandora's Box, were accessed to provide this fundamental information. Following the review of the first draft of this sub-Report it was noted that in some cases the data was considered inappropriate, had been superseded by results from modern studies or did not reflect the range of values retained by the original dataholders. Data from agrochemical company dossiers are more comprehensive than those found in the published literature and thus provide an essential basis for determining potential impact on the environment. In order that the wider community can access modern, validated information it is recommended that a Pesticides Properties and Ecotoxicological database, similar to Pandora's Box is established and routinely updated as European reviews and registration take place. This database could then be made available, for example, *via* the Internet.

Guidelines for determining the impact of a plant protection product on sediment dwelling aquatic species are required. No data were presented by the data holders for this group of non-target organisms. A limited number of field monitoring studies exist in the selected regions, though more were known to exist in other regions.

Impacts (particularly sub-lethal ones) of plant protection products are difficult to isolate because of the complex nature of the ecological system. It was noted that other agricultural activities or environmental processes can have greater detrimental effects on a system.

Data (obtained from the agrochemical industry itself) showed that acute and chronic exposures were monitored under controlled laboratory conditions. In the field situation the environmental conditions are dynamic with many processes controlling the dissipation of the active substance. Yet comparisons with standards or regulatory assessments are made which assume the same environmental conditions apply in the field. Assessment of impact is complex and as a result too many simplifications and worst/extreme case scenarios may be used which together combine to provide unrealistic and possibly unnecessarily large safety margins. Field studies are occasionally required by regulatory authorities but these data are not usually available in the public domain.

7.11 RECOMMENDATIONS

Central co-ordination and guidance from the EU is essential if monitoring data are to be subsequently evaluated at the EU level to determine the impact of environmental and agricultural policy. Many organisations are involved in the registration of plant protection products and their monitoring in the environment at the regional or national level. A co-ordinated national approach regarding monitoring in the environment and potential impact on non-target organisms is required. The EU should consider defining clear roles and responsibilities for Member States to comply with a specific monitoring strategy. The scientifically derived information should be made freely and easily accessible. This can then be collated as required at the EU level.

There needs to be an EU approach to regional and national environmental characterisation for soils, geology, land use, climate *etc*. Whilst EU systems do exist for some of these they do not provide the opportunity for interaction or easy access. In many cases the detail available for the EU is not sufficient and therefore a layered or nested approach should be considered whereby representative areas are identified and characterised at the scale required. Confidentiality, Intellectual Property Rights or cost of purchasing data may provide barriers to general access and will need to be overcome.

All future studies to determine residues and impacts should be catchment based (whether for groundwater or surface water sources) in order that quantitative assessments can be made. The EU should consider the development of a range of representative catchment based studies across Europe to provide the necessary data. These catchments would form the detailed level of a 'nested' or tiered approach to the evaluation of monitoring data at the EU level. Existing catchments with historical data could be considered if appropriate and representative of the required agroclimatic conditions.

Monitoring should be targeted for location, timing and use of active substance in accordance with a strategic monitoring plan designed to monitor potential impact on non-target organisms.

Clearer analytical techniques are required. Many methods are complex and often specific to the active substance. Techniques for fungicides and insecticides are especially required. Acceptable analytical methods are only available for approximately one quarter of all active substances. A list of priority active substances should be established. If comparisons are to be made at the European level a quality control and standard procedures should ideally be implemented for collection, storage, analyses and data reporting.

Consideration should be given to the purpose and value of statutory monitoring of older, more persistent, active substances, many of which are no longer registered but are required by EU Directives such as those for Groundwater and Drinking Water. It is argued that this requirement uses key resources which could be better used to identify and characterise current problems.

Collection of samples and associated analyses are time consuming and costly. Maximum benefit could be obtained if all data were centrally collated at the regional, national and European level. An EU database on pesticides in water, soil and sediment is recommended to evaluate the success of environmental protection policies within Europe. The database

software and structure developed in preparation of this sub-Report should be adopted by all Member States to facilitate easy interpretation and exchange of full scientific data. Supporting data on location, source type, sampling date and contact organisation are essential components of the database as any comparison of concentrations detected in isolation will otherwise be meaningless.

The development of environmental quality limits/standards in different countries is confusing and is a duplication of effort. The basis for calculation of each needs to be available as theoretically they are all based on available data yet different values are apparent. The process requires EU co-ordination. There is also concern at the status of EQS's in relation to the toxicity exposure ratios (TER's) calculated for regulatory compliance with EU Directive 91/414. The purpose of each value needs to be clearly defined and an evaluation of the relationship between the two values carried out. Clarification is required concerning the ecological basis for selecting the most sensitive species for toxicity calculations. The importance of the species in the ecosystem needs to be evaluated and factors such as population recovery rates, species abundance or influences on other compartments of the system need to be taken into account.

No soil or sediment standards were located which were relevant to the agricultural use of pesticides. The need for and feasibility of creating such standards and monitoring for their compliance should be carefully considered if resources were to be allocated for this task.

Summary data on environmental fate and ecotoxicology are essential for determination of the impact of residues of plant protection products. In order that the wider community can access modern validated information it is recommended that a European database, similar to Pandora's Box is established and routinely updated.

The impact of agricultural management systems designed to reduce contamination of the environment or simply compliance with good agricultural practice should be evaluated to determine whether these measures are likely to minimise contamination events.

Further studies which build on this preliminary desk study are required to make use of the considerable amount of information which has been collated and for which relatively little interpretation has been carried out. This sub-Report has therefore only served to initiate the process of investigating the presence of plant protection product residues in the environment and their potential impact on non-target organisms.