PESTICIDE POLICIES IN THE EUROPEAN UNION

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I. INTRODUCTION

There are widely held concerns over environmental contamination from agricultural pesticide applications in Europe.[1] Until recently, the prevailing view was that if pesticides were applied properly, that is, in accordance with manufacturers' instructions, safety would be ensured through the testing required before commercialization of a new pesticide. That assumption and the practice of regulating pesticide use solely by means of authorization is now being challenged as environmental monitoring and knowledge increase.[2] A particular issue is the water quality standard established by the European Drinking Water Directive which sets a maximum admissible concentration (MAC) of 0.1 μg/l (0.1 parts per billion) for an individual pesticide and of 0.5 μg/l for total pesticide concentration in any sample of drinking water.[3] This Directive takes the viewpoint that pesticide presence equates with risk, even though there might be no actual social and private cost.[4]

The Fifth Environmental Action Plan (FEAP) reflects the consensus in the European Union (E.U.) that usage is to be reduced and such has been institutionalized under the Fifth Environmental Action Plan (FEAP).[5] The FEAP

> sets as one of its targets the significant reduction of pesticide use per unit of land under production and conversion of farmers to methods of integrated pest control, at least in all areas of importance for nature conservation . . . [and] lists three actions for meeting these targets: (1) registration of sales and use of [pesticides]; (2) control on sale and use of [pesticides]; and (3) promotion of 'Integrated Control' (in particular training activities) and promotion of bio-agriculture.[6]

The reduction of pesticide use is already part of environmental policies in several Member States.[7] At the national level, Denmark, Sweden, Finland and The Netherlands have set programs in place to establish quantitative, timetabled usage reduction targets.[8] Although the Member States have approved the FEAP and its call

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1. *See, e.g.*, J.A.W.A. Reus et al., *Towards a Comprehensive Crop Protection Policy in the European Union*, *in* POLICY MEASURES TO CONTROL ENVIRONMENTAL IMPACTS FROM AGRICULTURE 74 (A.J. Oskam & R.A.N. Vijftigschild eds., 1997) (discussing the opportunities for a crop protection policy in the European Union); EUROPEAN COMM'N, POSSIBILITIES FOR FUTURE E.U. ENVIRONMENTAL POLICY ON PLANT PROTECTION PRODUCTS', SYNTHESIS REPORT § 1.1 (1997) (report prepared by Oppenheimer Wolff & Donnelly, Avenue Louise 240, Box 5, 1050 Brussels, Belgium).

2. *See* K.E. Falconer, *Managing Diffuse Environmental Contamination from Agricultural Pesticides: An Economic Perspective on Issues and Policy Options, with Particular Reference to Europe*, 69 AGRIC., ECOSYSTEMS AND ENV'T 37, 38 (1998).

3. *See* Council Directive 80/778, 1980 O.J. (L 229) 11.

4. *See* Falconer, *supra* note 2, at 38.

5. *See* EUROPEAN COMM'N, *supra* note 1, at § 1.1; 1993 O.J. (C 138) 5, 24.

6. EUROPEAN COMM'N, *supra* note 1, at § 2.1.

7. *See* A.J. OSKAM ET AL., ADDITIONAL EU POLICY INSTRUMENTS FOR PLANT PROTECTION PRODUCTS 61 (Wageningen Pers ed., 1998).

8. *See id.* at 60-62.

for a significant reduction in pesticide use, no clear consensus exists as to what the direction for future E.U. policy efforts should be.[9]

This Article gives an overview of pesticide use in the E.U.,[10] discusses the differences in national strategies of several member states,[11] and highlights potential options for an additional common E.U. policy.[12]

II. PESTICIDE USE IN EUROPE

Pesticides are defined as chemical "substances or mixture thereof intended for preventing, destroying, repelling, or mitigating any pest."[13] Also, "any substance or mixture intended for use as a plant regulator, defoliant, or desiccant" is considered a pesticide.[14] Pesticides can be classified according to intended use: disease and weed control, soil disinfecting, growth regulation, grassland enhancement, and so on.[15] A biological classification might also be used: herbicides, nematicides, bactericides and fungicides, insecticides, and acaricides (to control mites).[16] In practice, a mixture of classifications are usually employed and it is common to present consumption in terms of active ingredient (a.i.), that is, by the weight of the toxic substance.[17]

The global importance of chemical pesticides varies from region to region[18]. Herbicides are the principal pesticides used in the United States whereas in the temperate regions of western Europe, fungal diseases dominate and so fungicides account for about half of chemical pesticide usage.[19]

The main sources of information on pesticide consumption in Europe are the national associations of producers and importers of agro-chemicals and the Ministries of Agriculture, which provide annual sales statistics,[20] thus enabling a

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9. *See* EUROPEAN COMM'N, *supra* note 1, at § 2.1.

10. *See* discussion *infra* Part II.

11. *See* discussion *infra* Part IV.

12. *See* discussion *infra* Part V.

13. EPA, *Terms of Environment* (last modified May 13, 1998) <http://www.epa.gov/ocepa111/OCEPAterms/pterms.html>.

14. *Id.*

15. *See* A.J. OSKAM ET AL., WAGENINGSE ECONOMISCHE STUDIES 26, PESTICIDE USE AND PESTICIDE POLICY IN THE NETHERLANDS 8 (1992).

16. *See id.*

17. *See id.* at 8-13.

18. *See infra* Table 1.

19. *See* E-C. OERKE ET AL., CROP PRODUCTION AND CROP PROTECTION: ESTIMATED LOSSES IN MAJOR FOOD AND CASH CROPS 54 (1994).

20. The following aspects need to be considered when using and interpreting pesticide sales data:

(a) Statistics on the sales of pesticides in some countries only specify the total sales without a distinction in agricultural and non-agricultural use;

(b) Statistics provided by national associations of producers and importers exclude production and imports by non-affiliated firms;

comparison among E.U. Member States to be made. Annual sales of kilograms (kg) a.i. per hectare (ha) vary widely and range from less than two kg in Denmark, Finland, and Sweden, to over ten kg in Belgium, Ireland, and the Netherlands.[21] Another important characteristic is the efficiency of pesticide use measured by a.i. per unit of crop production, which is presented in the last column of Table 2.[22] Observe the Netherlands where pesticide use per ha is very high, but where use per unit of crop production is very low.[23] This example illustrates that the use of pesticides per ha is highly correlated to output levels—intensive farming systems with a high return per ha tend to have a higher usage of pesticides.[24] Illustrative in this respect is the detailed information by commodity group for the Netherlands given in Table 3.[25] The use of plant protection products is highest (more than fifty kg/ha) for mushroom production and greenhouse floriculture, and lowest (around one kg/ha) for grazing livestock.[26]

In addition to differences in volume of use and efficiency of use, the relative cost of pesticide use is important for policy design.[27] The ratio between cost of pesticide use and total cost of production reflects the intensity of using pesticides.[28] Where this ratio is high, the incentive to reduce costs in relation to risks of crop losses is likely to be stronger than where the ratio of costs is low.[29] For example, the use of plant protection products exceeds thirty kg/ha for greenhouse vegetables, greenhouse floriculture, and mushrooms, but intensity is less than two percent.[30] The use intensity of plant protection products in the Netherlands is highest (seven percent) for crop farms where average use is 'only' 16.4 kg a.i. per ha. So, the incentive to achieve a reduction in pesticide use is likely to be higher for arable farms than for those with mushrooms, greenhouse vegetables, or floriculture. This is

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(c) Sales statistics differ from the actual use of pesticide because of stock keeping by farmers.

See F.M. BROUWER ET AL., AGRICULTURAL ECONOMICS RESEARCH INSTITUTE (LEI-DLO), PESTICIDES IN THE EC § 3.1 (Apr. 1994) (verification in English version). *See also* J.L. Noé et al., *Crop Protection Products Quantitative Use Patterns in the European Union, in* POLICY MEASURES TO CONTROL ENVIRONMENTAL IMPACTS FROM AGRICULTURE 21 (A.J. Oskam & R.A.N. Vijftigschild eds., 1997).

21. *See* OSKAM ET AL., *supra* note 7, at 3; *infra* Table 2. See also the detailed overview of sales figures by pesticide category (fungicides, herbicides, insecticides), Member State, and year for the period of 1983-1996. *See id.* at 250-52.

22. *See id.* at 3; *infra* Table 2.

23. *See id.* at 3-4; *infra* Table 2.

24. *See* F.M. Brouwer & P.J.G.J. Hellegers, *Analysis of Intensive Farming Systems in the European Union, in* ECONOMICS OF AGRO-CHEMICALS: SELECTED PAPERS OF THE 1996 SYMPOSIUM OF THE INTERNATIONAL ASSOCIATION OF AGRICULTURAL ECONOMISTS 75 (G.A.A. Wossink et al. eds., 1998).

25. *See infra* Table 3.

26. *See* Brouwer & Hellegers, *supra* note 22, at 80.

27. *See* OSKAM ET AL., *supra* note 7, at 2-3.

28. *See id.* at 3-4.

29. *See id.*

30. *See* Brouwer & Hellegers, *supra* note 22, at 13.

important because crop farming is responsible for seventy percent of total pesticide use in the Netherlands.[31]

III. POLLUTION AND HEALTH PROBLEMS

In using pesticides at least three types of environmental and health risks matter: (1) risk to spray operators, (2) risk of pesticide residues in water, air, and food products to persons consuming those products, and (3) risk of emitted pesticides to the natural environment which eventually may affect biodiversity.[32] The latter effects of pesticides are caused by emission into groundwater, surface water, air, and adjacent fields.[33] These effects are specifically due to the fact that the amount of pesticides coming in direct contact with, or consumed by, the target pest is an extremely small percentage of the total amount applied.[34] In most studies the proportion of pesticides reaching the target pest was less than 0.3 percent, with the bulk being emitted into the environment.[35] Apart from environmental and health problems, pesticide use might also lead to agronomic problems, such as: phytotoxicity (manifested as damaged crops which is especially likely to occur when using herbicides), resistance, adaptation (for example, when the chemicals used are decomposed by micro-organisms before they can become active), the development of secondary pests, and changes in quality of the harvested product.[36]

The extent of pesticide usage in Europe suggests that environmental contamination could be widespread; however, the magnitude and distribution of this is only beginning to be more accurately characterized. Previously, little evidence existed of contamination and the lack of available data meant that there was little public concern or pressure on policy-makers.[37] With the Drinking Water Directive, drinking water suppliers are required to systematically monitor drinking water supplied to customers for a range of pollutants.[38] For example, from analyses of monitoring results between 1985 and 1987, it was found that in Britain the MAC for single pesticides was exceeded in 298 water supplies and "that for total pesticides in

31. *See* OSKAM ET AL., *supra* note 13, at 13.

32. *See* OSKAM ET AL., *supra* note 7, at 21.

33. *See id.*

34. *See* Hayo M.G. van der Werf, *Assessing the Impacts of Pesticides on the Environment*, 60 AGRIC., ECOSYSTEMS AND ENV'T 81, 81 (1996).

35. *See id.* (citing David Pimentel, *Amounts of Pesticides Reaching Targets Pests: Environmental Impacts and Ethics*, 8 J. OF AGRIC. ENVTL. ETHICS 17 (1995)).

36. *See* OSKAM ET AL., *supra* note 13, at 17-18.

37. *See* Falconer, *supra* note 2, at 38.

38. *See* Council Directive 80/778, 1980 O.J. (L 229) 11. Directive 80/778 lays down maximum admissible concentration levels for sixty-two microbiological, physical, and chemical parameters, and also requires Member States to ensure regular monitoring of water quality using the methods of analysis as set out in the Directive. *See id.*

70 supplies."[39] Experts calculated that in 1992 approximately 14.5 million people in England and Wales lived in zones supplied with drinking water in which pesticide level breached the MAC.[40]

Data at the European level on the quality of drinking water only became available in 1995 when a study funded by the E.U. showed that approximately thirty percent of drinking water supply exceeded the standards of the E.U. Drinking Water Directive with large variations among Member States.[41] In many regions the authorities actually tolerate (at least for a transitional period) the exceeding of the 0.1 μg/l limit.[42] In France, Italy, the United Kingdom, and the Netherlands, water suppliers employ water-conditioning measures to ensure compliance with maximum pesticide concentrations; at the local level in parts of Germany and Austria, suppliers have set up cooperative agreements with farmers to change farming methods.[43]

It has to be noted that the maximum concentration level of 0.1 μg/l for individual pesticides is frequently criticized, particularly on the grounds that it does not take into consideration the varying toxicological significance of individual pesticides and thus incurs unnecessary expense.[44] The United States, for example, applies differentiated limit values for pesticides,[45] as do the World Health Organization (WHO) Guidelines.[46] However, many toxicologists argue that the precautionary maximum concentration value used in the E.U. should be retained because the knowledge of the environmental risks is incomplete, particularly concerning synergistic or interaction effects.[47]

One of the few other significant E.U. studies of the human health risks of pesticides is on residues in fruits and vegetables.[48] The standard used in this assessment is the acceptable daily intake (ADI), which is the maximum amount of a pesticide that a human being can ingest daily per kg of body weight during a lifetime without damaging health.[49] There are significant differences among countries.[50]

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39. Neil Ward, *An Evolutionary Perspective on Pesticide Use and Water Pollution in Europe*, *in* POLICY MEASURES TO CONTROL ENVIRONMENTAL IMPACTS FROM AGRICULTURE 522 (A.J. Oskam & R.A.N. Vijftigschild eds., 1997).

40. *See id.*

41. *See* Ingo Heinz, *Cost and Benefits of Pesticide Reduction in Agriculture: Best Solutions*, *in* ECONOMICS OF AGRO-CHEMICALS: SELECTED PAPERS OF THE 1996 SYMPOSIUM OF THE INTERNATIONAL ASSOCIATION OF AGRICULTURAL ECONOMISTS 336 (G.A.A. Wossink et al. eds., 1998); *infra* Table 4.

42. *See id.* at 338.

43. *See id.* In 1995 the costs of these measures ranged from 0.02 ECU/m3 of drinking water in Austria and Germany to 0.07 ECU/m3 in the U.K. *See id.* at 339 & tbl.24.2. *See also* Falconer, *supra* note 2, at 39; OSKAM ET AL., *supra* note 7, at 107.

44. *See* Heinz, *supra* note 39, at 336.

45. *See* EPA, *Current Drinking Water Standards* (last modified Oct. 13, 1999) <http://www.epa.gov/OGWDW/wot/appa.html>.

46. *See generally*, 1 WORLD HEALTH ORGANIZATION, GUIDELINES FOR DRINKING WATER: RECOMMENDATIONS (1993) (providing recommendations for drinking water standards).

47. *See* Heinz, *supra* note 39, at 337.

48. *See id.* at 333-37.

49. OSKAM ET AL., *supra* note 13, at 19.

IV. CURRENT LEGAL INSTITUTIONS IN THE E.U. MEMBER STATES

Until the mid 1980s pesticide policies in the Member States of the European Union "focused mainly on qualitative standards and criteria for the admission of pesticides on the market," codes of practice, and chemical-specific use restrictions.[51] In response to public concern, almost all Member States now have some form of pesticide policy in place in addition to their authorization programs.[52] A distinction can be made between Member States that have adopted additional measures to achieve a quantitative reduction in pesticide use and those that have taken national incentives without reduction targets.[53]

A. *Strategies in Member States with a Pesticide Use Reduction Program*

Table 6 describes the Swedish, Danish and Dutch pesticide use reduction programs in greater detail.[54] Baseline figures upon which targets are set themselves differ between these countries but all have taken a similar approach in defining percentage reduction goals in two phases.[55] The range of policy instruments implemented in the pesticide reduction programs varies between the countries.[56]

The Danish Pesticide Action Plan was agreed upon in 1986 and includes a reduction target for total pesticide use on arable land as well as a reduction target for the treatment frequency.[57] To facilitate the reductions, all persons who use pesticides professionally have to pass a test in handling and applying pesticides.[58] A three percent value added tax was imposed on pesticide sales in order to support research

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50. *See* Grada A. Wossink et al., *Introduction to Agro-Chemicals Use, in* ECONOMICS OF AGRO-CHEMICALS: SELECTED PAPERS OF THE 1996 SYMPOSIUM OF THE INTERNATIONAL ASSOCIATION OF AGRICULTURAL ECONOMISTS 12 tbl.1.8 (G.A.A. Wossink et al. eds., 1998) (citing J.D. VAN KLAVEREN, RIKILT-DLO, RESULTATEN RESIDUBEWAKING IN NEDERLAND, KWALITEITSVERSLAG AGRARISCHE PRODUCTEN [RESULTS OF PESTICIDE RESIDUE CONTROL IN THE NETHERLANDS, QUALITY REPORT AGRICULTURAL PRODUCTS] 39 (1997)); *infra* Table 5.

51. Reus et al., *supra* note 1, at 74.

52. *See* EUROPEAN COMM'N, *supra* note 1, at § 1.3.1.

53. *See id.* at § 2.1-.2.

54. *See infra* Table 6. Finland also applied a pesticide reduction plan. The first target was set at fifty percent reduction by 1995 compared to the average use over 1987-1991. *See* OSKAM ET AL., *supra* note 7, at 61. The Finnish program was not included in the discussion here due to the lack of descriptive material in English on the realized reductions.

55. *See* E. Green and J.D. Mumford, *Policy Needs and Options for Agricultural Pesticide Controls in the European Union, in* POLICY MEASURES TO CONTROL ENVIRONMENTAL IMPACTS FROM AGRICULTURE 60 (A.J. Oskam & R.A.N. Vijftigschild eds., 1997).

56. *See infra* Table 6.

57. *See* Jesper S. Schou, *Regulating Agricultural Pesticide Use in Denmark, in* THE 1998 ANNUAL EUROPEAN ENVIRONMENT CONFERENCE: ADVANCES IN EUROPEAN ENVIRONMENTAL POLICY 165 (1998).

58. *See id.* at 166.

and extension in the use and effect of pesticides.[59] Pesticide use is prohibited in environmentally sensitive areas (e.g., meadows, hedgerows, drinking water collection areas) and up to a distance of two meters from streams and lakes.[60] Since 1994, "spraying journals" are mandatory for farms of more than ten ha.[61]

A marked increase in the Danish pesticide tax was introduced in January 1996 in order to enhance the reduction of the treatment frequency.[62] The 1996 tax is differentiated; so that insecticides, soil-disinfectants, combined pesticides and vermicides are taxed with twenty-seven percent of their retail price before tax; fungicides, herbicides, growth regulators and repellents are taxed thirteen percent; other pesticides are taxed three percent.[63] The tax differentiation is merely motivated by differences in the lack of reduction of the treatment frequency by pesticide category and does not reflect differences in environmental risks.[64] In January 1998 the Danish government decided to double the 1996 tax but no decision has been made yet as to the practical implementation of this tax increase.[65]

In Sweden, a pesticide use reduction plan was agreed upon in 1986 and two different types of taxes were imposed: administrative charges when registering pesticides and a fixed tax per standard dosage varying by pesticide.[66] The main purpose of the pesticide tax is to finance research and extension.[67] Besides pesticides, fertilizers also are taxed to finance export of surplus production.[68] Applicator training and certification is required for all applicators; application equipment testing and certification is required for all new equipment and is voluntary for existing equipment.[69] There are pesticide use restrictions including buffer zones around water and sensitive areas.[70]

In the Netherlands, a pesticide use reduction plan was approved in 1991.[71] No specific tax was imposed; rather the Dutch farmers' organization (*Landbouwschap*, meanwhile renamed *Federatie van Landbouw en Tuinbouw-Organisaties Nederland* (*LTO-Nederland))* signed an agreement ("covenant") with

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59. *See id.*

60. *See id.*

61. *See* Patricia C. Matteson, *The "50% Pesticide Cuts" in Europe: A Glimpse of Our Future?*, 41 AM. ENTOMOLOGIST 210, 212 (1995).

62. *See* Schou, *supra* note 55, at 168.

63. *See id*. On average, the 1996-tax increased cost of pesticide use in Denmark by fourteen percent. *See id.*

64. *See id.*

65. *See id.*

66. *See* OSKAM ET AL., *supra* note 13, at 49. The average price increase of pesticides due to the environmental tax was five percent in 1998. *See* OSKAM ET AL., *supra* note 7, at 132.

67. *See* OSKAM ET AL., *supra* note 13, at 49.

68. *See id.*

69. *See* Matteson, *supra* note 59, at 212.

70. *See id.*

71. *See* NATUURBEHEER EN VISSERIJ, MINISTERIE VAN LANDBOUW [NATURE MANAGEMENT AND FISHERIES, MINISTRY OF AGRICULTURE], MEERJARENPLAN GEWASBESCHERMING [LONG-TERM CROP PROTECTION PLAN] 7 (1991) (plan approved by Tweede Kamer [Netherland's Lower House]).

the government in May 1993 that committed them to achieve the reduction goals,[72] specifically those for crop farming.[73] Applicator training and certification is required for all applicators and since 1996, application equipment testing is required for all equipment.[74] Since 1993, soil sterilants[75] may only be applied by prescriptions obtained from a specific government agency and can only be applied once every four years on any given plot of land (once every five years after the year 2000).[76]

From the experience in Sweden, Denmark and The Netherlands, two major observations can be made regarding policy instrument selection:

> 1. Both the Swedish and the Danish tax can be considered a financial tax to provide resources for research and extension activities instead of a tax on pollution.[77] The size of the levy was not adjusted in accordance with the environmental objective to be met. In the Netherlands, no tax was imposed at all.[78]
> 2. In each country compliance was arranged largely through a combination of two policy instruments: voluntarism, and advice and education.[79] Crop protection research and extension programs became far "more focused, goal-oriented, interdisciplinary and responsive to farmers' needs."[80]

72. *See generally* Matteson, *supra* note 59, at 216 (discussing that in the covenant, agribusiness and farmers' unions agreed to help finance and implement the Long-term Crop Protection Plan if the government would drop its plan to tax pesticides and would only restrict in the year 2000, rather than immediately ban, a large number of particularly environmentally hazardous pesticides). *See also* OSKAM ET AL., *supra* note 7, at 132.

73. *See* OSKAM ET AL., *supra* note 13, at 13.

74. *See* Matteson, *supra* note 59, at 212.

75. Soil sterilants are broad-spectrum chemicals that kill all types of soil pests and are particularly used to control soil nematodes; before the 1990s it made up approximately fifty percent of pesticide use in the Netherlands. *See* OSKAM ET AL., *supra* note 13, at 8. The high use of these nematicides was due to the intensive character of Dutch agriculture. *Id.* Note that the targeted reduction for the year 2000 of seventy percent in the use of soil sterilants in arable farming, reflects a shift to non-chemical pest control practices, particularly changes in rotation and selection of resistant cultivars. *See id.* at 23, 82. By 1995, the sale of soil sterilants had already dropped seventy-seven percent. *See* NEFYTO [DUTCH PESTICIDE INDUSTRY ASSOCIATION], LANDBOUW EN CHEMISCHE GEWASBESCHERMING IN CIJFERS, GEGEVENS OVER 1995 [FIGURES ON AGRICULTURE AND PESTICIDES 1995 DATA] 4 (1996). The latter reduction accounted for the bulk of total pesticide use reduction achieved by 1995. *See id.*

76. *See* Matteson, *supra* note 59, at 212.

77. *See id.* at 212 tbl.1.

78. *See id.* at 212 tbl.1, 216; OSKAM ET AL., *supra* note 7, at 132.

79. *See* Matteson, *supra* note 59, at 213.

80. *Id.*

B. *Strategies in Some Other Member States*

Several E.U. Member States approached the goals of more sustainable pest control by additional policies based on programs without pesticide use reduction targets; four countries will be discussed in more detail.[81]

In France, emphasis is given to the introduction of *agriculture raisonée* [good agricultural practice] and to measures to reduce the risks of using pesticides.[82]

Current governmental policy in the United Kingdom on pesticides is aimed at minimizing rather than arbitrarily reducing use and it is intended, through measures such as stringent approval procedures and research into alternative methods of farming, that a significant decrease in the use of pesticide can be achieved without the need to impose explicit reduction targets.[83] A comprehensive legal framework was established in 1985 under the Food and Environment Protection Act, formalizing the emphasis on pesticide approval.[84]

In Germany, the "[f]ocus is on restrictions on using pesticides, as well as on banning specific compounds."[85] The *Plantzenschutzgesetz* [Plant Protection Act] "was amended in 1986 to consider stricter provisions for registration" and to restrict the use of pesticides according to *gute fachliche Praxis* [good technical practice].[86] To minimize the impact on drinking water, some German states such as Baden-

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81. The discussion here can address only a few of the twelve other Member States. For a complete listing of the type of policy instruments used in each of the fifteen Member States, see A.J. OSKAM ET AL., *supra* note 7, at 28-36.

82. *See* F.M. BROUWER & S. VAN BERKUM, AGRICULTURAL ECONOMICS RESEARCH INSTITUTE, CAP AND ENVIRONMENT IN THE EUROPEAN UNION 66 (1996).

83. *See* Harry M. Lawson, *Changes in Pesticide Usage in the United Kingdom: Policies, Results, and Long-Term Implications*, 8 WEED TECH. 360, 360-61 (1994). Pesticide use in the U.K. should be limited to "the minimum necessary for the effective control of pests compatible with the protection of human health and the environment." *Id.* at 360 (quoting Anonymous, This Common Inheritance: Britain's Environmental Strategy (White Paper) (CM1200, London: HMSO, 1990)).

84. *See* Falconer, *supra* note 2, at 41. *See also* Lawson, *supra* note 83, at 360.

85. BROUWER & VAN BERKUM, *supra* note 82, at 66.

86. *Id.* The amendments include:

(a) The *Pflanzenschutz-Sachkundeverordnung* [Plant Protection Special Knowledge Ordinance] that includes regulations of the application of pesticides;

(b) The *Plantzenschutz-Awendungsverordnung* [Ordinance on the Use of Plant Protection Products] that includes regulations on the use of active ingredients;

(c) The *Änderung der Plantzenschutzmittelverordnung* [Change of the Ordinance on Pesticides] that requires compulsory testing of plant protection equipment;

(d) The *Bienenschutzverordnung* [Bee Protection Ordinance] that includes restrictions on pesticide use to protect bees;

(e) The *Wasserhaushaltgesetz* [Water Resources Management Act] that establishes zones around drinking water collection areas in which pesticide application can be restricted or forbidden.

See id.

Württemberg have taken additional steps including buying out farmers in vulnerable watersheds or purchasing filter trips along key surface water bodies.[87]

In Spain, the focus is on the adoption of integrated pest management (IPM) as a strategy for a more rational use of plant protection, implemented through the creation of the Agrupaciones de Tratamienos Integrados en Agricultura (ATRIAS) [Farmers Association for Integrated Treatments in Agriculture] that provides training to farmers, monitoring and technical advice.[88] The Spanish Ministry of Agriculture finances the efforts of ATRIAS.[89]

Table 7 summarizes the existing national initiatives for six Member States and shows that the national strategies and policies within the European Union are very diverse.[90] Moreover, within individual countries there are also large differences; for example, in Baden-Württemberg in Germany and some areas in northern Italy, organic farming and IPM receive much more attention that in other parts of these countries. [91]

C. *National Additional Policies and Reductions in Pesticide Use*

Despite the significant differences in national pesticide policies in addition to authorization programs, patterns of declining pesticides use since the early 1990s have been observed across the E.U.[92] The general reductions in sales and use can be attributed, to a greater or lesser extent, to several factors, including: (a) "the increasing availability and use of low application rate products which require smaller amounts of chemicals to control pests and diseases";[93] (b) price decease following the 1992 reform in the E.U. Common Agricultural Policy resulting in weaker farm economics, stimulating more precise application and management techniques, and resulting in compulsory and voluntary set aside programs;[94] and (c) drastic cuts in agricultural prices following E.U. accession in January 1995 (particularly Finland).[95]

Opponents of pesticide use reduction programs point to the evidence of declining pesticide use to support the argument that E.U.-level action may not be

87. *See* Philip W. Gassman, *Pesticide Fate Research Trends within a Strict Regulatory Environment: The Case of Germany*, 48 J. OF SOIL & WATER CONSERVATION 179, 180 (1993).

88. *See* OSKAM ET AL., *supra* note 7, at 271, app. VIII at 280-83 (appendix compiled by Consuelo Varela-Ortega).

89. *See* BROUWER & VAN BERKUM, *supra* note 82, at 66.

90. *See infra* Table 7.

91. *See* EUROPEAN COMM'N, *supra* note 1, at § 3.8; *infra* Table 7.

92. *See* Green & Mumford, *supra* note 53, at 60; Noé et al., *supra* note 18, at 24.

93. Green & Mumford, *supra* note 53, at 61. Many of these products incorporate only the active isomers of the a.i.'s and are more biologically active, and it "therefore follows that a reduction in the amount of pesticide applied does not necessarily imply a reduction in the chemical's toxic effects on the environment or human health." *Id.* at 60.

94. *See id.* at 61.

95. *See* OSKAM ET AL., *supra* note 7, at 4.

necessary.[96] However, econometric analysis of pesticide sales data (a.i.) for the fourteen Member States[97] over the period 1983-1996 estimated a reduction plan to give a significant annual reduction of 3.9 percent *in addition* to a significant general negative trend of two percent per year.[98] These empirical results suggest that the pesticide use reduction plans of Sweden, Denmark, Finland,[99] and the Netherlands *had* an important effect on pesticide use in the period analyzed.[100]

V. CURRENT LEGAL INSTITUTIONS IN THE E.U.

Figure 1 orders the existing E.U. legislation according to the production chain for pesticides.[101] The overview illustrates that the existing policy has been developed mainly in the form of Directives.[102] By far the most important is the recent Directive 91/414 which harmonizes the registration procedure, sale, and use of pesticides at the E.U. level.[103] The target set for introduction of Directive 91/414 is the year 2003.[104]

As discussed above, "environmental criteria and standards vary considerably among E.U. Member States, which results in an unfair competition between farmers in the E.U."[105] Directive 91/414 obliges Member States to prohibit the placing on the market and use of pesticides in their territory unless the pesticide has been authorized in accordance with the Directive's provisions.[106] Important elements of Directive 91/414 are the "uniform principles," which include criteria and standards according to which Member States should decide on the authorization of specific

96. *See* EUROPEAN COMM'N, *supra* note 1, at § 2.1.

97. *See* OSKAM ET AL., *supra* note 7, at 243, app. III at 246 (tbl.III.2). Luxembourg was excluded because of a lack of time series observations for this country. *See id.*

98. *See id.* at 245 (emphasis added).

99. *See id.* at 61.

100. *See* OSKAM ET AL., *supra* note 13, at 18-19 (emphasis added). The large reduction in the use of soil sterilants (included among the insecticide in the econometric analysis) in the Netherlands had a large effect on the estimation results; still it can be argued that the change in legislation regarding the use of soil fumigation resulted from the whole process of the pesticide use reduction plan. *See id.* at 17-19; OSKAM ET AL., *supra* note 7, at 243, app. III at 246 (tbl.III.2).

101. *See infra* Figure 1.

102. *See* Council Directive 91/414, preamble, 1991 O.J. (L 230) 1, 2. The difference between an EU "Directive" and a "Regulation" is that a Regulation has the direct force of law in each Member State, whereas a Directive requires each Member State to amend its laws as needed to conform its terms. *See id.* at 2.

103. *See id.* at 1 (concerning the placing of plant protection products on the market).

104. *See* EUROPEAN COMM'N, *supra* note 1, at § 4.3.7.1. Given the lack of progress in the Annex I listing of common active substances, which will be discussed later, it is unlikely that the target of 2003 that was set in 1991 will be met. *See* OSKAM ET AL., *supra* note 7, at 47-50; discussion *infra* Parts V-VI. Directive 91/414 mandated the review of some 800 active substances currently on the EU market and it may well be fifteen to twenty years before the full impact of this Directive can be assessed. *See* EUROPEAN COMM'N, *supra* note 1, at § 2.7.

105. Reus et al., *supra* note 1, at 74.

106. *See* Council Directive 91/414, art. 1(1), 1991 O.J. (L 230) 2.

pesticides,[107] and a common positive list of active substances.[108] If a pesticide is authorized in one Member State, other Member States must authorize that product as well, to the extent that the agricultural, plant health and environmental conditions are comparable.[109] Individual Member States wishing to establish special controls over a pesticide deemed to pose a national or local risk will face the burden of having to establish non-comparability of conditions.[110] The loss of flexibility in this area may increase pesticide-related risks in those countries that had previously pursued aggressive re-registration programs to eliminate high-risk products.[111]

The question however, is whether the harmonization through Directive 91/414 is sufficient for sustainable crop protection in the E.U. This type of regulation is likely to have only limited affect on the quantity of pesticides applied although it ensures a process by which pesticide risks are reduced.[112] There are several reasons why an additional policy[113] is necessary:

- Present pesticide risk assessment procedures cannot guarantee adequate protection of human health and the environment, as knowledge of pesticide fate and behavior shows essential gaps (*e.g.*, dispersal of pesticide through air, effects of combined exposure, effects of chronic exposure to low concentration);
- the criteria and standards laid down in the uniform principles are a political compromise, which means there is a risk that countries that already have strict admission policy will have to allow pesticides on the market that were previously banned before;
- in the long term it is questionable whether crop protection which relies heavily on pesticides is sustainable, even when pesticides meet high environmental standards; the number of pesticides available will diminish because of stricter standards, development of resistance and market developments [ ];
- [Notwithstanding the issue of Directive 91/414's adequacy as a risk reduction measure] as a result, farmers will have to find ways to reduce the dependence on pesticides.[114]

Greater precautionary control and application of the principle of source reduction is a firm part of the E.U. political agenda and a significant reduction in

107. *See id.* art. 4(1), 1991 O.J. (L 230) at 4.

108. *See id.* art. 5(1), 1991 O.J. (L 230) at 6.

109. *See id.* art. 10, 1991 (L 230) at 8, 9. Directive 91/414 requests mutual recognition of tests and analyses submitted by industry and of authorizations delivered by Member States. *See id.*

110. *See* EUROPEAN COMM'N, *supra* note 1, at § 2.7.

111. *See id.*

112. *See* Green & Mumford, *supra* note 51, at 65.

113. *See* OSKAM ET AL., *supra* note 7, at 1. "An 'additional policy' at EU level is defined as 'additional to the current EU regulatory framework and in particular to Directive 91/414's authorization policy.'" *Id.*

114. Reus et al., *supra* note 1, at 75.

pesticide use per unit of land is required under the FEAP.[115] One of the key questions is whether an additional E.U. pesticide policy should be developed and implemented at the E.U. level or should be left to individual Member States. There are several reasons to argue for a comprehensive crop protection policy at the Community level:

- The FEAP stresses the importance of integration of environmental policy into the definition and implementation of other Community policies. Agricultural polic[ies] (including the registration of pesticides) are to a large extent determined at the EU level. . . . As the use of pesticides and control of their harmful effects are closely linked with these policies, it seems logical to develop a comprehensive pesticide policy of the EU level as well;
- An EU policy guarantees a more fair competition between farmers. As a result the agricultural sector may be more supportive of pesticide policy measures;
- Environmental effects of pesticides often transcend national borders, which calls for an international response;
- Certain policy instruments, *e.g*. financial instruments, can be implemented most effectively at the EU level.[116]

On the other hand, in view of the subsidiary principle, the E.U. "shall take action only if and insofar as the objectives of the proposed action cannot be sufficiently achieved by the Member States and can therefore, by reason of the scale or effect of the proposed action, be better achieved by the Community."[117] Besides, there is also considerable diversity in agricultural and environmental conditions within the E.U. that may require tailor-made policies.[118] This suggests a strategy by which "on the E.U. level general objectives [are] defined and a legal framework is created, while at the level of Member States these objectives are translated into national and regional action plans, including specific objectives, indicators to evaluate objectives, quantitative targets, [and an] appropriate mix of policy instruments."[119]

To address a broader set of instruments, the E.U. has funded considerable research effort.[120] In the main research report on an additional E.U. pesticide policy, thirty-one potential instruments are grouped according to their policy characteristics:

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115. *See, e.g.*, Council Directive 91/414, 1980 O.J. (L 229) 11 (relating to water quality).

116. Reus et al., *supra* note 1, at 77.

117. Theodor Schilling, *Subsidiary as a Rule and a Principle, or: Taking Subsidiary Seriously* (visited Feb. 3 2000) <http://www.law.harvard.edu/programs/JeanMonnet/papers/95/9510ind.html> (citing ECT, art. 3b(2)). The concept of subsidiary was introduced in 1987 into the then EEC Treaty in the context of environmental policy by the Single European Act. *See* 1987 O.J. (L 169) 1.

118. *See* Reus et al., *supra* note 1, at 77.

119. *Id.* at 78.

120. *See* OSKAM ET AL., *supra* note 7, at 4; EUROPEAN COMM'N, *supra* note 1, at § 1.1.

1. mandatory regulation [currently the most important instrument used by Member States in the are of pesticide use reduction];
2. information, persuasion and awareness;
3. covenants/arrangements between industry/government;
4. technological and institutional change;
5. economic incentives [where the government is the main initiator]; and
6. private law instruments.[121]

Each of the thirty-one policy instruments was evaluated against six criteria: (1) effectiveness as to the degree to which predetermined objectives can be achieved through the use of the instrument; (2) economic efficiency; (3) acceptability to those playing an important role in targeting policies; (4) enforceability, as to the legal basis and also the costs of monitoring required to detect non-compliance; (5) institutional homogeneity as to the compatibility with the policy principles in other governmental programs and the existing E.U. regulatory framework; and (6) property rights and income levels.[122]

The report defines three layers of additional policy instruments, which are in a decreasing order economically efficient and environmentally effective.[123] Each layer consists of a mix of instruments, which can be operated at different levels (federal, national, regional).[124] The first layer, that is the most attractive mix of additional policy instruments, is found to consist of the following elements:

1. Speeding up the review program of Directive 91/414;
2. Encouraging use/risk reduction plans;
3. Starting a program on resistant and sensitive cultivars at EU-level and at national/regional level;
4. Recognition of Integrated Farming/IPM-initiatives;
5. Stimulating test programs in relation to application technology; and
6. Effectuating a uniform high value added tax (VAT) for pesticides. [125]

These instruments would be directed mainly at the national and regional level, except for the speeding up of the review process.[126]

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121. *See* OSKAM ET AL., *supra* note 7, at 7-15.
122. *See id.* at 43-44, 168-74.
123. *See id.* at 179, 197.
124. *See id.* at 197.
125. *See id.* at 200.
126. *See id.* at 186.

A second layer of policy instruments would be required if targeted use reductions go about twenty to thirty percent.[127] The most important role for the E.U. in this layer would be to define a pesticide tax (in addition to the VAT on pesticides) and exploring the options of a covenant with the pesticide industry.[128]

VI. SUMMARY AND CONCLUSIONS

The overview in this paper makes it clear that application levels of pesticides in the E.U. are region specific and very dependent on crops and cropping systems that are also related to soil and climate. Three different parameters of pesticide use should be noted: the intensity of use (measured by means of kilogram active ingredient per ha),[129] the efficiency of use (measured mostly by means of kg a.i. per unit of crop output),[130] and the relative cost of pesticide use (ratio between costs of pesticide use and total costs of production).[131] There are large differences between the three characteristics, between and within the Member States of the E.U.

At least four different aspects are relevant in analyzing risks of pesticide use: (1) risk of yield loss due to pest weeds and diseases; (2) risk to workers' health; (3) risk related to pesticide residues in food; and (4) risk of emission of pesticides into the environment.[132] At the E.U. level and in the individual Member States, attention is focused on the control of the latter type of risk.[133] The emission into groundwater in relation with the quality of drinking water is given particular attention.[134]

Very diverse national policies have been implemented since the mid 1980s in addition to the common authorization programs.[135] Sweden, Finland, and Denmark are concentrating on reducing volume of pesticide use, the number of treatments in addition to a reduction in the number of authorized pesticides.[136] Germany works more along the lines of a stricter authorization process; The Netherlands focuses on volume, impact on the environment, and pesticide dependency reduction and some countries like Greece, Portugal and Spain are just starting to realize the impact of pesticide use for the environment.[137]

E.U. pesticide policy has a base in Directive 91/414 that harmonizes the registration procedure of pesticides.[138] However, it is felt that Directive 91/414 alone is insufficient to meet the goal of an E.U. pesticide policy particularly as it concerns

127. *See id.* at 200.
128. *See id.* at 187, 200.
129. *See* EUROPEAN COMM'N, *supra* note 1, at § 3.1.
130. *See id.*
131. *See* Brouwer & Hellegers, *supra* note 22, at 80.
132. *See* OSKAM ET AL., *supra* note 7, at 21.
133. *See* discussion *supra* Part IV.
134. *See* discussion *supra* Part IV.
135. *See* discussion *supra* Part IV.
136. *See* EUROPEAN COMM'N, *supra* note 1, at § 3.8.
137. *See id.*
138. *See* discussion *supra* Part V.

the standards set by the Drinking Water Directive.[139] The key question currently under consideration at the E.U. level is how to realize the reduction in pesticide use per unit of land as required under the FEAP.[140]

An observable trend in E.U. lawmaking is to set criteria and targets for Member State action, but leave how to determine the optimal means for achieving the common goals at the national level to each country.[141] In line with this subsidiary principle, the mix of policy instruments that has been identified as most attractive includes only one instrument that would require action at the E.U. level, namely the speeding up of the review process of active ingredients as part of the implementation of Directive 91/414.[142] Instruments to be implemented at the national/regional level include: the introduction of use/risk reduction plans; programs on resistant and sensitive cultivars; recognition of Integrated Farming/IPM-initiatives; test programs in relation to application technology; and effectuating a uniform high VAT for pesticides.[143]

Table 1: Regional Market Share of Pesticide Use by Percentage in 1991[144]

Product Group	United States	Western Europe	Eastern Europe	Latin America	Asia	Others	World Total
Herbicides	34	30	6	8	15	7	100
Insecticides	18	20	8	9	31	14	100
Fungicides	9	48	5	6	28	4	100
Total Share by Region	**20**	**33**	**6**	**8**	**25**	**8**	**100**

139. *See* discussion *supra* Part V.
140. *See* discussion *supra* Part V.
141. *See id.* at §§ 2.1-2.3.
142. *See* OSKAM ET AL., *supra* note 7, at 187.
143. *See id.* at 189.

Table 2: Overview of [pesticide] use characteristics in the Member States of the European Union in 1993-1995[145]

Country	Arable and hort. area incl. set aside (1000 ha)	Average Crop value 1992-1994 (million ECU)	Average Sales of [Pesticides] 1993-1995 (tons AI)	Sales of [Pesticides] (kg AI) per ha	Sales of [Pesticides] (kg AI) per 1000 ECU crop production
Austria	918	1,481	3,669	4.0	2.48
Belgium	747	2,600	10,282	13.8	3.95
Denmark	2,460	1,921	4,277	1.7	2.23
Finland	999	1,516	11,80	1.2	0.78
France	15,865	22,061	88,492	5.6	4.01
Germany	11,359	12,283	29,350	2.6	2.39
Greece	2,111	5,914	9,260	4.4	1.57
Ireland	155	532	2,523	16.3	4.74
Italy	8,464	20,969	78,394	9.3	3.74
Luxembourg	58	38	253	4.4	6.72
Netherlands	839	7,224	11,284	13.5	1.56
Portugal	1,578	1,362	9,426	6.0	6.92
Spain	12,888	13,099	29,501	2.3	2.25
Sweden	1,394	739	1,621	1.2	2.19
U.K.	5,186	6,722	33,240	6.4	4.95

Table 3: Use of plant protection products in the Netherlands, by farming type (kg of active ingredients/ha) and the intensity of total use (costs of pesticides as percentage of total production costs), 1993/94[146]

Farming Type	Insecticides	Fungicides	Herbicides	Other	Total	Intensity of Use
Arable Farms	1.8	4.1	2.7	7.8	16.4	7.2
Grazing Livestock	0.3	0.2	0.5	0.0	1.0	0.4
Field Vegetables	1.8	5.0	2.0	9.1	17.9	2.9
Greenhouse Vegetables	5.1	12.8	0.8	13.0	31.7	1.5
Greenhouse Floriculture	10.9	18.5	1.3	27.5	58.2	1.4
Mushrooms	7.8	5.8	1.7	90.2	104.8	0.5
Orchard	2.4	24.1	3.5	3.3	33.2	3.9
Tree Nursery	2.2	7.1	2.5	10.2	22.0	1.6

Table 4: Drinking Water Contamination from Pesticides in the E.U., 1995[147]

Country	Total Delivery million m^3	Of which groundwater (%)	Proportion > 0.1µg/l total (%)	Proportion > 0.1µg/l groundwater (%)	Proportion > 0.1µg/l surface water (%)
Austria	450	49	7	15	0
Denmark	348	99	5	5	N/A
France	6,080	62	48	40	60
Germany	6,052	64	15	15	15
Greece	950	68	12	N/A	50
Italy	8,465	48	31	50	50
Netherlands	1,227	69	48	25	100
U.K.	7,620	28	26	15	30

Table 5: International Results of Pesticide Residue Measurements by Percentage on Vegetables and Fruit[148]

Country	Product Group	Year	No residue	Residue < Norm	Residue > Norm
Denmark	Domestic	1994	87.8	11.7	0.5
	Imported	1994	74.7	23.0	2.3
Germany[149]	Domestic	1995	59.4	39.9	0.7
	Imported	1995	43.9	51.1	5.0
Greece	Domestic	1995	81.0	11.3	7.7
Netherlands	Domestic	1995	61.9	36.1	2.0
	Imported	1995	46.0	49.6	4.5
Spain	Domestic	1995	61.4	36.0	3.6
Sweden	Domestic	1995	90.2	9.4	0.4
	Imported	1995	55.8	38.2	6.0
U.K.	Domestic	1993	73.3	26.1	0.6
	Imported	1994	57.4	41.0	1.7
U.S.	Domestic	1994	56.2	42.5	1.3
	Imported	1994	64.6	31.3	4.1

Table 6: Quantitative Pesticide Reduction Targets in Sweden, Denmark, and the Netherlands, their Measurement and Realized Reductions

	Sweden	Denmark	The Netherlands
Baseline[150]	1981-1985	1981-1985	1984-1988
First Target Year[151]	1990	1990	1995
Reduction target relative to base line[152]	50 % in kg a.i.	25% in both kg a.i. and application frequency [154]	Targets by each of 11 sectors and 5 pesticide groups,[156] overall target[157] 35 % in kg a.i.
Realized reduction	48 % in kg a.i.[153]	18% in kg a.i., no significant reduction in application frequency [155]	45 % by 1995[158]
Second Target Year[159]	1996	1997	2000
Reduction target relative to base line[160]	75 % in kg a.i.	50 % in both kg a.i. and application frequency	Targets by each of 11 sectors and 5 pesticide groups,[163] overall target 50%[164]
Realized reduction	65% in kg a.i. by 1993[161]	47% in kg a.i. and 8% in application frequency[162]	48 % by 1997[165]
Monitoring[166]	Sales figure and farm surveys	Sales figures and survey data	Sales registration

Table 7: PPP Risk Reduction — National Initiatives[167]

National Initiatives	Denmark	Sweden	Netherlands	Germany	France	Italy
Requirement to spray only if observed need	X	X		X	X	
Re-registration program[168]	X	X	X			
Regular review of registrations		X		X		
Obligatory education/ certification of sprayers	X	X	X	X	X	
Mandatory farm-level record keeping of PPP use	X					
Approval of types of spray equipment	X		X	X		
Phase-out of harmful active substances	X	X	X	X		X
Permits for PPP use			X	X		X
Applied agriculture research program	X	X	X	X	X	X
Extension programs promoting need-based models		X	X	X	X	

Table 7 (Continued): PPP Risk Reduction — National Initiatives[169]

National Initiatives	Denmark	Sweden	Netherlands	Germany	France	Italy
Groundwater monitoring program	X		+/-	X	X	
Controls over PPP use in drinking water protection zones		X	X	X	X	
Strict limits on aerial spraying	X	X				
Tax on PPPs	X	X				
National reduction program	X	X	X			
Active research on integrated and biological farming	X	X	X	X		X
Economic support to convert to organic farming	X	X	X	X		X
Economic support for spray free zones	X			X		
Standards for maximum allowable concentrations of PPPs in environment general[170]			X			

Figure 1: Overview of Existing E.U. Legislation Related to Pesticides (Main Basic Legislative Instruments) [171]

MANUFACTURER'S PHASES	RELEVANT EUROPEAN UNION LEGISLATION
DEVELOPMENT	Directive 91/414/EEC
⇩	
PRODUCTION (including PACKING and LABELLING)	Directive 67/548/EEC Directive 74/464/EEC Directive 80/1107/EEC Directive 82/501/EEC Directive 90/394/EEC
⇩	
PLACING ON THE MARKET	
⇩ Authorization	Directive 91/414/EEC Directive 78/631/EEC
⇩ Prohibition	Directive 79/117/EEC
⇩ Export to third countries	Reg (EEC) no. 2455/92
DISTRIBUTION	
⇩	
USE	
⇩ Regulatory	Directive 91/414/EEC
⇩ Incentives to reduce use	Reg. (EEC) no. 2078/92
⇩ Eco labeling	Reg. (EEC) no. 2092/91
RESIDUES	
Treated crops	Directive 74/63/EEC Directive 76/895/EEC Directive 86/362/EEC Directive 90/642 Directive 91/414/EEC

Figure 1 (Continued): Overview of Existing E.U. Legislation Related to Pesticides (main basic legislative instruments) [172]

MANUFACTURER'S PHASES	RELEVANT EUROPEAN UNION LEGISLATION
RESIDUES (continued)	
Animal Products	Directive 86/363/EEC
Ground water	Directive 80/68/EEC
Surface water	Directive 75/440/EEC
Drinking water	Directive 80/778/EEC

144. *See* OERKE ET AL., *supra* note 17, at 55 (table modified from CountyNatWest WoodMac 1992).

145. OSKAM ET AL., *supra* note 7, at 3. To account for random effects in weather, pest patterns and prices, averages of a three-year period were used. *See id.* Besides stochastic factors, other disturbing elements influence the overall picture provided in Table 2: "(1) the share of [pesticides] used on grassland, which pushes up the data of Ireland and Luxembourg; (2) the high price level of agricultural product in Finland (and to a lesser extent Austria) which leads to a high efficiency level." *Id.* at 4. Finland and Austria only lately joined the E.U., namely in January,\ 1995.

146. Brouwer & Hellegers, *supra* note 22, at 75, 83.

147. *See* Heinz, *supra* note 39, at 336 tbl.24.1.

148. *See* Wossink et al., *supra* note 48, at 12 tbl.1.8.

149. Baden-Württemberg. *Id.*

150. Matteson, *supra* note 59, at 217; OSKAM ET AL., *supra* note 7, at 61.

151. *See id.*

152. *See* Matteson, *supra* note 59, at 217.

153. *See* OSKAM ET AL., *supra* note 13, at 50.

154. *See* Schou, *supra* note 55, at 165. Defined as the average number of label rate dosages applied annually to cultivated land, calculated from sales figures and survey data. *See id*; Matteson, *supra* note 59, at 216.

155. *See* Schou, *supra* note 55, at 167. Statistical data show a treatment frequency of 3.56 in 1990 and 2.68 in 1981-85. However, changes in treatment frequency and in pesticide use in general should be assessed over several seasons to account for stochastic impacts. *See id.* (citing Statistics Denmark, *Sales of Pesticides*, 2/1997 STATISTICS OF THE ENVIRONMENT (1997)). *See also* OSKAM ET AL., *supra* note 7, at 3.

156. *See* OSKAM ET AL., *supra* note 13, at 23.

157. *But see id.;* OSKAM ET AL., *supra* note 7, at 61.

158. *See* NEFYTO [DUTCH PESTICIDE INDUSTRY ASSOCIATION], *supra* note 71, at 4.

159. *See* OSKAM ET AL., *supra* note 7, at 61. *See also* Matteson, *supra* note 59, at 217.

160. *See* Matteson, *supra* note 55, at 217.

161. Anders Emmerman, *Programme to Reduce Pesticide Use: Education, Information and Advisory Services, in* POLICY MEASURES TO CONTROL ENVIRONMENTAL IMPACTS FROM AGRICULTURE 86 (A.J. Oskam & R.A.N. Vijftigschild eds., 1997). *See also* Olle Pettersson, *Pesticide Use in Swedish Agriculture: The Case of a 75% Reduction, in* TECHNIQUES FOR REDUCING PESTICIDE USE: ECONOMIC AND ENVIRONMENTAL BENEFITS 90 (David Pimentel ed., 1997).

162. *See* Schou, *supra* note 52, at 165.

163. *See* OSKAM ET AL., *supra* note 13, at 23.

164. *See* NATUURBEHEER EN VISSERIJ, *supra* note 67, at 6-7. Although the fifty percent reduction in total pesticide use is most frequently publicized, it is only one of a set of three The Netherlands adopted for pesticide use in the year 2000. The second unquantified target requires reduced dependence on pesticide and the third quantified target required reductions for pesticide emissions by weight of a.i. (fifty percent reduction of emission to air; seventy-five percent reduction of emissions to groundwater; ninety percent reduction of emissions to surface water). *See id.*

165. *See* NEFYTO [DUTCH PESTICIDE INDUSTRY ASSOCIATION BULLETIN], COMMUNICATIE OVER MILIEUBELASTING: INDUSTRIE ONTWIKKELT EIGEN SYSTEEM [ ] (Feb. 1998).

166. *See* Matteson, *supra* note 59, at 217.

167. EUROPEAN COMM'N, *supra* note 1, at § 2.3 tbl.1.

168. Since 1968, Germany requires all pesticides to be assessed against strict criteria at ten-year intervals. *Id.* at § 2.3 tbl.1 & n.4.

169. *Id*.

170. *See* NATUURBEHEER EN VISSERIJ, *supra* note 67, at 6-7.

171. OSKAM ET AL., *supra* note 7, at 9.

172. OSKAM ET AL., *supra* note 7, at 9.