An analysis of alternative legal instruments for the regulation of pesticides

Michael G. Faure and Jürgen G. J. Lefevere

Introduction

This chapter is a follow up to a previous paper in which a first attempt was made to address some of the institutional aspects of the European Commission Directive on drinking water. Whereas the previous paper, after a short theoretical introduction, focused mainly on the legal history of the Directive and its implementation in Italy, this chapter is devoted to the more theoretical question of what legal instruments can be used to avoid an accumulation of pesticides in drinking water. The current situation with drinking water is that the EU is using Directives to set strict quality standards to protect drinking-water supplies. Once these EU standards are set, the Member States have to implement them in their national systems. It has been shown that the current regulatory approach for pesticides is not functioning satisfactorily. The research by the ecotoxicology group has demonstrated that the current Italian approach of a ban on one pesticide (i.e. atrazine) is inefficient since it does not prevent an accumulation in drinking water of other pesticides. Moreover, the research has shown that the real problem with pesticides is not their toxicity, but more importantly the accumulation of potentially toxic elements in drinking water. The current regulatory approach gives the wrong incentives to pesticide manufacturers and to the users of the pesticides, the farmers. It does not lead to a reduction of toxic pesticide accumulation in drinking water.

The main research question that has therefore to be addressed in this chapter is 'what optimal legal rules should be developed in a combined European and national legal system for preventing the accumulation of pesticides and their toxic ingredients in drinking water?'

In order to answer this question we will first have to answer some other specific questions. First, we will have to establish the precise goal that we
want to reach with the rules. Once we have established that goal we will try to establish which incentives need to be given to whom; in other words, who will be subject to obligations under the regulation. Once the addressees of the regulation have been determined, the optimal differentiation of the regulation has to be examined. The question is whether a general rule suffices or whether the rule has to be differentiated according to possible location-specific circumstances that play an important role in determining the regulation. Once this level of optimal differentiation has been established the instrument of regulation has to be chosen. We will examine different instruments that can be used to regulate the use of pesticides. The conclusions of this analysis will be used to examine how these rules should be set in a combined European and national legal approach, taking into account an optimal distribution of powers, so that the subject can be regulated most effectively.

The chapter is constructed as follows. After this introduction some disadvantages of the current regulatory approach are outlined. Then we try to identify the precise aims we want to achieve with the regulation. After this we turn to some general questions on how standards should be set. These findings are then applied to some legal instruments. Subsequently, we describe the specific properties and advantages of setting rules in an EC context. The final question that is addressed is how these optimally differentiated rules should be set within a combined European and national context. Finally, a few conclusions are drawn.

**Some problems with the current regulatory approach**

The European Union Standard

Early on in the research project, all participants in the group came to the conclusion that the current regulatory approach with respect to pesticides is inefficient. This could apply to the 0.1 µg/l standard for pesticides in the drinking-water Directive, but especially to the Italian ban on atrazine. The problem with the current EC standard of 0.1 µg/l is that it is a rather restrictive interpretation of toxicological knowledge. In contrast to the EU norm, the World Health Organization uses the considerably higher limit of 2 µg/l. It has been argued that the EU standard is too strict for various reasons. Vighi and Zanin for instance argued that
in terms of real risk for the exposed human population as a consequence of the consumption of water contaminated by atrazine, it is clear that the EEC limit for individual pesticides in drinking water is very conservative and, in many cases, orders a magnitude [sic] below a demonstrable threshold value. The philosophy of this part of the EEC Directive is based on the notion that products such as pesticides (which are biocides by definition) should not be present in drinking water because this is a fundamental resource, intended for regular daily consumption.\(^5\)

The EU standard, which was basically set at the lowest amount detectable at that time\(^6\), now causes serious problems since the methods of analytical detection have improved, so that in many cases the 0.1 μg/l norm is violated although not causing a serious threat to human health. One could, however, argue that the ‘zero tolerance’ attitude of the EU takes a broader approach to the problem of drinking-water pollution than does the WHO. The philosophy of the EU is based mainly on broader principles. First, it is argued, since pesticides are toxic substances by definition, they should not be present in the natural environment at all. Secondly, the EU approach is based on the view that drinking water is an all-important human resource which human beings use intensively for a lifelong period. The possibility of high exposures therefore in the view of the EC warrants a strict approach.\(^7,8\)

The EU standard causes serious problems both for states and for water companies. States can be held liable by individuals for not, or incorrectly, transposing the European Directive into national law.\(^9\) They risk a conviction by the European Court of Justice if the water quality in their country does not meet the requirements of the Directive\(^10\) and they can be forced to pay a penalty payment for as long as the conditions of the Directive are not met.\(^11,12\) Since the Directive must also be implemented in national legislation, the water companies supplying water that does not meet the requirements of the Directive risk civil liability and their officials even risk criminal liability on the basis of national law. The effect will be that both the state and the water companies will have strong incentives to invest in treatment methods in order to meet the 0.1 μg/l EU limit and so avoid liability.\(^13\)

Although one could argue that more resources are being spent to reach the EU standard than would be efficient, one could defend the EU approach even if the attainment of a stricter standard would be more costly. Relevant in this context is, however, also how much Member States are willing to pay for clean drinking water, which is of course dependent on their varying preferences.
The Italian approach

At first sight the Italian approach to the pesticide problem, i.e. the ban on one compound (atrazine), looks effective and cheap to enforce. In practice, however, it clearly raises several problems. It is a very harsh, uniform rule that does not take local differences into account in any way. A ban on atrazine might be useful in one region of the country, where products are grown that need a lot of pesticides and where the hydrogeological situation will lead to a high accumulation of pesticides. The simulation model constructed by Zanin et al.\textsuperscript{14} shows that, in areas with permeable soils, under rainy weather conditions even small amounts of atrazine have a significant effect on the levels reached in drinking water. In other, drier regions, with less permeable soils, a ban on atrazine might not be necessary at all. In those regions the agronomic benefits of the use of atrazine might largely outweigh possible disadvantages for the pollution of the drinking water. By introducing such a general ban on atrazine, including in those regions where its use would be harmless to the water consumer and beneficial for the farmer, Italian farmers are put in a disadvantageous competitive position compared to farmers in countries where a (restricted) use of atrazine is still allowed. Furthermore restrictions on the import of atrazine might cause market distortions within the EU.\textsuperscript{15}

Generally, the ban on one compound is ineffective if it can easily be replaced by substitutes that also accumulate in drinking water. Farmers will shift to other pesticides for the protection of their crops,\textsuperscript{16} which will then need new legislation to ban or regulate their use. If this is not done, then other pesticides will be found in amounts exceeding the EU limit, which is indeed the case in Italy today. Hence, the total ban on atrazine does not solve Italy’s regulatory problem of non-compliance with the EU limit. As Swanson has argued, the ban does not provide the pesticide manufacturers with incentives to produce pesticides that do not accumulate in drinking water.\textsuperscript{17}

A basic problem with the current regulation of the use of pesticides in this context is the fact that it is not the pesticide toxicity as such that is the problem, but its ability to accumulate in different compartments of the natural environment, as in the case of atrazine in drinking water. The accumulation of atrazine in drinking water depends not only on various chemical characteristics (among which the persistence of the pesticide is important) but also on the types of product grown (which influences the demand for pesticides), on the amount applied and on hydrogeological
factors. The conclusion would be, therefore, at first sight that the legal system should take all these factors into account. The question we have to address now, therefore, is whether a regulation should be uniform, or whether there can be differentiation, taking these factors into account.

**Regulating pesticides: goals and incentives**

Before discussing the general principles of standard-setting and giving some examples of regulatory instruments, the goal of pesticide regulation has to be identified; in other words, 'what is the problem that we want to solve?' The current problem is the presence of potentially dangerous substances, *in casu* atrazine, in the drinking water of the Member States. Although there is some discussion on the admissible level of atrazine in drinking water, it is generally agreed that the amount of atrazine in the drinking water should not exceed a certain limit. Therefore a general quality standard for the pollution of drinking water by pesticides should be established, either as a legal norm or as a policy objective.

As we have seen, our problem with pesticides is their accumulation in drinking water. In order to overcome the accumulation problem, the causes of this accumulation have to be found. There is no general rate of accumulation for a unit of pesticide. The accumulation rate of atrazine is dependent on several factors. Atrazine is water-soluble and therefore readily accumulates in drinking water. Because of this water solubility, weather and hydrological conditions play an important role. The accumulation of atrazine in drinking water is much higher when the pesticide is applied in wet conditions than when it is used in dry conditions. The geographical characteristics of the region of application also play an important role. Areas with permeable soils are more likely to become contaminated than areas with, for instance, clay soils. Thus, widespread drinking-water contamination by atrazine in the Po Valley in northern Italy has been caused by the infiltration of water with pesticides through very permeable soils into the underlying aquifer.

As the accumulation of atrazine is very dependent on local geographical and hydrological conditions, two factors can be identified that determine the actual pollution of the drinking water by atrazine. First, there is the actual accumulation rate of the pesticide combined with its toxic properties. Secondly, there are the geographical and hydrological conditions under which atrazine is being used. The aim of regulating the use of
pesticides in general and of atrazine in particular should therefore also be two-fold. First, incentives should be given to producers of pesticides to produce 'less polluting' alternatives for atrazine. Secondly, because research has shown that there are at present no good alternatives available to replace atrazine, the aim of regulation should be to give farmers incentives to use atrazine under the right conditions in the right quantities on the right soil. In the following sections the methods which can be used to reach these aims are examined.

**Principles of standard-setting**

In the previous section we outlined some aspects of the goal of the legislation and the incentives that this legislation would have to give to the farmers and the pesticide producers. The question now arises as to how these criteria, especially location-specific features such as the hydrogeological situation, can be taken into account in the process of regulating the use of pesticides. In the next section we address the question of what kind of legal instrument would be best to take these criteria into account. In this section, however, we first formulate a few general observations concerning standard-setting in environmental law that might be also of relevance for the pesticide problem.

**Setting the level of environmental protection**

A crucial question is how, in a public interest perspective, efficient environmental standards should be set. It is often argued that the standard should be set at the level where the marginal costs of pollution abatement are equal to the marginal benefits in reduction of environmental damage. This means that a newly developed environmental technology would only be efficient and should therefore only be incorporated into a legal standard if its marginal costs are lower or equal to the marginal benefits in additional reduction of environmental damage. In principle this can also be applied to the use of pesticides. The optimal level of care or the appropriate efficient standard would then address the type of pesticide to be applied or the amount or mix of various pesticides under specific hydrogeological conditions. To determine the optimal standard for the pesticides to be applied, one would have to take into account the benefits of the use of agronomically sophisticated pesticides with a high kill rate
of specific weeds at low costs on the one hand versus the marginal costs of the additional use of the pesticide for the environment on the other. An estimation of these costs, including the costs of subsequent additional water treatment, has been made by the economist group.24

Differentiation and optimal specificity

Obviously these marginal costs of the additional use of pesticides will depend upon the extent to which the pesticides accumulate in drinking water. As we have just indicated, the property of accumulation is dependent not only upon the type of compound used and the amount applied, but also upon local and hydrogeological conditions. The marginal costs of the use of some pesticides might therefore be relatively low in some regions where the accumulation risk is low as a consequence of the specific hydrogeological condition.

Hence, the question arises as to whether a standard for the use of pesticides should be uniform or differentiated. Generally, economists argue that, in a public interest view, standards should be differentiated not only according to region, local needs and industry type, but also according to preferences of the public. In different regions citizens might have different preferences regarding the appropriate trade-off between environmental quality and industrial production.25 The question of course arises as to what influences the choice between uniform or differentiated standards and, if differentiated standards are preferred, through what kind of legal mechanism should they be introduced and enforced.

The question of optimal specificity has received some attention in the literature on law and economics, especially in an article by Ehrlich and Posner, but also recently in the work of Ogus.26 Uniform standards are obviously cheaper to formulate and enforce. They also do not depend on individual bargaining between an administrative agency and those regulated, so that there is less risk of capturing27 of the agency28. On the other hand, it is clear that the social costs arising from an activity will differ according to location specific circumstances. Uniform standards that do not take into account these differences will therefore lead to welfare losses. Moreover, individuals in various regions might have different preferences with respect to environmental protection.

These are arguments that take into account location-specific circumstances, where possible. It is, however, also clear that one could go very far
in differentiation by taking all kinds of details into account, which would lead to highly varied environmental standards. Although the optimum in an ideal world would be to set the environmental standard exactly equal to the location-specific costs, it goes without saying that this is impossible because of the administrative costs that are incurred with a highly detailed standard-setting process and because of the information and enforcement costs that might also increase with the greater differentiation of standards. Hence, there is a trade-off between the benefits of adapting the standard to the specific social costs of an activity by introducing differentiated standards on the one hand and the increasing information, administrative and enforcement costs of such an increased differentiation on the other. The trade-off should result in an optimal specificity of standards, found at the point where the additional administrative costs of a further differentiation equal the benefits of such a differentiation. In the words of Posner, 'the question is whether the benefits of particularization outweigh the costs'.

The costs of differentiation

Let us address briefly the various costs involved in a further differentiation with respect to the pesticide accumulation problem. We mentioned above that the real social costs of the use of pesticides will vary according to their propensity to accumulate in drinking water. This accumulation problem again depends upon several factors, among which are the types of pesticides used and the amounts applied to the soil, the types of product grown on the land and the hydrogeological conditions.

What are the costs involved in taking into account some of these differences? Three types of cost can be distinguished here. Of primary importance is the information cost. This is the cost incurred in collecting the information necessary for the application and elaboration of the rule by either the standard setter or the regulated. A second type of cost is that due to administration. Once a standard has been set, a rule has been made, and this rule has to be applied. In the case of licensing, for instance, authorities will have to set up a body that gives the licenses. Apart from applying the law, the law also has to be enforced. This enforcement produces the third type of cost, enforcement. The authorities have to set up some kind of environmental police force to check compliance with the legislation by the people to whom this legislation is addressed.
The *information* cost to examine what types of pesticide are highly persistent and will certainly accumulate in drinking water and the accumulation effects in cases where mixtures of pesticides are used is at first sight enormous. For an individual farmer it would be extremely costly to acquire that kind of information. Of course, some of this information on the persistence or accumulative properties of pesticides is readily available through technical journals. If not, it is clear that information on these kinds of property can be better acquired by a government, after which the information can be passed on to the public at large. The advantage of a governmental examination is also that economies of scale advantages apply with respect to research and development costs. Once the specific properties of a pesticide have been found out, the information can be made available and the cost can be spread over a larger number of people. The same goes probably for investigations into the hydrogeological conditions of the soil. The effect that the condition of the soil has for the accumulation of pesticides in drinking water can scarcely be examined by one individual farmer. A further problem would be that if an individual farmer invested in research to examine the hydrogeological conditions of the soil and then made this information freely available, third parties could take advantage of his or her investments without making any compensating payments. The only type of information that is probably readily available is what types of product require a large amount of a certain pesticide to produce an economic yield. Farmers tend to be fully aware of what types of product do not need so much in the way of persistent weed killers or other pesticides.

If one or more of these decisive factors were to be incorporated into legislation, information costs will also be incurred with respect to administering and enforcing a certain regulation. In the next section we examine several legal instruments and ask the question 'what legal instrument would be best adapted to take into account those specific conditions that influence the accumulation problem'. An important factor in that respect is of course whether the information needed to apply a certain legal instrument can be obtained by the regulatory authority at relatively low cost. Hence, the information needed will also influence the choice of legal instruments to reach the required differentiation.

The *administrative* cost varies, of course, according to the legal instrument chosen. We discuss this point further in the next section. The same can be said for the *enforcement* cost.
Interest group aspects

Within this socio-legal framework of standard-setting and regulating the accumulation problem with respect to pesticides, one should note that the choice of legal instruments will not only be influenced by the various costs mentioned, but also by the politico-economic dimensions. Standards can of course be influenced by private interest groups. An obvious disadvantage of an over-detailed differentiation is that the potential for introducing specific private interests will increase.

An example of detailed European legislation that appears to have been influenced by private interest groups is the Directive of 22 March 1982 concerning discharges by the chlor-alkali industry. It is indeed remarkable that a separate regulation was promulgated for this specific industry. The text preceding the Directive states that the pollution by discharges of mercury into water is caused, to a large extent, by the electrolysis of alkali chlorides. It says: 'in the first instance limit values should be established for this industry and quality objectives should be laid down for the aquatic environment into which mercury is discharged by this industry'. Thus, it would undoubtedly be useful to set quality objectives for the aquatic environment and it might be necessary to set limit values as well. As far as limit values are concerned, however, the question arises as to why the EU should set these limits and in particular one can wonder why separate standards are set for one sector of industry. Another example of the increased private interest influence of detailed legislation is the titanium dioxide Directive. This Directive incorporates, in its Articles 4 and 6, a classic 'grandfather' clause. The Directive sets different standards for firms that are already in the market on the date the directive is promulgated than for newcomers to the market. Obviously the established firms can continue the use of their existing treatment plant whereas newcomers have to comply with more severe standards. One cannot therefore escape the impression that these types of specific standard-setting aim more at rent-seeking (i.e. obtaining an economic advantage) through limiting market entry than at genuine environmental concerns. If the latter were the case a separate Directive for the chlor-alkali industry would not be necessary at all in the first place.

The finding that some Directives create different standards for small branches of industry such as the chlor-alkali or the titanium dioxide industry cannot be explained as a useful means of differentiation in the public
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interest. It seems better to fit into the public choice theory that predicts that especially small, well-organised pressure groups with low organisation costs, no start-up costs and a single issue to fight for, will be successful rent seekers.\(^a\) Hence, within the choice of legal instruments one should also take into account that, preferably, a legal framework should be so designed as to minimise the risk of successful rent-seeking by lobby groups.

In the next section we apply these general observations to the choice of legal instruments by asking the question ‘what type of instrument would be best suited to prevent pesticides from accumulating in drinking water?’

Choice of instruments for environmental protection

Generally three categories of instruments for environmental protection can be distinguished. The first category consists of liability rules. By setting general rules for liability for environmental pollution, the legislator can steer control of the process of environmental pollution by, for instance, placing strict liability on the polluter, or shifting the burden of proof. The question of liability in a specific case will often be made by the judge. The second category of instruments are the market based or economic instruments. These instruments are characterised by minimal intervention by the legislator. The legislator merely sets up a framework in which the ‘invisible hand’ of the market economy will eventually lead to the right result. The third type of instrument is the command and control approach. Using these instruments the legislator intervenes directly in the polluting processes by, for example, requiring firms to have emission permits or product licenses. These three categories will be examined below.

Liability rules

In our previous paper on the institutional aspects of the European Commission drinking-water Directive we discussed the classic literature on the criteria for safety regulation, as developed by Shavell\(^b\). In this literature, the criteria for regulation are discussed, especially in comparison with liability rules. Also the information, administrative and enforcement costs are introduced as a criterion. In that respect it is argued that liability rules would be preferred if the necessary information were better obtained by private parties in an accident setting than by a regulatory agency. It seems very difficult to use the liability system to deter an accumulation of
pesticides in drinking water. As Swanson indicated in his chapter on the accumulation
type problem, a liability rule will probably not have the desired
deterrent effect since defendants might be judgement proof, or a proof of
negligence or of causation might be very difficult.35 Most literature argues
that, with respect to environmental standards, liability rules alone will not
have enough deterrent effect to reach a full internalisation of the environ-
mental harm. Moreover, empirical research by Dewees has showed that in
the USA the quality of the environment has been improved mainly as a
result of regulatory efforts, and to a lesser extent by tort law actions.36

To return to the information problem mentioned on pp. 253–4, it does
indeed seem inefficient to hold a farmer liable for pollution of drinking
water if he or she lacks information on the properties of pesticides applied
or on the hydrogeological properties of the land. That information can
better be obtained through regulatory agencies and be passed on to the
regulated farmer in regulation prescribing or prohibiting the use of certain
pesticides in specific regions. Moreover, one should not forget that the
information needed to make an efficient use of the tort system is not only
the information needed by the potential injurer (i.e. the farmer) which
should lead him or her to rational decisions concerning pesticides use, but
also information needed by the courts. In a perfect negligence liability
system, a court would balance, on the one hand, the various pesticides
the farmer could have used and, on the other, the social costs that each one of
them might have caused to decide upon the negligence of the farmer. The
information needed for a court to engage in such a detailed cost–benefit
balancing is enormous.

However, most authors argue that the tort system can still play a role in a
regulatory world, for instance to provide additional deterrence in situa-
tions where regulation fails.37 But for the accumulation of pesticides in
drinking water it is doubtful whether the tort law system can play even this
supplementary role. The information costs for judges seem simply too high
to make an adequate cost–benefit analysis to determine whether the
farmer used efficient care by applying a certain type of pesticide on a
specific product in an area with a given hydrogeological condition.

Economic instruments, the accumulation tax

Swanson mentioned that the aim of pesticide regulation should be to
provide the pesticide manufacturers with incentives to produce pesticides
that do not accumulate in drinking water. He argues that since 'prevention is better than cure' an accumulation tax should be introduced to give manufacturers the correct incentives at the stage when new chemicals are being designed.  

The introduction of such an accumulation tax could be seen as a first choice solution. Economists have indeed often advanced the imposition of a Pigouvian tax to control externalities. Although this tax approach is supposed to have many advantages over regulatory approaches, it is not yet used to a large extent in many countries. Posner gives some explanations as to why, in general, a pollution tax is so rarely introduced despite being much favoured by economists: a tax might be counterproductive in situations where the victim is the cheapest pollution avoider. This also raises questions about the accumulation tax. Although it might be very costly for the real victims (the users of the water) to reduce pollution by purifying the water, the question certainly arises as to whether the accumulation tax should be levied upon the manufacturer of the pesticide or upon the farmer who applies the pesticides. In order to reach an optimal use of the right pesticides on the right land (with the right hydrogeological conditions) it might be more logical to tax the use of the pesticide, rather than the production. Eventually one could think of taxing both the manufacturer and the user. Furthermore Posner indicates that there are billions of emissions of pollutants every year and it is very difficult to estimate the social cost of each one for the purpose of setting the correct tax rate. Also the social costs of pollutants in different parts of the country are not uniform. Since the correct tax should be equal to the marginal social cost of one pollutant, the information cost required to apply a tax schedule is very high.

These arguments that explain in general why so little is made of taxes on pollution, even though this seems a first choice solution, might also be applicable to the accumulation tax approach.

Command and control regulation

Clearly, therefore, one has to turn to a regulatory solution to take into account the accumulation problem. What are the costs involved? The administrative and enforcement costs are always higher with regulation than under a liability system. It is therefore important to look for a regulatory framework that encompasses the accumulation problem with the lowest possible costs. Four regulatory instruments are discussed here: the
prohibition of pesticides, a licensing system, a zoning system and quality standards.

Prohibition

If the propensity to accumulate in drinking water is influenced to a large extent by the type of pesticide used, a simple solution would be to regulate the types of pesticide to be used by farmers *ex ante* by prohibiting the use of certain pesticides that are most likely to accumulate in drinking water. This naïve solution seems, however, inefficient. A property of a successful pesticide is precisely its capacity to persist, so that it needs to be applied less frequently. This inevitably creates an accumulation problem as well. Moreover, by prohibiting as a general rule *ex ante* all pesticides that might accumulate in drinking water, one might also exclude pesticides with good agronomic properties, and thus inefficiencies arise. Again, it might be efficient to exclude the use of these pesticides in one region, but maybe not in another where the hydrogeological situation will not as easily cause accumulation problems. In addition, the Swanson indicated that a simple ban on a certain pesticide will create the wrong incentives for the manufacturers of pesticides. Given the problem of substitution, one would have to ban not only one pesticide but all possible pesticides that could accumulate in drinking water. Given the impracticability and inefficiencies that this might create, a more balanced approach seems warranted.

Zoning

The use of zoning is a regulatory solution that takes into account local conditions influencing the possibilities of accumulation of pesticides. Zoning is a legal instrument used in urbanisation law. It is an instrument that indicates in what part of a city or region specific activities can be undertaken or what types of construction can be built. Classic examples of zoning occur within cities where a specific area is reserved for shops, another one for apartment buildings and similar types of housing, other regions for suburban luxury houses and again other areas for industry. One could of course consider a type of zoning for pesticide use, provided that the region where the pesticides are applied is indeed a decisive criterion for the accumulation problem. If hydrogeological conditions which are crucial
for the accumulation problem can be easily recognised by an administrative agency functioning as a zoning board, the agency could indicate in what area certain pesticides could be applied. Such ease of recognition would also solve the information problem. In any event the information costs for an individual farmer to examine the hydrogeological situation of the soil on which he or she is growing products are of course much higher than the costs of an agency that can do the same research for a whole area. The administrative costs of zoning are still relatively low once the relevant geological conditions are known. In that case the zoning board would probably issue a regulation indicating that certain types of pesticide are banned in areas with a sensitive hydrogeological condition. A decree of the zoning board can be made self-executive and enforced by criminal sanctions. Of course it involves enforcement costs to control such a decree, but clearly the same problems arise with the general ban on atrazine in Italy that also has to be enforced.

The difference with the current Italian ban on one compound would be that, with zoning, a more sophisticated analysis could be made of the influence of several compounds, given the hydrogeological situation, and a board of technical experts could decide that the use of several compounds in a specific area is prohibited. This would also have the advantage that the substitution problem is solved, since the exclusion would apply not just to one pesticide but to all pesticides capable of accumulating in drinking water (provided of course that this is not true for all pesticides and that the accumulation properties of the pesticides can be easily recognised). Another advantage is that the efficiency of excluding agronomically useful pesticides is not extended to regions where the use of these pesticides would be relatively harmless. Thus, the costs of an exclusion can be limited through zoning and there should be some efficiency gain compared to the current situation in Italy.

Of course zoning creates politico-economic problems. In particular the discriminatory nature of zoning will mean that farmers in less sensitive hydrogeological areas receive a benefit since they can continue the use of the agronomically sophisticated pesticides. One could, for political reasons, consider some kind of compensation to the 'losing farmers'. However, one could argue that a farmer should always take into account the local conditions such as weather and the properties of the soil when deciding which crop to be grown. Therefore one could argue that zoning, which takes into account the accumulation problem, should in the end lead to the
correct incentives for farmers either to change their production to a type of crop that needs less or other pesticides or to relocate crops or the entire farm to areas that are less sensitive for the accumulation problem. A steady reduction in the annual compensation payments may assist this process.

Of course one could also suggest that the zoning ordinance was not aimed directly at the types of pesticide used, but at a prohibition of the cultivation of a certain product that demands an excessive use of pesticides. However, since the pesticide used is the real problem it seems better to direct a regulatory action such as a zoning ordinance towards such a use. Moreover, from a political point of view it might be very difficult to tell a farmer by regulation what type of product can be grown in a certain area. The same effect can of course be reached in an indirect way by prohibiting certain pesticides in hydrogeologically sensitive areas, which should also give the farmer an incentive either to change the product grown to products needing less pesticide or to relocate.

Of course we assume that there is a zoning board which follows a public interest-type balancing of costs and benefits to set restrictions upon land use. However, in reality zoning boards often appear to be political institutions that tend to introduce restrictions on land use in order to increase the value of the property of the people who elect the board.46 Thus, zoning will prove to be inefficient if these kinds of classic public choice effect take place.

**Quality or target standards**

Target standards are often used to translate the policy goal of environmental legislation directly into legally binding norms. As they are simply a translation of the policy goal, the information costs of target standards are generally quite low. The problem of quality standards is, however, that they are very costly to administrate and enforce upon polluters. Once the quality of, for instance, a river is below a certain level, it is very difficult to find out who is responsible for this pollution, especially when there are several polluting industries located on this river, each making a different contribution to the harmful effect. Target standards are therefore mostly not used as single regulatory instruments, but in combination with other instruments; that is, specific emission standards (licensing system) or economic instruments, where the total emissions of the granted licenses or pollution rights are subject to the maximum admissible amount laid down in the quality standard. In this context, the quality standard is therefore often generally
seen as a standard that is legally binding upon the agency that sets the more specific standards rather than upon the polluters themselves.

\textit{Licensing}

Finally the regulation could go one step further, in the direction of an individual licensing system. In that case either one would incorporate the relevant criteria for the accumulation problem into an already existing environment or other permit that a farmer needs to have or one would introduce a new licensing system. The advantage of the system is that it allows as much differentiation as one wants. A well-informed agency could set the standard for the pesticide to be applied, taking into account all the relevant location-specific criteria. In principle such a detailed and differentiated system could be efficient. Of course it could also go so far as to regulate in detail, for instance, what kinds of product a farmer could grow, but this seems politically infeasible. The administrative costs of an over-detailed regulation might also be too high. Of course, there is a problem of information costs. Will a local agency have all the necessary information to decide what the optimal mix of pesticides to be applied is, taking into account all the technical criteria such as the hydrogeological situation? This might still be relatively easy to determine for a larger area by, for instance, a board of experts in a zoning system, but can be relatively difficult to determine for local administrative agencies that have to issue the licenses. In that respect one could combine a zoning system with licensing, whereby the licensing administrative agency is bound by the zoning decree. But then of course what are the additional benefits of licensing? Unless one really wants to regulate in so much detail that the administrative agency has to build into the license the exact types of pesticide and amounts to be applied (of which the administrative and enforcement costs are of course enormous) the advantages of a licensing system compared to zoning seem to be limited.

Moreover, the disadvantages of licensing are well known. A detailed system of licensing is very costly to administer and the risks are high that private interests will again play an important role in the licensing system. Hence, the licensing system might result in large differences between the situation of individual farmers that cannot be explained on public interest grounds, but are probably the result of successful lobbying with the licensing administrative agency. Also the public choice literature has pointed to the market distortive effects of licensing.\textsuperscript{66}
Summary

One can point to various instruments that could control the use of pesticides so as to reduce their accumulation in drinking water. Of course the mechanism which is finally chosen will depend upon the technical criteria that influence the accumulation problem. These may be difficult to ascertain or the information costs used to include them in the regulation may be enormous. It is these information costs which will often be crucial in the choice of instruments. For that reason it was stated that liability rules alone will not suffice to control the accumulation problem. Neither the parties in a liability setting (i.e. the farmer), nor the judge who has to fix the due care standard can be expected to have accurate information on the true social costs of pesticide use. The problem of using an accumulation tax is that the aim of the tax should be to give farmers incentives to use the right pesticide in the right quantity on a specific type of land and under specific conditions. Therefore it should be the farmer who should be taxed for the incorrect use of the pesticide and not the producer who should be taxed for the production of a certain type of pesticide. The information and enforcement costs required to apply such a tax schedule are very high. Therefore some regulatory intervention seems warranted. A simple ban will again not suffice, since, on the one hand, it neglects the substitution problem and, on the other, creates inefficiencies by prohibiting pesticides in areas where their use might be relatively harmless. A more balanced approach might be found in zoning regulations, provided that areas can be distinguished where pesticide use would lead less quickly to accumulation in drinking water than in other areas. A system of individual licensing would go too far. The additional benefits compared to a zoning system are minor and the disadvantages both with respect to administrative costs and with respect to the risks of subverting the agency are large. Hence, the accumulation problem might be best controlled through zoning regulation. Of course all this depends on the question of whether the location is indeed a decisive criterion for the accumulation problem. Moreover, liability rules should always play an additional role as a 'catch all' legal instrument that can still lead to some marginal deterrence of wrongful behaviour.

Standard-setting in a European context

Before designing a system for the regulation of pesticides we should look first at the characteristics of the regulatory framework in which this
regulatory system should be constructed. The EU context has two major
characteristics: the fact that an extra level of regulation is established, and
the fact that this regulation can be enforced upon the lower levels of
government.

Regulation of the EU level

The EU adds an extra layer of government to the already existing hierarchi-
cal structures of the Member States. As an approximation one can say,
therefore, that the basic governmental structure of Member States of the
EU comprises first a European level, second a Member State level, third a
regional level and fourth a municipal level. Each level of government has
its own competencies. The EU can regulate in the field of the environment
as long as it takes into account the principle of subsidiarity, which states
that:

In areas which do not fall within its exclusive competence (such as the
environment), the Community shall take action, in accordance with the
principle of subsidiarity, only if and in so far as the objectives of the
proposed action cannot be sufficiently achieved by the Member States
and can therefore, by reason of the scale or the effects of the proposed
action, be better achieved by the Community.

Any action by the Community shall not go beyond what is necessary to
achieve the objectives of this Treaty.

The principle of subsidiarity, as laid down in Article 3B of the EC Treaty, is a
general guideline for the action of the EU *inter alia*, in the field of the
environment. It comprises two tests. First, it formally introduces an
*efficiency test* into the EC Treaty. Matters that can be dealt with better at the
EU level should be regulated by the EU; matters that are better dealt with by
the Member States should be left to their competence. Secondly, it com-
prises the *principle of proportionality*. This principle adds to the efficiency
consideration that matters which are dealt with at a European level should
not regulate more than is strictly necessary. The efficiency and proportion-
ality tests in Article 3B, if correctly used, allow for an optimal differentiation
of rules with an effective distribution of competencies between the EU and
the Member States.

Once the EU has adopted legislation, this legislation is binding on the
national authorities, the 'lower' levels of government. As soon as a certain
field or subject is harmonised, Member States lose their competence to
legislate in this field, which is then an exclusive field of Community policy.\textsuperscript{46} The remaining competence for the other layers of 'European government' in this field is the discretion that is left to the government of the Member State to implement, or transpose, the European standards into national legislation. In the case of standards for drinking water, the EU has set clear binding standards by adopting a directive which the Member States have to implement into their national legal system. A margin of discretion is, however, allowed in that 'a directive is binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods' (Article 189 EC). The discretion of the Member States is therefore in choosing the way of enforcing these standards, and putting them into actual legislation, which, in the case of atrazine, Italy did by completely banning its use.\textsuperscript{49}

Enforcement of EU legislation upon Member States

The second characteristic of the unique relation between the EU level of government and the Member States is the growing possibility of the enforcement of compliance of the European environmental standards on Member States by the EU and individuals. Individuals or environmental groups can file a complaint with the Commission in the case of poor or non-compliance by a Member State. The Commission can subsequently decide to bring infringement proceedings in the European Court of Justice under Article 169 EC.\textsuperscript{50} Until recently the enforcement of the implementation of directives was mainly aimed at the formal (i.e. the text of the national legislation was in conformity with the text of the EU Directive) compliance of the Member States. The problem was however that most Member States formally complied with the Directives, but in practice did not enforce\textsuperscript{51} and apply them (practical implementation).\textsuperscript{52} The attitude of the Commission has, however, changed importantly. The Commission is increasingly initiating proceedings on the basis of Article 169 EC against Member States that in practice do not comply with European environmental Directives. Recent examples of this are the case of the drinking water in Verviers\textsuperscript{53} and the case of the bathing waters at Blackpool and Southport.\textsuperscript{54} In the case of Verviers the Commission initiated 169 proceedings, and the ECJ convicted the Belgian government because the quality of the drinking water in Verviers did not comply with the quality standards as laid down in Directive 75/440/EEC on the quality of drinking water.
Until recently neither the ECJ nor the Commission had the power to enforce the compliance with the judgment of the ECJ. However, since the entry into force of the Maastricht Treaty, a new Article 171 has been introduced in the EC Treaty, stating that:

- If the Member State concerned fails to take the necessary measures to comply with the Court's judgement within the time limit laid down by the Commission, the latter may bring the case before the Court of Justice. In doing so it shall specify the amount of the lump sum or penalty payment to be paid by the Member State concerned which it considers appropriate in the circumstances.
- If the Court of Justice finds that the Member State concerned has not complied with its judgement it may impose a lump sum or penalty payment on it.

Furthermore the ECJ, in its decision in Francovich, opened the possibility for individuals (or even environmental groups?) to hold Member States liable in national courts for the damage suffered as a result of the Member State's failure to implement the directive. In order for damages to be received, first the Directive has to grant rights to individuals, secondly it should be able to identify the content of those rights on the basis of the provisions of the directive, and thirdly there has to exist a causal link between the breach of the State's obligation to implement the EU norm and the loss and damage suffered by the injured parties.

Summary

The European context adds an extra European regulatory level to the already existing national levels of environmental legislation. This extra level makes it possible to establish within the context of the subsidiarity principle, general quality goals of European environmental standards. In addition, the new Article 171 and the rules for state liability under Francovich open up important new possibilities to enforcing the compliance of Member States with these standards of European environmental legislation. The existence of European standards, combined with the extra 'European enforcement' makes national compliance with environmental standards more likely. In developing a regulatory framework for the prevention of the accumulation of pesticides in drinking water, these characteristics of the European context have to be taken into account.
Proposal for pesticide regulation in a European–national context

We have already given a description of the possible instruments for regulating pesticides. However, as we said before, the actual usefulness and effectiveness of a regulatory instrument also depends on the context in which it is used and the enforcement methods available. The question is therefore how, using the instruments we have examined before, the use of pesticides should be regulated in a specific EU context, taking into account the optimal differentiation of standards.

The European Union standards

We have already described some of the economic principles of standard-setting and we have indicated that as far as possible an optimal specificity of standards should be achieved, which means that differentiated standards, taking into account location-specific criteria, should be applied where possible. This poses some serious questions with respect to environmental policy within the EU. Taking into account the economic criteria for standard-setting one could argue that location-specific criteria should be taken into account and that therefore environmental standards should not be the same throughout the whole EU. The efficient standard might be relatively high in the industrial areas of the EU with a high population density and a consequent heavy load of environmental pollution, but might be more lenient in areas where the natural cleansing capacity of the environment can still absorb a certain amount of pollution. Indeed, the requirements on disposal of industrial waste-water can certainly be different for instance in the city of Antwerp than in a non-industrial area somewhere else in Europe. Obviously one has to take into account that the marginal benefit of investment in highly sophisticated environmental technology is relatively high in existing heavily polluted areas. Pollution abatement in non-industrial areas might well be possible with relatively modest technological equipment, given the much higher biodegradability of pollution in unpolluted areas. Requiring more stringent standards in Antwerp than in these other areas would therefore be efficient, since the marginal social costs of pollution differ. Requiring more stringent standards in the non-polluted, non-industrial areas or for instance the same standard as in Antwerp might even be inefficient, since
it neglects a possible higher natural capacity for self-purification in the environment.

The question therefore is 'which instrument can be best used that takes into account these regional differences?' As mentioned above, the philosophy of the EU is that products such as pesticides should not be present in drinking water, as this is a fundamental resource, intended for regular daily consumption. It is therefore generally agreed that there should not be more than a specific amount of pesticides in the drinking water. The logical solution therefore seems to be to impose a general quality standard for drinking water on the Member States. This standard, however, has to be set at a level which is assumed not to cause danger to the environment and human health. At the moment the EU has already adopted this approach for the general protection of the drinking water. More stringent standards that were set in the past when compliance with Directives was to all intents and purposes optional should be revised when they are shown to be clearly inefficient.

Member States, however, have to comply with the quality standards as set. As we have seen before, the means of enforcement for both the Commission and individuals of the EU standards on Member States have increased significantly only in the last few years. At the moment only a few cases are known of the enforcement by the Commission of practical compliance with quality standards on Member States via an Article 169 procedure and of individuals using the Francovich construction. However, as these enforcement procedures are developing rapidly, much will be expected from them in the future.

As regards the incentives that have to be given to the producers of pesticides, it seems effective to formulate these rules on a European level, in order not to distort the free trade in pesticides. First, it should be decided, at the European level, which pesticides are under no circumstances safe to use because of their consequences for the environment and human health. Secondly, producers should be given incentives generally to develop and produce 'friendlier' pesticides, or alternative methods of crop protection. This could be done by a kind of community-wide tax system. Indeed, a location-specific tax as applied to the producer would run counter to the idea of the free movement of goods, since it would imply that products are marketed at different prices in various regions because of the different accumulation tax. Location-specific circumstances could, however, be taken into account in setting the national standards.
The national standards

As we have already seen, a simple ban on the use of a pesticide is not alone sufficient to achieve the aim of giving farmers the incentive to use pesticides under the right conditions. The regulation of the pesticides therefore needs to be differentiated according to the circumstances under which these pesticides can best be used. The properties of atrazine require regulation that takes into account the hydrological and geological conditions of the area.

As Vighi and Zanin have shown, areas can be separated into four types in terms of the vulnerability of their aquifers:

(1) Areas where herbicides could be used without particular restrictions.
(2) Areas where 'leaching' herbicides could be used only in exceptional cases, and with a restriction on the amount used.
(3) Areas where only 'non-leaching' herbicides can be used and with some control of the amount used.
(4) Areas where the use of herbicides (and perhaps all pesticides) should be completely forbidden because of the vulnerability of the aquifers and their strategic value as drinking-water supplies.

To make this classification, Vighi and Zanin composed a list of necessary information, which includes *inter alia* the permeability of surface soils, the hydrogeological structure of the area, the herbicides used and their characteristics and the distribution of the crop types. Although the information is not yet complete for all areas, *ad hoc* studies fill the gaps.

Using this classification of four types of vulnerability, zones can be established in which different rules for the use of pesticides may be imposed. A general regulation would be enough to set standards for the use of specific pesticides in each type of zone. The administrative and enforcement costs of such a system would be minimal. Every time a new pesticide is put on the market research has to be done on the polluting, accumulative properties of this pesticide. Once the pesticide is included in the regulation, enforcement authorities would have to take regular soil and drinking-water samples in order to determine the compliance. High penalties for non-compliance would have to be set to support the enforcement aspects of the regulatory system.

The influence of the likely public choice effects on the decisions concerning the designation of the zones and the admissibility of pesticides in
these zones will be considered diminished by the enforceability of the EU quality standards on the Member States. Zoning authorities will not be able to adopt less stringent standards than practically possible because they might then be liable for a subsequent breach of the EU quality objectives.

As said before the use of zoning has already proved quite successful in planning law. There are, however, also some examples of types of zoning in environmental protection law. An example of this is the Dutch 'Besluit gebruik dierlijke meststoffen' (Regulation on the use of animal fertilisers). This regulation specifies which quantities of animal fertilisers can be used on which types of soil and the periods in which the use of fertilisers is allowed. The regulation proves that zoning might be a useful instrument in pesticide regulation. Furthermore, using the instrument of zoning with fixed rules for each type of zone will not attract the considerable administrative costs incurred by giving each farmer a licence for the pesticides he or she wants to use. Also, it will allow for an optimal efficient use of pesticides, taking into account the location-specific circumstances. In the United Kingdom a parallel case exists with the control of nitrate fertilisers used in designated zones where groundwater quality can be adversely affected.

One of the advantages of a zoning system is that it can be used in combination with other types of regulatory instrument. Instead of imposing detailed standards on the use of the pesticides in the specific zones, the national authorities might choose economic instruments for giving the farmers the right incentives. An example might be putting a higher tax, under specific circumstances, on the use of more polluting pesticides. The problem might be, however, that this could entail high administrative and enforcement costs.

Another important advantage of the zoning system is that in regulating the use of pesticides with reference to the hydrogeological situation, the users of pesticides will automatically create a market for pesticides that are more fit to be used within a specific area. As the use of pesticides in a certain zone is permitted on the basis of their accumulation or pollution value, farmers will try to find pesticides which pollute less under those circumstances. An open pesticide market will automatically try to develop new products to satisfy the newly created demands. The market itself will give producers the incentive to create a broader spectrum of pesticides for specific hydrogeological conditions.
Conclusion

In this chapter we have tried to establish a framework for the optimal regulation of the use of pesticides, specifically atrazine, on the basis of their property of accumulating in drinking water. We concluded from a review of previous research that the current regulatory approach to the accumulation of pesticides in drinking water is not working properly, in that it only transfers the environmental problems to other areas or other types of pesticide. We found that the aim of the regulation of pesticides should be two-fold. Firstly, and most importantly, incentives should be given to producers of pesticides to produce ‘less polluting’ alternatives for atrazine. Secondly, we found that farmers should be given incentives to use certain pesticides under the right conditions.

We discussed the law and economics of standard setting and optimal differentiation in order to point out that the current system is inefficient and in order to find criteria for efficient regulatory methods. With reference to the current institutional framework of regulation and enforcement in a European and national context we tried to take the advantages of this framework into account in proposing a regulation of pesticides.

We believe that the most efficient way of regulating the use of pesticides in order to protect the drinking water is by setting different rules on two different levels. First of all, quality standards have to be set at the European level. These quality standards should be enforceable upon the Member States by both the Commission and individuals who suffer damage because the Member States do not meet the Union standards. Member States can most efficiently reach these goals by using a system of zoning of regions where pesticides are frequently used. In each type of zone rules should be set that ensure the correct use of pesticides with regard to the characteristics of the zone. The system of zoning allows for an optimal use of pesticides, leading to an acceptably low amount of accumulation in the drinking water. Of course these zoning rules have to be enforced upon the farmers by the State or regional authorities. The ‘invisible hand’ of the open market for pesticides will then automatically create incentives for pesticide producers to produce less-accumulating pesticides. This system could be supplemented by European legislation giving the producers of pesticides incentives to produce ‘cleaner’ chemicals, possibly using a tax system, making the framework of optimal regulation of the market and the use of pesticides complete.
We feel that designing and implementing a regulatory framework as described above will lead to an efficient, optimally differentiated regulation of the use of pesticides, in the context of the goal of preventing the accumulation of pesticides in drinking water.

Notes

1 This paper was made possible by financial support from the European Science Foundation, which we gratefully acknowledge.
5 Vighi and Zanin 1994, p. 112.
7 Vighi et al., Chapter 4, this volume.
8 Atrazine does indeed seem to have significant, previously unknown effects on human health, causing inter alia, breast-cancer, ENDS Report 241, February 1995.
11 The New Article 171 of the EC Treaty, introduced by the Maastricht Treaty on the EU.
12 See pp. 266–9.
15 This point concerning market distortions is further developed in Faure, 1994, pp. 77–80.
16 This has indeed happened in Italy, see Vighi and Zanin, 1994.
17 See Swanson, Chapter 9, this volume.
18 See p. 250–1: the precise level of admissible atrazine is, however, not a point of discussion here.
22 A third possibility would be to consider cleaning the polluted groundwater if it is used, for example, as drinking water. Within the scope of this paper we do not examine this further.
23 Risk neutrality is assumed here. In the case of risk aversion higher investments in environmental technology might be efficient since they can remove disutility of risk from risk-averse persons.
27 'Capturing' refers to a subversive pressure being put on the agency by the regulated.
28 See Ogus, 1994a.
33 Tollison, 1982, p. 590.
34 See Shavell, 1984; and see the discussion of this literature in Faure, 1994, pp. 42–4.
35 Swanson, Chapter 9, this volume.
36 Dewees, 1992a, b.
38 Mason, Chapter 9, this volume.
40 They are therefore not the 'cheapest cost avoider'.
43 Swanson, Chapter 9, this volume.
44 In the law and economics literature zoning is discussed as a solution to the problem of conflicting land uses (Posner, 1986, pp. 60–1) and as a response to market failure (Cooter, and Ulen, 1989, pp. 205–9). For an example of planning controls around hazardous installations see Rocard and Smets, 1982, 488–84.
46 See Moore, 1961.
47 Of course depending on the constitutional structure of a Member State there can be more levels, such as the German Bundesländer and the Spanish Comunidades Autónomas.
48 Case 22/70, Commission v. Council (Re European Road Transport Agreement), 1[971] ECR 263.
49 A clear description of the directive and its implementation measures in Italy has already been given in Faure, 1994.
Alternative legal instruments for pesticides

50 See Harlow (1992, p. 343), who gives the example of the British environmental groups using the complaint procedure to force the UK to comply with the Bathing Waters Directive.

51 The formal implementation might take place because of its symbolic value. One can often note that after a symbolic implementation no resources are allocated to monitoring and enforcement activities; compare Han, 1990, p. 35.

52 Tenth report of the Commission on the application of Community Law, COM (93) 320 Final of 28 April 1993, pp. 101–2.


54 ECJ decision of 14 July 1993, Commission v. United Kingdom, Case C-56/90, unreported.

55 Cases 689/90, Francovitch and Bonifact v. Italian Republic, ECR [1991], page i-5347.


References


