

9. Economic Instruments for Environmental Protection in Agriculture: Some Basic Problems of Implementation

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1. Economic Instruments: Foundations, Classification and Implementation

Frequently, environmental policy is perceived as a problem of choice between different policy instruments. In this context, environmental policy instruments are sometimes subdivided, as a first approximation, into three broad, sometimes overlapping categories: *regulatory instruments*, *economic instruments* and *moral suasion*.

But before addressing the application of these different instruments, a more basic choice problem has to be resolved: *first*, it has to be decided which elements of the economic sphere are to be considered as constituent parts of the economic system,¹ and hence are a precondition of the economic process.² These constituent parts are not subject to economic evaluation but are determined on the basis of fundamental principles, such as preservation of human life and dignity or – in the case of insufficient knowledge – the precautionary principle (cf., Pearce, Turner, O’Riordan, 1992). For example, in the case of highly toxic and dangerous pollutants (such as PCPs) we have good reasons to exempt those elements from any economic evaluation and to forbid them outright.³ The specification of those constituent parts of the economic system should not be regarded as part of the regulation process, but as a necessary element in the original problem formulation.

This leads to a *second* step: after the basic elements of the economic system have been properly defined – but only then – the question of the choice between different instruments of environmental policy arises in a meaningful sense.⁴ Of course, the theoretical formulation (and the practical realization) of the economic system has its implicit impact on the economic process and the evaluations taking place within this process.

As our discussion of economic instruments will make clear, we have good arguments for preferring economic instruments to regulatory ones, if the institutional and legal order is reasonably specified by excluding, *inter alia*, imminent threats

to human life or nature.⁵ But even then, in some cases (e.g., the transaction costs of implementing those economic instruments or problems of imperfect information)⁶ practical considerations can militate against the use of economic instruments, not because there is an imminent threat to human life or nature, but because the costs of applying market-oriented instruments can sometimes be higher than the benefits accruing from the choices and the decentralized evaluations generated by those economic devices.⁷ As we will see, both kinds of considerations have to be taken into account when we consider the implementation of economic instruments for environmental policy related to agriculture. Before doing that, we will look more closely into the three types of environmental policy instruments:

- (1) The traditional instruments of environmental policy are of the *regulatory* or of the *administrative type*, and they can best be described as

institutional measures aimed at directly influencing the environmental performance of polluters by regulating processes or products used, by abandoning or limiting the discharge of certain pollutants, and/or by restricting activities to certain times, areas etc., through licensing, setting of standards, zoning, etc. (Opschoor and Vos, 1989, p. 12).

Within the limits set by the regulatory instruments, utilisation of the environment is normally free of charge, whereas any transgression of the limits is considered to be a legal offence subject to judicial or administrative penalties. Therefore the polluter's room for manoeuvre is limited, and, above all, he is not directly confronted with prices for his use of the environment. In terms of comparative systems, this regime is very close to *central planning* (cf., Nutzinger, 1974, section III.2; 1988, section 3), at least as far as the utilization of the environment is concerned. Broadly speaking, the right to use environmental resources is not allocated according to each potential willingness to pay, but rather through devices of governmental *command and control*.

- (2) In contrast to the first category, instruments are labeled *economic* if

they affect estimates of costs and benefits of alternative actions open to economic agents, with the effect of influencing decision-making and behaviour in such a way that alternatives are chosen that lead to an environmentally more desirable situation than in the absence of the instrument (Opschoor and Vos, loc. cit.).

Within this broad category at least three different subdivisions have to be considered (relating to different theoretical or practical justifications):

- (1) We speak of market-oriented instruments, such as taxes, charges, certificates (including the 'bubble' and the 'offset' policy practised in the US), liability rules etc. if they try to apply the economic 'polluter pays principle (PPP)' based on environmental damage costs.⁸ In the language of welfare economics, these instruments aim at internalizing the negative externalities of production and/or consumption upon the environment.

- (2) It is also possible to impose taxes or charges on the use of exhaustible resources, such as energy taxes, which try to telescope the future shortage of these limited resources into the present time by putting a 'surcharge' (user cost) on current prices. From the perspective of future generations, who are the prospective victims of today's excessive use of those resources, these taxes can also be seen as an application of the 'polluter pays principle' in a broader sense: in this case, the *user* has to pay.
- (3) Commonly used *subsidies* are economic instruments only insofar as they influence the cost-benefit ratio of certain activities in the direction of a reduced use of the environment, but normally they cannot be regarded as an application of the 'polluter pays principle'.⁹ Their practical justification lies in their function as a 'lubricant' to facilitate desired changes in economic behavior.
- (3) A third category of instruments is *moral suasion*, whereby some political and public pressure is used in order to bring about a 'voluntary' change in the behavior of economic agents. Basically this involves the internalizing of environmental awareness and responsibility into individual decision-making by applying pressure and/or persuasion either indirectly or directly (e.g., in negotiations aimed at 'voluntary' agreements or covenants between industry and governments, on environmental issues) (Opschoor and Vos, 1989, p. 13).

The moral suasion approach has characteristics in common with both the regulatory and the economic instruments as it uses the threat of possible regulations in order to bring about 'voluntary', more flexible settlements and behavioral changes, often supported by economic incentives and disincentives.

Whereas it is correct to state that regulatory instruments – in contrast to economic ones – do not directly encompass the use of the environment in prices, this does not mean that they will not affect costs. On the contrary, in general the costs of meeting the regulatory standards will *ceteris paribus* be higher than with economic instruments, as the standards affect all producers in the same way regardless of their specific abatement cost conditions. Therefore, whenever there are cost differences among producers, a desired average level of environmental quality will be achieved with higher costs as no individual trade-offs between costs and benefits of the use of the environment are allowed under a regulatory scheme.¹⁰

As noted above, this broad theoretical classification is less clear-cut in reality and very often instruments of environmental policy may combine elements of the regulatory, economic pricing and suasion approaches. We will not go deeper into the theoretical classifications and foundations (for this, see Endres (1985) and Opschoor and Vos (1989, chapters 2 and 3)).

2. The Basic Elements of the Agricultural 'Market' in European Countries

The question of the use of economic instruments in environmental policy can only be raised properly after a prior specification of the constituent parts of the economic system. Therefore, a brief look into specificities of the agricultural 'market' is needed.

In practically all European countries, and particularly in those within the European Community, agriculture is largely exempted from the normal market mechanism.¹¹ Usually, the following three types of arguments are raised in order to justify this market-constraint policy:

- (1) Securing a stable food supply involves providing for basic human needs.
- (2) Without a specific agricultural policy, farmers' incomes cannot be stabilized at a socially acceptable level.
- (3) Agriculture does not only mean the production of food, but also implies the cultivation of landscape as a by-product.

Based on those general arguments, practical agricultural policy inside, but also outside the European Community, is generally characterized by a series of interventions and specific programs whereby agricultural prices have largely lost the function of harmonizing supply and demand, and have instead assumed the role of maintaining a socially acceptable level of farmers' incomes. This shift in the role of prices does not fit into the normal functioning of mixed market economies, and therefore it comes as no surprise that long sequences of specific measures, interventions and counter measures have had to be introduced without resolving the basic problem – the disequilibria on agricultural markets brought about by the agricultural policy of the European Community and most other OECD countries.

Guaranteeing agricultural prices in order to maintain a certain income level for farmers only makes sense if these prices are fixed above the market level; and this is exactly the case for numerous agricultural product prices within the European Community and also in non-EC countries such as Sweden, Austria and Switzerland. The consequences of this approach are obvious:

- International agricultural markets have to be protected against foreign competition via tariffs and/or import quotas.¹²
- As prices are guaranteed above the market level, there is a constant incentive for farmers to produce even more agricultural surpluses.
- These surpluses in turn absorb many financial and material resources for storage, transportation, processing for non-agricultural purposes, export subsidies, disposal as manure, etc.
- In order to limit resource misallocation related to those activities, production quotas (e.g., for milk or sugar-beets) are assigned to individual farmers,

and financial incentives for early retirement or for temporary non-use of arable land are also applied. In EC countries, for some products, such as cereals, milk and sugar, there is also an indirect taxation of production via the so-called 'joint responsibility charges'¹⁴ which in turn decrease farmers' incomes without increasing consumer demand.

- As a consequence of this intensive overproduction, there is a corresponding excess use of inputs, fertilizers and pesticides which has caused serious negative effects on the environment, especially on soil and water.

To sum up: considered from a welfare economics viewpoint, relative prices in agriculture have ceased to reflect the relevant scarcities. High guaranteed prices tell the farmers that there is a high demand for their products (whereas, in fact, more and more surpluses are generated); production quotas, 'joint responsibility charges' and incentives for early retirement as well as temporary non-use of arable land (*land set-aside programs*) indicate the contrary: that there is in fact an excess supply of agricultural goods. This system of contradictory economic incentives has been widely criticized¹⁴ and there are also attempts at explaining the 'political economy' which leads to this rather confusing situation. I do not want to go deeper into this discussion; instead I would like to focus on those characteristics of the regulated agricultural market which are relevant for the question: What kind of economic and regulatory instruments for environmental protection can be applied to the agricultural sector?

3. Applying Economic Instruments for Environmental Protection to the Agricultural Sector: A Perspective of Comparative Systems

The characteristics of the EC agricultural order belong more to the type of indirect central planning (through fixed non-market prices) than to normal market mechanisms; even some elements of direct physical planning are applied by means of a purchasing quota for some agricultural goods. The basic consequences of this situation are twofold: on the one hand, they affect the production processes in farming and, on the other hand, they influence the applicability and efficiency of economic instruments for environmental protection in agriculture:

- (1) State-guaranteed prices for agricultural goods above the market level do not only provide incentives for surplus production, they also lead to a distortion between output and input prices, thereby inducing an excessive use of capital and material inputs, such as fertilizers and pesticides;¹⁵ those inputs are relatively cheap compared with the artificially high commodity prices. This is one of the basic reasons why in most developed countries, capital and material intensive ways of farming have become dominant.¹⁶

- (2) The theoretical idea of internalizing negative externalities via a Pigouvian tax does not make much sense in a world of seriously distorted commodity prices, especially if they are fixed for the sake of income stabilization.¹⁷

While it is true that even under conditions of central price planning – be it in specific sectors, such as agriculture, or in whole economies – economic instruments can be (and have been) applied,¹⁸ they seem less suited to induce fundamental ecological improvements. The reason for this reduced efficiency of economic instruments under a regime of fixed prices, and hence in most branches of agriculture in EC and other European countries, can be briefly summarized as follows (cf., Nutzinger, 1991, p. 32):

- As centrally planned or exogenously fixed prices are largely biased and frequently inconsistent, the imposition of ‘ecological duties’ (e.g., through environmental taxes) onto these prices will be less effective than they should be because the underlying price base is already inappropriate.¹⁹
- Due to the misallocation of resources, based on distorted relative prices, there is a tendency for excessive application of material inputs, such as fertilizers and pesticides (with accompanying negative effects on air, soil, water and food).²⁰ This tendency is very difficult to counteract by means of specific input charges because the income losses generated by those taxes would provide strong incentives for further increases in state-guaranteed commodity prices which, in turn, would lead again to intensified application of pesticides and fertilizers. In order to counteract this tendency, specific compensation schemes which are not related to the (former) application of fertilizers have to be implemented.²¹
- If input and output prices are increased in the same proportion, we should not expect any significant change in agricultural output and in the use of non-labor inputs but an increase in farm income, as the costs of non-labor inputs are only a part of farmers’ gross income. Hence, farmers’ income can be held constant if the increase in input prices is higher than the increase in output prices. In this case, input use and physical output are both reduced, but the former reduction is greater than the latter. This effect will be dominant if the expenditure on a specific input is only a small fraction of farmers’ gross income. Therefore, taxation of minor inputs is probably not an effective instrument to reduce agricultural production, whereas taxation of outputs will normally not lead to important reductions in the use of fertilizer inputs.²²
- The effectiveness of economic instruments in agriculture will be further reduced by the fact that they have to be embedded in a very complex, if not confusing network of purchasing quotas, ‘joint responsibility charges’, economic incentives for temporary non-use of arable land (*land set-aside*

programs) and for early retirement of farmers, combined with a host of specific national, regional and sectoral programs.

This reduced efficiency of economic instruments for environmental protection in agriculture does not necessarily mean that regulatory instruments would do any better. The basic problem is agricultural surplus production in response to artificially high state-guaranteed prices. Therefore, economic instruments can be considered in a more favorable perspective if they seem suited for reducing both environmental destruction *and* agricultural overproduction. For this reason, we will now discuss the practical applicability of economic instruments for environmental protection in European agriculture taking the examples of a nitrogen tax, a pesticide tax and a specific water charge. Finally, I would like to summarize the preliminary results in order to indicate broadly the general direction in which the agricultural sector has to be restructured in order to meet both economic and ecological requirements.

4. Three Practical Examples

The Case of Nitrogen Taxes

As indicated in the previous section, agricultural policy in developed countries has contributed to intensive and spatially concentrated agricultural production. Relative to the high and guaranteed commodity prices, most material factors of production are too cheap; this is particularly true for yield-increasing inputs such as pesticides and nitrogen.

The excessive use of nitrogen is a particular problem in terms of contamination of ground water, rivers and lakes; the concentration of nitrate is contributing to the eutrophication of coastal waters and is thus posing a threat to the diversity of species. This intensive agricultural system while providing relatively cheap foodstuffs also contributes to an excessive separation of cattle breeding (including intensive livestock production, e.g., pigs and poultry) on the one hand and plant cultivation on the other hand, and thus supports an ecologically dangerous specialization between different farms and different regions; the accompanying tendency to monoculture is also threatening the bio-diversity in these areas. For example, liquid manure from cattle is frequently diverted away from its former disposal outlet in plant cultivation; instead, excessive 'free disposal' of liquid manure by cattle breeders concentrated in their small areas of land takes place and this effluent loading is added to by the increased application of artificial nitrogen fertilizers by plant cultivators. Moreover, the excessive use of nitrogen favors a simpler crop rotation which is less resistant to external influences and therefore more dependent upon an increased use of pesticides.

For these reasons, nitrogen could be regarded as the central input for an economic and ecological policy of cost internalization and of extensification in agriculture (cf., Binswanger *et al.*, 1990, section 2.3). Due to the decisive role of nitrogen fertilizers, a rise in their price may lead to a strong reduction in fertilizer application, much stronger than would be the case with lower product prices; furthermore, the resulting income losses will be relatively smaller.²³

It is very difficult to calculate the quantitative impact of a nitrogen tax on the use of this and other inputs, on agricultural output and on farmers' incomes. Most German studies²⁴ agree that a considerable reduction in agricultural production can only be expected if current nitrogen prices are increased by about 100%. The estimated results of this doubling vary considerably according to the quality of soil and the farm size; moreover, farms concentrating on plant cultivation are much more sensitive to increases in nitrogen prices than cattle breeding farms which can partially compensate for the price increase through intensified utilization of their own liquid manure.²⁵

Given the variety of conditions and the range of differing estimates, the following figures (cf., Weinschenck, 1989; Binswanger *et al.*, 1990; Dubgaard, 1990) are only intended to give a rough idea of the magnitude of the probable impact of a nitrogen tax.²⁶ Based on 1989 prices it can be expected that a doubling of nitrogen prices (i.e., a 100% nitrogen tax rate) will reduce nitrogen use in plant cultivation on average by about 20%.²⁷ This reduction will probably not lead to important yield reductions, given present levels of fertilizer input. Both from an ecological viewpoint (which would require a dramatic decrease in nitrogen use) and from an economic viewpoint (which would favor significant reductions of agricultural surpluses) this is far from being sufficient. Either consideration would call for dramatic price increases in the range of 300–400%, i.e., a nitrogen tax rate of about 200–300% added to current prices. At least for the time being, such increases are not acceptable for political, social and technical reasons. Therefore, more time for the necessary adjustment processes has to be granted, and the nitrogen tax has to be implemented in a stepwise fashion, starting with a tax rate of about 100% (amounting to about 1 DM per kg pure nitrogen). In order both to facilitate the adjustments in crop cultivation and to induce early changes in long-run decisions (e.g., related to investments in farming and to the development of technical progress in agriculture), a definite plan for achieving the final level of the nitrogen tax should be agreed, indicating the time span and the single steps in the increasing tax rate schedule. In this way, the costs of any necessary adaptations would be minimised, and the efficiency of nitrogen taxation would be greatly improved. In this longer perspective, there is also a dynamic taxation effect involved: the more profitable it seems to reduce or maybe even to eliminate the input for fertilizers and pesticides, the faster alternative ways of farming will be developed.

The final nitrogen tax rate would lead to a considerable decrease in agricul-

tural production; this reduction of supply would in turn contribute to an elimination of agricultural surpluses and probably also to a moderate commodity price increase. Of course, as long as there is no world-wide agreement on nitrogen taxes, the corresponding import protection levels for agricultural goods have to be maintained by the European Community in order to prevent imports from intensive farming abroad. In this case, part of the income losses due to higher fertilizer costs would be compensated for by probably slightly higher prices for agricultural commodities.

If we start with a nitrogen tax rate of about 100%, then initially product prices are unlikely to rise. It would be possible to compensate for this income loss by paying back revenues to farmers in the form of a fixed amount per hectare.²⁸ Technically, there are only two ways legally to enact the proposed combination of a special duty on nitrogen and compensation for the consequent income losses. Either the nitrogen tax is passed on as a special *charge*, or there is a political obligation on both Parliament and the administration to grant income compensations when the nitrogen tax law is passed.²⁹

After the nitrogen tax rate has reached its final target level, there will be a strong economic incentive for farmers to use less intensive production methods in agriculture. As nitrogen fertilizers have become more costly, there has been an incentive to use liquid manure in a more economical way, which would reduce 'free disposal' on small parcels of land and would contribute to a re-integration of cattle breeding and plant cultivation. In addition, more natural ways of crop rotation would become competitive, and hence the dependency on pesticides would decrease. Therefore, positive consequences can be expected from a nitrogen tax both on environmental grounds and via the reduction in agricultural surpluses.³⁰

As stated earlier, the forecasted effects of a nitrogen tax differ considerably between plant cultivation and cattle breeding, between various qualities of soil, and across various farm sizes within a single country. Furthermore, differences in the own-price elasticities of nitrogen can be expected between various countries. Therefore, the analysis above should be viewed as an illustration of the general procedure through which the nitrogen tax instrument can be implemented, what kind of compensation schemes should be added, and what kind of qualitative effects can be reasonably expected. As there is a broad range of probable quantitative impacts on various groups of farmers according to the criteria mentioned above, some accompanying measures will be necessary in order to avoid harmful social effects and to bring about the desired changes even for those farms and those farming methods which are only slightly affected by taxation alone. For example, it will still be necessary to limit the intensive rearing of animals by specific regulations which tie the number of animals to the available farm land (1.5 to 2 large animal units per hectare).³¹

In order to develop more concrete tax proposals, more detailed studies and

calculations for the different cases might be necessary. Another or complementary approach could be based on some kind of trial and error procedure, whereby the different steps in the nitrogen taxation schedule would be adjusted according to the observed empirical results of each successive tax increase. In any case it would not be reasonable to postpone nitrogen taxation for a long time just because of the absence of full knowledge of all quantitative effects; alternative regulatory measures also have their side effects on costs, prices and income which are not fully known to the administrators whenever they implement those devices. For the reasons given at the beginning of this section, a nitrogen tax appears to be an appropriate starting point – not a panacea – in order to initiate the necessary economic and ecological changes in European agricultural policy. At the same time it is obvious that supplementary measures, partly of the administrative type, will also be necessary.

The Case of Pesticide Taxes

As already indicated in note 16 above, the risk-reducing properties of pesticides could lead to an anomalous impact on pesticide applications in the wake of a specific tax on this input. Clearly this effect would not count in favor of a pesticide tax. There are, however, even more compelling arguments against this instrument: the impact of different pesticides on the environment varies widely, and very often we do not have sufficient knowledge of their specific consequences. Therefore, a general tax or charge on pesticides does not make sense, given their large number and variety, unless we can find a common denominator in terms of toxicity.

As there is no clear correlation between the toxicity of pesticides and their prices, it might well be the case that cheaper pesticides are even more detrimental to the environment than more expensive ones. So, neither price nor sheer quantity would give an environmentally reasonable tax base. Moreover, the share of pesticides in total production costs is, in general, rather low so that significant changes in usage rates can reasonably be expected only at very high (and politically unacceptable) tax rates. Therefore, it is perhaps impossible to solve the problem of pesticide application by changes in relative prices. If so, we have a case which requires physical regulation of agricultural production. Tough licensing procedures where the burden of the environmental proof rests on the pesticide supplier and strict application controls for licensed pesticides are then called for. Here, we have a good illustration of the possibility that – contrary to prevalent a priori reasoning of naive economists – economic instruments are not always superior to regulatory devices. Under certain specific conditions, there is not much ecological room for economic choices, and in this case the regulatory instrument is superior.

Whether the conditions are favorable for pesticide taxation or not, cannot be

decided on theoretical grounds. As Ing-Marie Andréasson-Gren (1992) argues, it is possible to take account of the differing toxicity of various pesticides by relating it to some physical measure such as kilogram of active substance. If this measure is a sufficiently reliable indicator of the respective toxicity, then (but only then) the use of economic instruments, such as charges (or permit markets) makes sense. Additionally, one can think of detailed rules for and some random controls of pesticide application.

The Wasserpennig in the German Federal State of Baden-Württemberg

In protected ground water zones, there are specific restrictions on the use of fertilizers and pesticides as well as on crop cultivation. Compared with a restriction-free situation this means yield and income losses for the farmers concerned. One German Federal State, Baden-Württemberg, has introduced a particular compensation scheme for farmers, based on a specific water charge (*Wasserpennig*).

The principle of this charge is as follows: pumping water in this state carries a certain duty (the *Wasserpennig*) which has to be paid by enterprises and public water utilities. This charge is passed on to the users of water (households, etc.) via higher water tariffs so that, finally, every user of water has to carry the charge. Of course, by making the use of water more expensive, some incentives to save water are provided.³² The revenues arising from this charge are distributed to the farmers affected who then have to reduce the intensity of their agricultural practices in certain areas in order to improve the quality of surface and ground water reserves.

There has been some discussion whether this *Wasserpennig* can be regarded as an application of the 'polluter pays principle'. In a technical sense, farmers' intensive use of land is the cause of the strain on surface and ground water, and therefore it seems inappropriate to compensate (or to subsidize) them for reducing their activity levels in protected water zones. However, as e.g., Bonus (1987) has argued, the *Wasserpennig* can also be considered as an application of the *Coase (1960) Theorem*: both water users and farmers are competing for the utilization of scarce resources; the excessive zoning and the high quality level needed for surface and ground water is also a result of permanent increases in household demand for drinking water.³³ Therefore not only farmers but also consumers are contributing to the problem.

Nevertheless, there are also good reasons for rejecting this instrument. If farmers are not expected to reduce their production, even in protected water zones – because the misguided agricultural policy outlined above gives them the wrong incentives –, then such compensation payments should be financed for a transitional period out of general taxation, and not by the users of water. The basic problem is the European agricultural policy which favors intensive farming methods, and under

these conditions, the application of a water charge is more a treatment of symptoms. Whereas from a welfare economics viewpoint it is not correct to say that the *Wasserpennig* turns the 'polluter pays principle' upside down, there are practical arguments against it. Acceptance of this combination of an environmental charge and the subsidization of affected groups, carries with it the danger that more and more compensation claims will be put forward whenever a reduction in polluting activities is required. This could lead to a serious financial constraint on the implementation of environmental policy.

Therefore the *Wasserpennig* might be considered as a pragmatic solution under the specific conditions of a German Federal State. It should not be taken as a starting point for a generalized scheme of environmental charges for the compensation of people affected by environmental policy. Moreover, as indicated above, the basic problem is agricultural policy in the EC.

5. Final Remarks on Economic Instruments in Agriculture

The discussion of three possible economic instruments for environmental protection in agriculture was an attempt to illustrate the kind of practical considerations which have to be taken on board when we leave the ideal world of general competitive equilibrium prices and enter a sector such as agriculture which is characterized by lots of already existing regulations and government interventions on the one hand, and by a variety of technical and social problems on the other hand. We have tried to show that even under these conditions, the application of economic instruments can be helpful in terms of a 'second best' solution.

This is particularly true in the case of a nitrogen tax which can contribute to a reduction in overproduction due to price fixing, and hence in the long run, can contribute to the restoration of market equilibria in agriculture; at the same time, it can support more natural and extensive ways of farming which are less detrimental to the environment. If combined with appropriate compensation schemes, it can also alleviate social problems for the people working and living in the agricultural sector.

It should also have become clear that a nitrogen tax cannot be considered as the panacea for all the economic, social and ecological problems of farming, but rather as a reasonable point of departure. Of course, it has to be supplemented and accompanied by a series of other measures, both of the economic and of the regulatory type. In the long run, even the more fundamental questions of the national and international economic system have to be addressed.³⁴ This goes far beyond the scope of this paper.

The discussion of the pesticide tax was presented as an illustrative example of a context in which regulatory instruments could prove superior. Here, the crucial question is whether we can relate the tax rate (or the price of a permit) to a suffi-

ciently reliable measure of toxicity. In any case, detailed rules for (and some random controls of) pesticide application seem to be necessary. Under these conditions, a pesticide tax could contribute considerably to reducing the environmental damages associated with its application.³⁵ It will probably not contribute much to reducing the agricultural surpluses due to the fact that in most cases the share of pesticide costs in total production costs is rather low (even after imposing an additional charge on pesticide prices).

So far we have not addressed the question whether economic instruments for environmental protection in agriculture should be applied by single countries or by the EC as a whole. There are good reasons – such as unbiased competitive conditions between member states – for favoring an EC-wide solution. This is particularly important if we value the side-effect of a reduced surplus production very highly.³⁶ There is, however, an even more compelling argument for a common environmental EC policy in agriculture (Dubgaard, 1990, pp. 135–136). The supra-national nature of the common agricultural market enables a member state to transfer most of the marginal costs of its own contribution to agricultural surpluses to the other member states. This ‘free rider’ problem has a clear impact on national environmental policies for agriculture. Member countries will not attach much importance to savings on the EC budget due to reduced agricultural surpluses. Their national agricultural policies will be guided by internal EC prices, and the resulting costs in terms of surplus administration will be largely neglected.

For these reasons, in each single EC member country the negative output effects of reducing agricultural intensity will be overvalued. Environmental damages associated with surplus production and intensive farming will be consequently undervalued in relation to possible income losses in agriculture. Therefore, at a national level the less efficient subsidization of environmentally favorable practices in agriculture which violates the polluter pays principle has become predominant. Hence Dubgaard (1990, p. 136) summarizes correctly: ‘For the EC as a whole it is a rather inefficient way of dealing with agricultural pollution. There is a need, therefore, to establish a common input pricing policy for EC agriculture using levies to ensure that prices paid by farmers for environmentally damaging inputs will cover environmental as well as private costs.’ As a nitrogen tax also contributes to the reduction of surpluses in the common agricultural market (which is less probable in the case of a pesticide tax or of a water charge), it can be considered as a valuable economic instrument which helps to bring about, at least in the long run, the desirable economic *and* ecological changes in agriculture.

In the last example of a specific water charge, there were good economic reasons for both its implementation and for its rejection. The main criticism which was raised against it was its ‘embeddedness’ in a misguided agricultural policy. The competing (and conflicting) claims on the use of ground water by both farmers and non-farmers cannot be reasonably harmonized within the context of a European

agricultural price policy which favors intensive ways of farming. Therefore, the *Wasserpfeffernig* could only be regarded as a transitional solution, and not as a substitute for the necessary change in agriculture policy.

In contrast to this, the nitrogen tax could be considered as an instrument which helps to bring about the necessary long run changes in agriculture. But accompanying regulations will be needed for political and social reasons. This reminds us of a general problem of the 'second best' world in which we live: very often, both inside and outside agriculture we are faced with conditions where the theoretical superiority of economic instruments is superseded or at least modified by the specific conditions of the case in question. Therefore, in many cases a combination of regulatory and economic instruments will prove to be the realistic optimum choice.

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Notes

- ¹ Following Walter Eucken (1975), in the German discussion the notion of *Rahmenordnung* ('frame order') is used in order to describe the constituent parts of the economic system.
- ² In this context, Eucken (1975) distinguishes between the shaping of the 'frame order' (*Rahmenordnung*), which he calls *Ordnungspolitik* ('order policy'), on the one hand, and government attempts at influencing the economic process which takes place within this prespecified 'frame order' on the other hand; the latter is called *Prozeßpolitik* ('process policy').
- ³ Unfortunately, PCPs are forbidden only in some countries, such as Germany. Another example of a strict ban would be the highly toxic pollutant dioxine; however, for practical reasons (dioxine cannot be completely removed from the atmosphere in the short run) we must confine ourselves to very restrictive upper limits. The general reasoning, however, is the same as in the case of PCPs.
- ⁴ Of course, this two-step procedure of first defining an economic system and then choosing the appropriate instruments is an oversimplification; in reality, this procedure will take place as an iterative process where certain experiences with the implementation of policy instruments can be

used in order to redefine the underlying economic system. But this realistic feedback does not essentially change the basic choice problem discussed above.

- ⁵ In the case of unknown risks, the necessary specification can only be based on pragmatic considerations given the uncertainties present.
- ⁶ For instance, administrative costs of applying economic instruments might be prohibitive, or in a realistic world of imperfect knowledge and corresponding uncertainties in the application of instruments, mistakes in indirect price planning might have very severe consequences (Weitzman, 1974, pp. 485–487).
- ⁷ In a fundamental theoretical contribution concerning the relative merits of price versus quantity planning, Martin L. Weitzman (1974) has illustrated this theoretical ‘second best’ problem by using the example of air pollution whereby both costs and benefits of a certain level of air cleanliness are not fully known to the controlling agency. In his model, there are good arguments for preferring indirect price planning to direct quantity planning if the benefit function is closer to being linear than the cost function. However, if marginal costs rise very steeply around the target level, the difference between controlling by price or quantity instruments is diminished. Moreover, if the cost function is closer to being linear than the benefit function, the consequences of price planning will then be inferior and in some cases even disastrous. So, in a realistic world with incomplete information about costs and benefits of certain environmental activities, there can be sound arguments for direct quantity planning, depending on the curvature of the relevant cost and benefit functions.
- ⁸ In practice, PPP has been interpreted such that it includes the imposition of regulatory measures (standards, permits etc.) forcing the polluters to take concrete measures, the costs of which they have to bear themselves; but no costs are imposed for any residual pollution beyond the limits of the regulation. For the development and the meaning of the PPP principle in the context of the OECD see Opschoor and Vos (1989, chapter 1 and chapter 2, sections 2.3 and 2.5).
- ⁹ There might be good theoretical reasons for subsidies in support of basic environmental research. Arguments for subsidies related to the so-called *Coase Theorem* will be discussed later on in section 4.3 in the frame of German water charges. See also OECD (1992).
- ¹⁰ If for some reason – e.g., in order to avoid dangerous local concentrations of toxic material (‘hot spots’) – standards have to be set at the enterprise level, then of course there is no room for individual trade-offs, and in this case physical regulation might be more appropriate than economic instruments.
- ¹¹ The different devices which are applied in order to exempt the agricultural market from the usual price mechanism are listed in section 3 below. They can be considered as illustrative examples of *policy failure* which add to the traditional *market failure* described above (divergence between social and private costs of production). Instead of correcting market failure, this kind of policy increases ecological and social problems associated with farming.
- ¹² This statement does not imply that the present agricultural world market prices are to be considered as the correct ones. On the contrary, they are seriously distorted because transportation costs usually fail to reflect the accompanying environmental damages. In addition, the social and ecological conditions of agricultural production in most countries, especially in the Third World, give rise to serious doubts whether there is not a big gap between social and private costs of farming with the corresponding distortions of agricultural prices.
- ¹³ In addition to these measures at the EC level, there are numerous specific agricultural programs within each single member country at national, regional and sectoral levels. This makes the situation even more complicated (if not confusing), but we omit these specific programs as they do not change the basic line of our argument.
- ¹⁴ For a comprehensive critique from a liberal viewpoint, see, e.g., the evaluation of the Frankfurter Institut: *Argumente zur Wirtschaftspolitik* 18/April 1988. – For the reasons indicated in notes 13 and 35 I do not agree to the liberal proposals for changes in European agricultural policy whereas I share the liberal critique of the *status quo* in agriculture.
- ¹⁵ If fertilizer and pesticide prices are relatively low, farmers may have an additional incentive to

overapply them in order to increase the security of reaching the target level; with low marginal costs of fertilizer and pesticide application, a certain amount of overdosing can be considered as some kind of risk premium against possible yield reductions 'in the worst case', following the dictum: if overdosing does not benefit much it will at least do no harm.

- ¹⁶ Certain anomalies in the application of economic instruments in agriculture, such as the possibility of increased use of pesticides in response to an increase in pesticide prices (e.g., brought about by a pesticide tax) can be traced back to a combination of two features: first, to the incentive for an excessive use of pesticides and fertilizers as a consequence of artificially high commodity prices, and second, to the risk-reducing – and therefore yield stabilizing – properties of pesticides; this leads under some specific assumptions about risk behavior to an anomalous reaction similar to the classical Giffen case in consumption. For this see Antle (1988), and Andréasson-Gren (1992). According to German studies (Krayl, Leibfried and Werner, 1990; Hanf and Hilbert, 1991), the use of pesticides as an insurance against the yield risk leads to a high level of pesticide application, but not to an anomalous price reaction. See also section 4.2 below.
- ¹⁷ Remember that Pigou's (1920) original tax approach was based on the assumption of equilibrium prices under perfect competition in all markets. Even for more modest attempts, such as the standard price approach by Baumol and Oates (1971), there is no arbitrary room for commodity price fixing: The intention of the latter is to stabilize farmers' incomes, and this function would be hampered by the application of input taxes which do not only lead to desired allocative effects but also to an undesired negative impact on farmers' incomes. As long as the goal of stabilizing farmers' incomes via state-guaranteed agricultural prices is not abandoned, there will generally be a strong incentive for further increases in output prices (in order to compensate for the tax-generated income losses) which in turn will counteract the intended reduction of pesticides and fertilizers in agriculture. This, however, is not inevitable; for alternative compensation schemes see note 21 below.
- ¹⁸ They may be applied either in the form of environmental taxes and subsidies, or licenses, and/or in form of changed liability rules, sometimes combined with additional administrative regulations; for East Germany see Leipold (1983).
- ¹⁹ The basic problem can be sketched as follow: If we impose ecological taxes or charges on distorted prices, we will undoubtedly create incentives for reduced production (and for reduced environmental damages); however, relative prices both of taxed and non-taxed commodities remain distorted with further consequences for the size of the sectors involved and the use of inputs in different branches of production. Assume, for example, we have two ecologically dangerous inputs *A* and *B*, let the price P_A be too low compared with P_B . If we now impose an eco-tax at the rate *t* on both inputs, there is an incentive to reduce both inputs in production, but the relative share of input *A* still remains too high. Therefore, the notion of correcting taxes cannot be applied properly in this context. For a general welfare economics discussion of the problem see Sohmen (1976, chapters 5 and 7), and for a brief discussion in a planning context cf., Nutzinger (1988, section 4; 1991, p. 32–33) – For an empirical comparison and evaluation of environmental policy between West and East Germany see Leipold (1983).
- ²⁰ For a comprehensive survey on the consequences of intensive farming for the environment see Rat von Scherständigen für Umweltfragen (1985, chapters 3 and 4). This report focuses on the German situation but both the description of the present state and of the perspectives of agriculture apply in a qualitative sense more or less to most European countries.
- ²¹ Exactly for this reason, the German *Rat von Sachverständigen für Umweltfragen* (1985, pp. 364–366) has proposed to use the receipts of a nitrogen tax (see section 4.1 above) for farmers' compensation in the form of a fixed lump sum payment per hectare of arable farm land, and not related in any way to the (former) use of nitrogen. These lump sum payments should not be considered as subsidies conflicting with the 'polluter pays principle' but rather as a payment for landscape cultivation.
- ²² This will be illustrated below by comparing the case of a nitrogen tax with a taxation of pesticides.
- ²³ The underlying theoretical reasoning for this is described in the preceding section.
- ²⁴ For a survey and a tentative evaluation of German research studies up to 1985 see Rat von

Sachverständigen für Umweltfragen (1985, pp. 363–365). For the Danish experience see Dubgaard (1987, 1990, 1991(a), 1991(b)).

- ²⁵ For a detailed quantitative estimate based on a German cluster sample see Weinschenck (1989, pp. 152–155).
- ²⁶ In the following example, the own-price elasticity of nitrogen is assumed to be -0.2 . According to a survey (Burrell, 1989) the elasticity may vary between -0.15 and -2.1 .
- ²⁷ According to Dubgaard (1990), a levy of 150% on the present Danish nitrogen price would reduce the use of inorganic nitrogen by 20 to 25%. The corresponding output reduction is estimated to range from 5 to 10%. This fall in crop production would lead to an appreciable alleviation of EC surplus problems (cf., note 36 below) although it is less than what would be needed to remove the total agricultural surplus even after the reductions of agricultural guaranteed prices agreed upon by the EC Council of Ministers in May 20, 1992; whereas these EC decisions do not remove completely agricultural surplus production, they will help to decrease it and hence support the reduction effect of nitrogen taxation. See also von Urff (1992).
- ²⁸ This compensation per hectare could also be justified as a payment for the positive externalities of landscape cultivation. Another possibility for compensation has been proposed by Dubgaard (1990, p. 131): 'The income effects of nitrogen tax could be reduced significantly by combining taxation and quota regulation, for example by allocating a tax-free quota of nitrogen to farmers and taxing only additional nitrogen purchase.' This idea has the additional advantage of transforming liquid manure from an undesirable waste of cattle-breeding into a valuable agricultural input which then should be used in a more economical *and* ecological manner, at least within the limits of the tax-free allowance of nitrogen for each farmer. Strong incentives for the transport or the processing of manure can be expected.
- ²⁹ In this respect, the proposal of a nitrogen tax has some parallels with Dutch government plans for a high energy charge coupled with reimbursing certain affected groups.
- ³⁰ Additional positive effects can be brought about if there are economic incentives related to alternative land use which reduces the dangerous nitrogen leakages into ground water, such as forestry, wetland and catch crop cultivation.
- ³¹ For a good survey of the qualitative effects of nitrogen taxation and the necessary accompanying measures see *Rat von Sachverständigen für Umweltfragen* (1985, section 5.7.4).
- ³² Other Federal States in Germany are considering the introduction of a comparable water charge, but so far they have not yet come to a final decision.
- ³³ In Coase's (1960, p. 2) original example, a crop-growing farmer and a cattle raiser are competing for the use of land; he speaks of 'the reciprocal nature of the problem'. However, by addressing himself mainly to the question of the cattle raiser's or the farmer's liability for the damage caused by the straying cattle and to the compensation payments taking place between both producers, Coase does not make sufficiently clear that the competition for the use of a scarce resource (land) lies at the heart of his problem. Of course, only in this generalized sense can the *Wasserpennig* be considered as an application of his famous theorem. – See also Endres (1976).
- ³⁴ The current attempts at a worldwide liberalization of agricultural markets, for instance, seem to be misguided, for the reasons indicated above (note 12), as agricultural world market prices do not reflect the full social and environmental costs of farming and transportation; therefore, currently they cannot be taken as a point of reference for liberalization of agricultural markets which might be desirable in the long run.
- ³⁵ For a detailed description of the negative impacts see the paper by Andréasson-Gren (1992).
- ³⁶ Following Dubgaard (1990, p. 135) the tentative estimate that a 30% reduction in the use of nitrogen in commercial fertilizer (due to a tax rate of about 150%) could lead to a 5 to 10% fall in total crop production. As for the EC as a whole, grain surplus is about 15% of total production and a 5 to 10% fall in EC crop production would result in an appreciable alleviation of agricultural surplus problems.

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