9.0 TAXES ON FERTILISERS AND MINERAL SURPLUSES

9.1 Introduction

Nitrogen emissions from agriculture cause a number of significant and growing environmental problems, including the pollution of drinking water, eutrophication of surface waters (inland and coastal), and acidification of natural landscapes. In response, the European Union adopted the Nitrate Directive in 1991 and many countries are developing polices to reduce nitrogen emissions.

Environmental taxes are little used or were abandoned by countries when joining the EU, as was the case for Austria and Finland. Taxes might be an effective instrument in reducing nitrogen emissions. However, the problem of nitrate pollution from agriculture is a classic example of how difficult it is to address such diffuse pollution through 'first-best' instruments. Taxing nitrate itself is not an efficient solution since the problem which the instrument seeks to address – emissions to various media – is related to the application of nitrate in rather complex ways. The method of cultivation, the crop being cultivated (and the timing thereof), the type of soil and the weather will all influence these emissions. Furthermore, whilst other sources of diffuse pollution from agriculture, such as pesticides, are not absolutely necessary for the cultivation of crops, the presence of nitrate in the soil is necessary for plant growth.

Ideally, one taxes not nitrate per se, but that proportion of nitrate that is applied which causes the pollution of surface and ground waters (in other words the surplus of nitrates). In this context, one can point to some rather complex theoretical work concerning optimal taxes for diffuse pollution, as well as more practical schemes using land-use permits (though this would require complex administration). The Netherlands has also recently implemented a system of nitrate surplus taxes. In this chapter, we discuss the national tax systems on fertilisers for the agricultural sector in Austria, Sweden, and Finland. We also look at the development of the Dutch scheme

9.2 Austrian Tax on Fertilisers

Introduction: Design and development of the tax

In Austria, the government implemented a tax system on fertilisers (on its own) in 1986. The tax was abolished in 1994, when Austria joined the EU. There were no alternative / replacement instruments implemented at that time.

Table 34 summarises information on the tax. Rates are given for 1986 and for the period 1991 till 1994. In the years 1987 till 1990 the tax rates stayed between these two levels.

Table 34. Description of Fertiliser Taxes in Austria

Period of Operation	**1986 till 1994**	
		Point of application:
Rate 1986	ATS 3.5 (EUR 0.25) ATS 2.0 (EUR 0.15) ATS 1.0 (EUR 0.07)	per kg N per kg P_2O_5 per kg K_2O
Rate 1991 till 1994	ATS 6.5 (EUR 0.47) ATS 3.5 (EUR 0.25) ATS 1.9 (EUR 0.13)	per kg N per kg P_2O_5 per kg K_2O
Tax Revenues 1986/'87	ATS 737 m (EUR 53.6 m)	
Tax Revenues 1993/'94	ATS 1177 m (EUR 85.5 m)	

During the late 70s, Austria became a net exporter of cereals. Since domestic administered prices were higher than world market prices, exports had to be subsidised. To finance these subsidies, farmers received a slightly lower price for the quantity that had to be exported. This price gap was called the 'marketing contribution'.

In 1985, it became evident that the volume of 'marketing contributions' collected from farmers would not be sufficient to sell the extraordinary good grain harvest of that year. After debating a couple of possible alternatives a decision was made not only to raise the rates of the marketing contributions of farmers but also to introduce a new tax on mineral fertilisers. The Federal Ministry of Agriculture designed the tax in co-operation with Dr. Matthias Schneider of the WIFO ("Wirtschafstforum"). Prior to the tax's introduction, no evaluation was carried out of the impact of such a tax.

Revenue and Use of Revenue

The tax was primarily intended to raise funds to support and promote the grain production sector, with soil conservation as a secondary goal. It did not directly substitute another instrument, but in its absence, additional budgetary resources would have been required to support grain exports. Besides providing funds for export subsidies the proceeds of this tax have also been devoted to stimulating the production of 'alternative crops', in particular,

leguminous crops (which fix their own nitrogen from the air). Crops supported include oilseeds, soybeans, rape seed, and field beans. Support for leguminous crops led to an extra reduction of about 6000 tonnes of nitrogen (about 6%).

Organisational Roles and Administration

For the administration of the tax, the retailer had to send monthly statements about the amount of tax collected to the 'Getreidewirtschaftsfonds' (Grain Marketing Board). This Board collected the money on behalf of the Ministry of Finance and received a small percentage of the proceeds to cover administrative costs. At the beginning the Board was entitled to deduct 1% for these costs. After January 1, 1988 the Ministry of Finance decreased this rate to 0.7%. Hence, the administrative burden out of this tax was remarkably low, which may be partly due to the fact that the costs out of the practical handling at the retail level was not fully compensated. In practical terms the Board normally received amounts slightly less than 10 million ATS (EUR 730.000).

Environmental Effect

After the introduction of the tax, an increase in price of fertiliser was expected. However, the price of fertiliser did not increase at first. The expected increase in 1986 did not appear, since fertiliser suppliers simply reduced the 'before-tax' prices for their product. So, there was no extra economic stimulus for farmers to reduce their fertiliser use. However, there still was a decrease in the use of nitrogen fertilisers of about 15% during 1986, indicating that farmers had revised their nitrogen application plans. This change in fertiliser use must be due to other effects than direct price effects, perhaps being due to expectations of further increases in the future.

In the medium term, nitrogen prices have gradually increased due to the rise in tax rates in mid 1987. Prices increased 10 to 12% between mid 1987 and mid 1989. The direct effect of the price increases between 1987 and 1989 is estimated to be a reduction in nitrogen demand of about 2.5% (4000 tonnes of a total of 160000 tonnes). When we combine this number with the price increase of 10 to 12% we can calculate a price elasticity of demand for nitrogen fertiliser in Austria until 1993 of about -0.2. In earlier studies the nitrogen elasticity of demand was found to be -0.29.

This confirms experience elsewhere which suggests that demand for fertiliser is relatively inelastic with respect to price, indicating that a tax on fertiliser on its own is not a very effective instrument to reduce the use of fertiliser. However, the indirect effects, which were observed in 1986, have to be taken into account as well. The decrease in fertiliser demand is not only an economic effect, but also due to psychological factors as well as changing attitudes of farmers to environmental issues. The tax seems to act as a strong reminder of the fact that nitrogen is a cost factor, which has to be observed closely, so that it has a signalling effect. Besides, the tax seemed to have appealed to the environmental motivation of a part of Austrian farmers.

The decrease in demand since 1986 has been caused mainly by decreased profitability from fertiliser use, increased production of leguminous crops, better utilisation of manure, reduction in excessive use of fertilisers and improved extension services. As a result of the tax, there was a win-win situation for farmers and the environment. The use of fertiliser went down, despite the fact that the price of fertilisers did not change at first. So, farmers seemed to use the fertilisers more efficiently. During the period 1987 till 1994 the annual decline in N-fertiliser application per ha was about 0.8%, which equals -0.5 kg per ha per year.

A nationwide groundwater quality monitoring program has been in place in Austria only since 1992. However, interpreting the known facts with respect to this tax leads to the conclusion that the direct environmental consequences of this tax have been negligible. It has to be said that the effects of reducing nitrate applications in terms of the impact on groundwater will be observed only many years after the event, although more sophisticated monitoring approaches can capture changes over shorter periods of time.

Effects on Producers

The economic effects of economic instruments are hard to quantify empirically, due to the fact that all kind of decisions and changing circumstances affect the final outcome on the farm. The height of tax in 1986 in Austria was about 24% of the original fertiliser price. However, the price of fertilisers paid by Austrian farmers did not increase at first, as was explained in the previous paragraph. The fertiliser industry and the distributors probably carried the additional cost, together with possible change in production costs. In the medium term, nitrogen prices have gradually increased due to the rise in tax rates in mid 1987, but also as a consequence of slightly rising pre-tax rates. The price increased 10% to 12% between mid 1987 and 1989. As the Austrian farming sector consists of thousands of individual farms with millions of competitors outside Austria, price raises cannot be passed through to food consumers. Fertiliser expenditure is about 8% of the farmers' income (Gross Added Value).

Farm enterprises that do not have good opportunities to substitute mineral by organic fertilisers have most probably lost most from the tax. This implies that arable farming, mostly specialised grain farmers, were disadvantaged, while e.g. beef and milk sub-sectors would not suffer significant losses due to their reliance on substitutable form of manure. This holds especially for the most extensive forms of livestock farming. However, the proceeds of the tax were devoted to financing subsidies for grain exports, which actually favoured the subgroup of farmers potentially facing the highest income losses through this tax. Hence, by this reversal of the distribution consequences intensive grain producers on average profited most. Next to that: the fertility industry decreased the price fertiliser, so they had lower profits. This is not necessarily an undesirable effect of a tax. As described below, the industry in Austria is monopolistic so this perhaps suggests that monopoly rents which may have been accruing to the fertiliser industry were effectively (through the tax) being transferred to the Treasury (and then used to subsidise exports).

Competitiveness Impacts

The government abolished the tax on fertilisers in 1994 before Austria joined the EU in 1995. The costs to Austrian farmers of the tax were considered too high when set alongside increased competition with other EU member states. Furthermore, a number of interviewees suggests there was a feeling that the tax had achieved the aims set for it.

Prior to entering the EU, the effect of existing agricultural policies would have been a key determinant of the competitiveness impacts of a fertiliser tax. Price support was used to maintain incomes, and border measures were used to protect the market for agricultural produce. This would have negated the impact which a tax might have had in a more open trading system, in which one might have expected greater import penetration to have arisen from the tax. Instead, since the goal of the tax had been to raise funds for the grain production sector so as to subsidise exports, one could argue that this led to a transfer from all fertiliser users to grain exporters, increasing the ability of grain exports from Austria to compete in what was a heavily distorted grain sector. Indeed, one representative of the International Wheat Council referred to this as a period of 'two-tier' pricing where quoted market prices bore little relation to actual prices paid for grain (going to export subsidies).

The fertiliser industry faced a reduction in the competitiveness of their product because of the price increase. Other competing options for fertilisation, (for instance the use of organic manure, and the use of leguminous crops) became relatively more attractive. It may be no co-incidence that Austria is amongst the leading states in the EU in terms of the use of organic 'wastes' (municipal and otherwise) in agriculture.

Internal Market Effects and impacts on trade

One cannot comment on the single market effects of this tax since the tax was removed prior to entry into the EU. As discussed above, this was due to the perceived competitiveness impacts of the tax and a feeling that the tax had achieved its objectives.

In Austria one producer of fertiliser is dominating the market. This was the case before the introduction of the tax, and this situation continued when the tax was introduced. So, this was not influenced by the tax.

As regards trade in agricultural products, as discussed in the section on competitiveness, import penetration was prevented by the prevailing agricultural policy.

As regards exports, the grain market was influenced indirectly, because of the use of revenues for export subsidies. It was argued that this way farmers would pay export subsidies partly by themselves. Such a process of subsidisation of exports has increasingly been frowned upon in trade fora such as the GATT, now WTO because they are seen as a reflection of price supports and import tariffs / trade barriers, which distort trade. Exports might be assumed to have been greater than under the counterfactual scenario.

Impact on Employment

We do not have information available on the influence of the tax on employment for Austria. Most probably these effects – negative or positive - are very small. In Austria no concerns were raised on the employment impacts of the tax and there are no indications that the tax has influenced employment.

Impact on Consumers

The impact on direct consumers (i.e. farmers) has been assessed above. As regards end consumers (of food products), it seems that within Austria, there was little or no effect on consumers due to the tax. This suggests that once manufacturers began to pass the tax through to the farmers, one of two things happened:

a) Farmers were able to adjust fertilisation patterns such that the tax, though paid by them, did not increase the costs of production (they were using fertiliser more efficiently); or

b) Farmers were unable to pass the tax on to end-consumers, and that any cost increases were being absorbed by the retailers, or the farmers, or both (in partial measure).

We are unaware of any analysis of the impact on those farmers who switched to leguminous crops.

9.3 Sweden

Introduction: Design and process development of the tax

The tax system in Sweden is somewhat similar to that found for pesticides (see previous chapter) in that what was once an environmental charge (implemented on July 1st 1984 for all chemical fertilisers) has graduated into a tax (since July 1st 1995). Pre-dating the environmental charge was the introduction of a price regulation charge on nitrogen in commercial fertiliser. Table 35 shows information on tax rates, point of application and tax revenues (as far as known). The 1994 environmental tax rate is equivalent to approximately EUR 0.21/kg of nitrogen.

Table 35. Rates of the Tax in Sweden in Ore/Kg (EUR/Kg)

	Price Regulation Charge			**Environmental Charge / Tax**		**Total Revenue**		
Date	***N***	***P***	***K***	***N***	***P***	***N***	***P***	***K***
1/1 85	72 (0.08)	138 (0.15)	43 (0.05)	30 (0.033)	60 (0.066)	102 (0.11)	198 (0.22)	43 (0.05)
1/7 85	93 (0.1)	179 (0.2)	56 (0.06)	30 (0.033)	60 (0.066)	123 (0.14)	239 (0.27)	56 (0.06)
1/7 86	112 (0.12)	243 (0.27)	76 (0.08)	30 (0.033)	60 (0.066)	142 (0.16)	303 (0.34)	76 (0.08)
1/7 88	112 (0.12)	243 (0.27)	76 (0.08)	60 (0.066)	120 (0.13)	172 (0.19)	363 (0.40)	76 (0.08)
6/11 90	146 (0.16)	316 (0.35)	99 (0.11)	60 (0.066)	120 (0.13)	206 (0.23)	436 (0.48)	99 (0.11)
8/3 91	175 (0.19)	379 (0.42)	119 (0.13)	60 (0.066)	120 (0.13)	235 (0.26)	499 (0.55)	119 (0.13)
1/7 92	112 (0.12)	243 (0.27)	76 (0.08)	60 (0.066)	120 (0.13)	172 (0.19)	363 (0.40)	76 (0.08)
2/12 92	0	0	0	60 (0.066)	120 (0.13)	60 (0.066)	120 (0.13)	0
1/1 94	0	0	0	60 (0.066)	0	60 (0.066)	0	0
3/11 94	0	0	0	180 (0.19)	0	180 (0.19)	0	0

Key: N: Nitrogen; P: Phosphorus; K: Potassium

Note that there is no environmental charge on potassium in commercial fertiliser as this is not thought to have any negative environmental effects. Note also that when the phosphorous charge was eliminated in 1994, it was replaced by a charge on the cadmium content of commercial fertiliser. The two are related by the fact that cadmium occurs in mineral deposits

(at varying concentrations) in phosphate rock (so that phosphate fertilisers are frequently sources of cadmium pollution in the soil). The charge was set in January 1994 at a rate of SEK 30 per gram of cadmium where the cadmium content exceeded 50g /tonne of phosphorous. This threshold was lowered to 5g/tonne of phosphorous in November of the same year.

Unlike Austria, Sweden did not abolish their fertiliser tax upon accession in 1995. The government saw the tax as a good way to finance environmental projects. Apart from that, the tax as such was expected to have a positive effect on the environment. From that time on, the tax on fertiliser has been equivalent to about 20% of the price of fertiliser.

The Swedish government introduced the environmental charge / tax to reduce the use of fertilisers in agriculture and forestry and so reduce the adverse impact of agriculture on the environment. The goal of the price regulation tax was principally to finance export subsidies though it appears to have been recognised that this too will have had an impact on fertiliser use (and, presumably, the magnitude of the exported surplus). This seems to be an important point since from Table 35 above, it is quite clear that prior to its abolition, the price regulation charge was set far higher than the environmental charge. As such, any price incentive conveyed by the combined system might have been expected to be more significant in the case of the price regulation charge.

We do not have information on the design of the environmental charge in 1984. In July 1995 the special tax office at Dalarna County Tax Authority in central Sweden was appointed taxation authority in place of the National Board of Agriculture. This occurred as the charge was converted to a tax.

The tax is levied on commercial fertiliser manufactured in Sweden or imported. Manufacturers and importers are under a duty to register, submit returns and pay tax on quantities delivered each month. SEPA (1997) reports that there were 45 registered manufacturers, of which 5 were importing for their own use. 37 were importing for resale and only 3 were manufacturing in Sweden itself.

In 1992 the National Board of Agriculture evaluated the effect of environmental charges as economic instruments on the government's instruction. In 1999 the Board did some additional calculations concerning the level of levy that would be necessary to achieve an extra reduction in nitrogen losses by the year 2005. The results of this evaluation and the calculations are discussed later on.

Revenue and Use of Revenue

Revenues are shown in Table 36. Most of the charge revenues generated in Sweden between 1984 and 1995 were used for research and various environmentally oriented projects. The action programs have included investment in fertiliser management units, advisory services and special information and research programs in the agricultural and forestry sectors.

In 1994, the steep rise in the environmental levy occasioned its transformation into a tax. Following this rise only a small proportion of tax revenues have been channelled to environmental projects in the field. The effect of the change is that measures to reduce the use of commercial fertiliser in agriculture will not in future be financed using funds earmarked for the purpose. Revenues go to the state budget, but funds are still allocated for environmental improvements in agriculture.

Table 36: Revenues from Taxes/Charges on Commercial Fertiliser

Date implemented	**1984**
Tax Revenues 1985	SEK 271 m / 93 m[1)] (EUR 31 m / 11 m)
Tax Revenues 1988	SEK 481 m / 141 m[1)] (EUR 56 m / 16 m)

[1)] *Price regulation charge / environmental charge. Environmental charge was doubled in 1988. Price regulation was stopped in 1992. From 1994 on there was only an environmental charge on nitrogen (not on P and K).*

Organisational Roles and Administration

Before the tax office administered the tax, the National Board of Agriculture administered it. The experience of the special tax office at Dalarna County Tax Authority is that the tax is not difficult to administer. We do not have data on the administrative costs of the tax office.

Environmental Effect

In 1992, an evaluation was carried out in Sweden on the effect of the environmental charges on commercial fertiliser use. This evaluation suggested that the charge had some impact on the use of commercial fertiliser, and thus directly on nitrate and phosphate emissions to water, but that the main effect was indirect through the financing of action programs leading to a decrease in intensive use. It is unclear whether the same study was asked to report on the effects of the price regulation charge. As noted above, this stood at a higher level than the environmental charge.

Figures for the use of constituent nutrients in commercial fertiliser are shown in Table 37. We have shown these alongside the appropriate combined charge / tax rates from Table 35. In the first years of implementation of the tax, the fertiliser use declined by 2 to 3%. Nitrogen and phosphorus consumption was at its lowest in 1991/1992, when total taxes per kg of fertiliser were at a maximum. The years 1991/92 to 1994/95 would appear to indicate a price responsiveness in respect of all component nutrients that supports a belief that farmers are responsive to price. Note also that some of this response might have been obscured by changes in levels of price support over the same period. One could speculate that if these would have remained at the same level, the response to the changing charge level (in terms of increases in demand for phosphorous and potassium) would have been greater than is revealed in the Table.

Table 37: Use of Commercial Fertiliser and Charge / Tax Rates

	Use of Commercial Fertiliser per hectare			**Total in ore (EUR)/kg**		
	N	***P***	***K***	***N***	***P***	***K***
1985/6	81	13.3	26	102 (0.11)	198 (0.22)	43 (0.05)
				123 (0.14)	239 (0.27)	56 (0.06)
				142 (0.16)	303 (0.34)	76 (0.08)
1987/8	86.3	12.9	26.7	172 (0.19)	363 (0.40)	76 (0.08)
1989/90	80	11.6	22.6	206 (0.23)	436 (0.48)	99 (0.11)
1990/91	82.6	10.3	19.8	235 (0.26)	499 (0.55)	119 (0.13)
1991/92	70.3	8.0	16.4	172 (0.19)	363 (0.40)	76 (0.08)
1992/93	81	8	16.4	60 (0.066)	120 (0.13)	0
1993/94	85.5	9.0	17.0	60 (0.066)	0	0
1994/95	76.4	9.0	16.7	180 (0.19)	0	0

Key: N: Nitrogen; P: Phosphorus; K: Potassium

A calculation of the optimal nitrogen dosage with and without the levies shows that the levies probably reduced use of nitrogen fertilisers by 15 to 20% in 1991/1992. The effect of the tax level of 1997 may be estimated at around 10%. The price elasticity of chemical nitrogen fertiliser is estimated to be between -0.17 and -0.25 for Sweden in one study and between -0.12 and -0.51 in another study. In the longer term elasticity may be expected to be greater, since other factors (for instance new technology) may reduce the need of fertiliser-N.

There is some evidence to suggest that average levels of cadmium in fertiliser have fallen since the charge on cadmium content was introduced. There were no data available on the effect of fertiliser tax on the mineral surplus or the nitrate level in water.

Effects on Producers and on Prices

The economic effects of economic instruments are hard to quantify empirically. The reason is that all kind of decisions and changing circumstances affect the final outcome on the farm. This is the case in Sweden as well. However, the change in price of fertiliser over time gives some information on effects on producers and on prices.

Due to the tax, the price of fertiliser-N rose at first about 10% in the first years of implementation. The height of the price regulation tax increased over time to about 20% of the purchase price of fertiliser. The environmental charge on phosphorus in fertiliser was 8% of the price. The total taxes per kg of fertiliser were at a maximum in 1991/92, representing 30 to 35% of the price of the product. The price regulation tax was abolished in 1992, and the tax on phosphorus in 1994. However, the environmental tax on nitrogen was increased in 1995 from SEK 0.60 to SEK 1.80 per kg of nitrogen. In 1996 the nitrogen-tax amounted to about 20% of the price of fertiliser. This is still the case in the year 2000.

Since the introduction of the tax in 1985 until now there have been discussions about the desirability of the tax. Concerns are raised regarding the costs for farmers. Farmers argue that the tax revenues should be returned to the farmers (for instance on a per hectare basis). However, at the moment the tax revenues are channelled to the central budget.

The Federation of Swedish Farmers (LRF) has recently started a campaign to abolish the tax, or at least reduce it. They argue that the tax system is not very efficient to reduce nitrate leaching and that the costs for the farmer are very high. They estimated that the farmer has to pay 300 SEK (EUR 35) to reduce nitrate leaching by 1 kg. The LRF is convinced that some sort of system is needed to save the environment, but that the tax system is inefficient, so they argue. The LRF suggests a switch from a unit tax system to a system based on surpluses, as is the case in the Netherlands, because such a system is much more efficient. This discussion is still going on.

These data make it clear that the agricultural sector is affected. In 1994, the ratio between fertiliser expenditure and farm income (Gross Added Value) in Sweden was 14%. In addition, the fertiliser industry faces a decreasing demand of fertilisers, so they are affected as well. However, they are affected less than during the pre-Accession years, when the combination of price regulation and environmental charges was almost twice as large.

The Swedish Board of Agriculture has calculated in 1999 that the tax on fertiliser-N should be between 10.5 and 15 SEK per kg N (EUR 1.21 -1.74) to achieve the environmental goals of an extra N-reduction of 7850 tons for the year 2005. This is six to eight times the current levy. If such a levy were implemented, and if the fertiliser industry passes these costs completely through to farmers, the price of fertiliser will at least double. This would increase costs to the Swedish agricultural sector by an estimated 1930 million SEK.

Competitiveness Impacts

When the tax was first introduced, similar considerations applied in the Swedish case as with the Austrian case discussed above. Swedish agriculture was heavily protected and, as such, it was insulated from concerns regarding international competitiveness. Because part of the tax was a price regulation tax used for export subsidies, exports became more price competitive. On entry to the EU, there were concerns for competitiveness. On the other hand, there was also a view that the environmental aspect of agriculture might give Swedish products a competitive edge in the EU. Hence, whilst in other countries covered in this chapter, accession to the EU occasioned a removal of this type of charge / tax, Sweden retained its environmental tax on nitrogen. As mentioned above (see Table 35), the combined rate on nitrogen is lower in the post-accession years, and the charge on phosphorous has been removed in favour of one on cadmium content.

Again as in the Austrian case, the fertiliser industry has seen a decrease in the competitiveness of their product, because other options for fertilising (use of organic manure, use of leguminous, and new technologies which can reduce the use of fertilisers) have become relatively more attractive. However, the majority of fertilisers appear to be imported

so that the industry is not a major one in Sweden. The principal competitiveness issue is as much one of enforcement as one of competitiveness per se. Imports of fertiliser for farmers' own use are a concern. If farmers register, they still pay the tax, and the net effect is to cut out the role of distributors. However, if they avoid registration they pay no tax.

Internal Market Effects

There appear to be no major Single Market effects. Fertiliser importers are required to register for payment of the tax. This has to occur monthly. Although this may impose some costs on importers, the same applies to domestic suppliers and importers for own use. It is not clear whether this provides any major barrier to the free movement of goods in the EU, though an incentive clearly exists to import for own use without registering for tax payment.

Impacts on Trade

In Sweden, the arable land in use has decreased compared to 1985/86. However, it is unclear what the situation would be without the tax. We do not have information on the impact of the tax on trade, but at least the consumption and thus the trade in fertilisers decreased.

Calculations of the Swedish Board of Agriculture showed that the levy should be 6 to 8 times as high as the current level to achieve the goal of an extra N-reduction in the year 2005 of 7850 ton at a national level. Most probably this will disturb the fertiliser market, it will make the fertiliser industry less competitive, as well as the agricultural sector as a whole.

Impacts on Employment

We do not have information available on the impact of the Swedish tax on employment.

Impact on Consumers

We do not have information on the impact of the tax on the consumers in Sweden. At first glance, the effect of the environmental and price regulation charges would have been greater in the past than the effect of the environmental tax is currently. However, it is difficult to be clear on this matter since price support levels will have altered over the same period. It could be argued that consumers are deriving benefits from, for example, lower levels of cadmium in soil and specific food products, as well as reduced acidification and eutrophication. After all, these are the rationales for the tax.

Their administrative costs were estimated at approximately SEK 0.5 million in 1994, or less than 0.8% of the total revenues.

9.4 Finland

Introduction: Design and development of the tax

In Finland there was a fertiliser tax at a national level between 1976 and 1994. It was abolished when Finland joined the EU. Table 38 shows information on tax rates, point of application, and tax revenues (as far as known). In 1992, there was a steep rise of the tax. Until then, the tax was levied on fertiliser quantity regardless of the content. When we express this tax per kg N in the fertiliser, the tax varied between FIM 0.03 and FIM 1.50 per kg N. From 1992 on, the tax was levied on the nitrogen in fertiliser: FIM 2.90 per kg N.

Table 38. Design of Fertiliser Tax System in Finland in Finnish Mark per Kg (EUR/Kg)

Period of implementation	**Tax Rates**	**Point of application:**
1976 – 1992	Range: FIM 0.04 – 0.60 / kg N (0.006 - 0.09 EUR/kg N)	Per kg fertiliser, per kg P/N[1)]
1993 – 1994	FIM 2.90 (0.44)	per kg P/N
Tax Revenues	Unknown	

[1)] *Initially the tax was levied not on nutrient content but on quantity regardless of the content. From 1990 onwards, there was a specific tax on phosphorus fertilisers and from 1992 on nitrogen as well.*

The goal of the tax on fertilisers in Finland was to lower production levels of cereals for export and to provide funds to finance export subsidies. The design of the tax was the result of negotiations and part of general agricultural policy. There was no complete evaluation of the tax performed in advance. However, there was an increasing awareness of environmental problems. The state and a state owned fertiliser company were responsible for implementation and administration of the tax. In addition to the tax, there were strict limits on animal densities.

At the time of abolishment of the tax in Finland in 1994, the government changed their agricultural policy from a market driven price support policy towards a direct support policy. Voluntary programs for reduced fertiliser use were also implemented mainly through Regulation 2078/92 (the Agri-environmental Regulation).

Administration

Despite the lack of monitoring data, the administrative burden of the tax in Finland was considered small and the roles are unclear.

Environmental Effect

The primary goal of the tax was not to solve environmental problems, so there was no specific monitoring of the effects on pollution, making it difficult to assess the environmental

effect and effectiveness. However, there are data on price and on fertiliser use. These data can be used to calculate price elasticity, serving as an indirect indicator for the environmental effect of the tax.

Fertilisation levels decreased in the first year of the tax, although by less than expected. Initially the tax was levied not on nutrient content but on fertiliser quantity regardless of the content. A system of taxes on fertiliser quantity might result into the perverse incentive to use fertiliser with higher nutrient content. This might be one of the reasons for the finding that fertilisation levels decreased less than expected in the first year of the agri-environmental program.

The decrease in fertiliser use turned around into an increase after a few years. This can partly be explained by increased yields and therefore, by increased crops requirement for nutrients. There was a clear increase in use of fertilisers through the 1980s. From 1990 onwards the tax system was changed into a tax on the nutrient content of the fertiliser. In 1992 there was a huge tax rise. Due to that, the use of nitrogen fertilisers decreased from 1990 at first by around 39 million kg, but then picked up again slightly on a per hectare basis.

Assuming a price rise of 72% of fertilisers in Finland, the aggregated price elasticity of demand based on two 3 year averages is about -0.3 (due to an average decrease of nitrogen use of about 22%). If the administrative set-aside effect of fertiliser is considered (the growth of the area under set-aside was 300,000 hectares), relative change in total use of fertilisers is about 11%, resulting in a price elasticity of demand of about -0.15. But lower use of fertiliser is also an effect of lower prices for outputs. So, elasticity might be lower than -0.15.

Since EU accession, policies employing fixed quotas in a voluntary program and associated lower output prices have clearly reduced the use of fertilisers even more than the fertiliser taxes (see ECOTEC 1998). There are no data available on the effect of fertiliser tax on the mineral surplus or the nitrate level in water.

Effects on Producers and on Prices

The tax on fertilisers in the 90s in Finland increased the price of CAN (special type of fertilisers, including 27.5% N) by 72%. Meanwhile, the price of cereals decreased in the 1990s. The price of wheat, for instance, was FIM 2.60 (EUR 0.40) per kg in 1989 and FIM 0.87 (EUR 0.13) per kg in 1995. In 1994, the fertiliser expenditure (including tax) was EUR 133 per hectare (ratio with Gross Added Value: 37%). Expenditure without tax would have been EUR 77 per ha (ratio 21%).

It is clear that the agricultural sector is affected. Next to that, the fertilizer industry faces a decreasing demand of fertilizers, but at least there was no price pass through from producer to farmer. Unfortunately for the not very flourishing Finnish farming sector the price effect of the tax could not be passed through to the consumers. As the revenues were used for export subsidies, grain producers benefited from the arrangement.

Competitiveness Impacts

The fertiliser industry has faced a decrease of the competitiveness of their product, because other options for fertilising (use of organic manure, use of leguminous, and new technologies which can reduce the use of fertilisers) became relatively more attractive.

The tax on fertilisers in Finland was used for export subsidies. Due to that, the competitiveness of these products for export has most probably increased.

Internal Market Effects

Environmental taxes should be effective in attaining environmental standards. For nitrogen the EU set standards for nitrates in groundwater and surface water, which can be seen as a goal to reach with the tax on nitrogen in fertiliser. Therefore, the tax needs to have a certain level. However, a high tax probably overcompensates for environmental costs, which leads to undesired disturbance of the single market. In the case of Finland the internal market of the EU was not affected by the taxes, because these taxes were abolished when the countries joined the EU.

Impacts on Trade

The situation in Finland regarding the impacts of the tax on trade is equal to the situation in Austria: the grain market was influenced indirectly, because of the use of revenues for exporting subsidies. Of course fertiliser consumption and trade decreased.

Impact on Employment

No information is available on the influence of the tax on employment for Finland. If we only consider the trade-off between labour and capital, then the tax would result in an increased employment.

Impact on consumers

In Finland the price of fertilisers increased due to the tax. However, the price of cereals decreased over time. This indicates that the extra costs are not passed through to the consumers.

9.5 Levies on Nitrogen and Phosphate Surpluses in the Netherlands

Introduction

In the Netherlands the government introduced a levy system on the nitrogen and the phosphate surplus in 1998 to reduce emissions. In this summary we discuss this levy system.

Design of the tax

Levies on Nitrogen and Phosphorus (P_2O_5) surpluses above a levy free surplus per hectare were implemented in the Netherlands on January 1st 1998 for the agricultural sector. The system is called Minas and operates at a national level. The goal of the system is to reduce the mineral surpluses and to increase mineral efficiency, as part of the Nitrate Directive.

Farmers keep records concerning the N and P_2O_5 inputs in purchased feed, chemical fertiliser, and manure, and outputs in animal and plant products. In this way, a balance at farm level is set up. The N- and P_2O_5-surplus per hectare are calculated as input per hectare minus output per hectare. Not all inputs are included in the system: N-fixing of leguminous crops and deposition (from the atmosphere) are not incorporated.

Certain levels of phosphate and nitrogen surplus are allowed (the levy-free surplus), and these are lowered over time. For the surplus above this level the farmer has to pay a levy. The tax rates which will be in place for different years are given in Table 39. The final tax rates for 2003 have not yet been decided upon by the Government. The numbers in the table for this year are based on plans of the government.

Table 39: Tax Rates under Minas System in the Netherlands in NLG/Kg (EUR/Kg)

	Levy-free N-surplus (Kg/ha)		**Levy-free P_2O_5-surplus (Kg/ha)**	**Tax Rate Applied NLG/kg**	
Year	**Grass land**	**Arable land**		**Nitrogen**	**Phosphorus**
1998	300	175	40	1.50 (0.7)	2.50 (1.1)
2000	250	125	35	1.50 (0.7)	5.00 (2.3)
2002	220	110	30	1.50 (0.7)	5.00 (2.2)
2003	180	100	20	5.00 (2.3)	20 (9.1)
2003 – sandy soils	140	60	20	5.00 (2.3)	20 (9.1)

The Centre for Agriculture and Environment (CLM) mentioned in 1990 the possibility for using the mineral balance as a policy instrument with the possibility of a levy on high surpluses and a premium on low mineral surpluses. In the 'National Environmental Policy Plan' (1989) a gradual introduction of the mineral balance to reduce mineral surpluses was suggested. However, the use of levies was not mentioned. In 1992, the 'Landbouwschap' advised the compulsory introduction of the mineral balance. Eventually the government introduced Minas in 1998.

In 1998 and 1999 Minas was only compulsory for dairy farms with more than 2.5 GVE (or living stock unit, a measure of the number of animals per hectare, about 2.5 cows) and for pigs and poultry farms. In the future, Minas will be compulsory for all farms in the Netherlands. The Dutch government takes the final decision on implementation of Minas and on exemptions.

Minas was designed to reduce mineral surpluses in the Netherlands to meet the objectives formulated in the Nitrate Directive (Council Directive 91/676/EEC). The main objective of the Directive is to reduce and prevent surface and groundwater pollution caused by nitrates from agricultural sources. In the Netherlands, the entire country has been classified as vulnerable, indicating that in the whole country agricultural production contributes to drinking water problems (exceeding the limit of 50 mg nitrates per litre). The nitrate level in the Netherlands is monitored by the National Institute of Public Health and the Environment (RIVM).

The introduction of Minas can be seen as a 'package deal', because it is related to all kind of other policy instruments. Van Zeijts et al. (1993) discussed the relation between the mineral balance and other policies. It is, for instance, not permitted, at certain times of the year, to apply manure and the working in of manure is compulsory. Goals of these policies are to reduce mineral and ammonia losses. Due to Minas, it is attractive for farmers to use manure in such a way that the N-efficiency is optimal. So, Minas makes it more attractive for farmers to apply the other policies correctly as well.

In 1986, the government introduced a system of manure production quotas. The quotas were based on historical standard manure production amounts per animal. Farms were allocated manure production quota, expressed in kg P_2O_5. All farms above 125 kg P_2O_5 per hectare pay a yearly surplus levy of EUR 0.11 to EUR 0.23 per kg P_2O_5. In order to stimulate lower P and N excretions, the government gave pig and poultry farmers the option of proving that the P and N contents in the feed were lower, thus lowering the surplus levy. Minas replaced this old system.

Revenue and Use of Revenue

The Dutch government expected to generate revenues from the levy of Dfl. 16 million (EUR 7.3 million). It is not (yet) clear what the real revenues of the levy were in the first years of Minas. The revenues are not earmarked. The revenues contribute to the total budget of the Ministry of Finance. However, the decisions on the available budgets that are available for

other manure policies, are partly influenced by the magnitude of the revenues derived from Minas.

Organisational Roles and Administration

The Levies Bureau manages Minas. This Bureau is responsible for implementation and the administration of the scheme. The administrative burden consists of the administrative costs of the Levies Bureau and the control costs of the General Inspection Service (AID). The Ministry of Agriculture estimated these costs (in advance) to be Dfl. 27.9 million (EUR 12.7 million) for the Levies Bureau and Dfl. 25.4 million (EUR 11.5 million) for the control costs of the AID. The total amount of Dfl. 53.3 million (EUR 24.2 million) is Dfl. 25 million (EUR 11.3 million) more than the 'old' manure policy in 1996.

For the agricultural sector the administrative burden is the time needed to set up the mineral balance. The costs of an accountant check are between Dfl. 250 (EUR 113) and Dfl. 500 (EUR 227) for each mineral balance. From the above, we can calculate the administration and control costs per farm. These costs lie between Dfl. 480 (EUR 220) and Dfl. 1280 (EUR 580) per farm. For comparison: a levy system on fertiliser and feed would have cost about Dfl. 20 (EUR 9) per farm.

Alternative Approaches

The current levy system was not evaluated relative to alternative approaches. However, some studies have been done on systems that show similarities with Minas. Van Zeijts et al. (1993), for instance, compared a system with levies and premiums on respectively high and low mineral surpluses with a system with levies on N and P in concentrates and fertiliser. They concluded that the system of levies on N and P in concentrates and fertiliser was slightly less effective in reducing mineral surpluses than the system with levies and premiums on mineral surpluses. The system with levies on N and P in concentrates and fertiliser, however, was expected to have a slightly better feasibility. Hellegers (1996) compared a slightly different levy system with the manure application standard, indicating a maximum manure input of 170 kg N per hectare (as part of the Nitrate Directive). She found that a very high levy brings about a much larger reduction than the manure application standard. Her calculation was made with a levy of EUR 3 per kg on the N-surplus, with a levy-free amount of 100 kg N per hectare. A high levy, therefore, could replace the manure application standard. The same may be possible for other elements of the Nitrate Directive (e.g. method and timing of manure application), but this has not been investigated.

Environmental Effect

In the previous studies it was shown how environmental effects of the taxes on chemical fertilisers could be related to parameters such as the price elasticity of demand of fertiliser. However, the levies within Minas are not imposed upon a good but upon a surplus, so the elasticity of demand for fertiliser *per se* cannot be used to anticipate the effects of the policy so easily. Alternatives to measure the environmental effects are measurements regarding the groundwater pollution and the mineral balances as such.

Different modelling studies focus on the environmental effect of levies. Minas was introduced in the Netherlands in 1998. So, there are no empirical data on the environmental effects available yet. We have brought together the results of the modelling studies in Table 40.

Table 40. Environmental Effect of Introduction of a System of Levies on Mineral Surpluses.

Study	Levy-free Kg/ha	Levy NLG/Kg N (EUR/kg)	Sector	Change in pollution
Berentsen & Giesen ('94)	200 (N)	4.00 (1.8)	dairy	-17 to -47%
Baltussen ('92)	200 - 90 (N)	2.00 (0.9)	dairy / arable	-15 to -32%
Oude Lansink & Peerlings ('96)	75 (N)	0.27 (0.1)	arable	-7.8 kg N/ha
Fontein et al. ('92)	300 (N)	1.50 (0.7)	dairy	-40 % emission
Polman & Thijssen ('94)	N.A	1/2 (0.5/0.9)	pigs	-50 to -75%

The different studies in Table 40 are difficult to compare, due to differences in levy-free amount, magnitude of the levy, the sector to which it applies, and the way the pollution was measured. However, all studies show decreasing pollution. Most probably Minas has resulted in more awareness of farmers regarding the effects of their management on pollution. Minas is expected not to have any perverse incentives, because the tax is put on the pollution itself. This makes it hard to avoid the tax by use of substitutes, as can be the case with tax on products (fertiliser for instance). The EFMA (1999) expects a significant reduction in the use of fertiliser in the Netherlands between 1998/99 and 2008/09; more than 20% decrease in use of N, more than 30% decrease in use of P, but about a 5% increase in use of K. This decrease is expected because animal production generates large amounts of nutrient in farmyard manure and slurries which farmers are re-cycling more effectively.

Effects on Producers and on Prices

Nieuwenhuize et al. (1995) showed that 41% of Dutch dairy farmers can improve their profits by decreasing the fertilisation level by on average 13%, and almost all Dutch dairy farmers should be able to reduce feed input without any financial loss. If true, this suggests a win-win outcome is possible in respect of the environment and farm financial performance.

Until 2001, the only part of the agricultural sector influenced by Minas will be pig and poultry farms, and dairy farms with more than 2.5 living stock units (GVE) per hectare. However, in future Minas will be compulsory for all farms. In principle, the costs of the levy will not be passed through to the price of the final products (milk, meat and eggs). So, the agricultural sector will experience the true final burden. However, within the agricultural sector, the costs can be passed through between sectors. Rougoor et al. (1999) concluded that in the final situation, with all sectors included in Minas, the loss of N-efficiency of using manure instead of fertiliser will be paid by the pigs and poultry farms (i.e. the price of export

manure will increase). So, pig and poultry farms will experience a relative big part of the final burden.

Table 41 shows the estimated effects of the introduction of Minas on economic results. No empirical data are available. See Table 40 for more information on the different studies.

Table 41: Economic Effects of Introduction of a Levy System.

Study	Situation / sector (EUR/Kg)	Economic effects (EUR)
Berentsen & Giesen ('94)	dairy farms	Labour income: NLG -890 (-404) to NLG. -7759 (-3521)
Baltussen ('92)	dairy farms arable farms	NLG –542 per ha (-246) NLG –264 per ha (-120)
Oude Lansink & Peerlings ('96)	Arable	0.3 - 1.1% reduction in profit
Fontein et al. (1992)	dairy, NLG 4.00 / kg N (1.8)	Gross margin -5%
Polman & Thijssen ('94)	pigs, NLG 1.00 / kg N (0.5) NLG 2.00 / kg N (0.9)	20% profit reduction 33% profit reduction

Table 41 shows that pig farms especially face the costs of introducing a premium, primarily due to the increasing costs of exporting manure. The first year's arable farms are not yet included in Minas, so they do not face economic effects. In future, arable will be included in Minas as well. Table 41 and the study of Rougoor et al. (1999) show that the burden will be relatively small for this sector.

Competitiveness Impacts

Agricultural practice in the Netherlands is more intense than in other EU Member States. Due to that, mineral surpluses in the Netherlands are higher than in other countries. However, due to this more intense farming, Dutch farmers could produce relatively efficiently. There is no evidence that Minas has influenced the competitiveness of Dutch agriculture, suggesting that the greater efficiency outweighed the impact of the additional cost from the manure surplus.

Internal Market Effects

No concerns were raised regarding the effect of Minas on the internal market. Furthermore, the design of Minas is not heavily influenced by internal market effects. However, one aspect that has been taken into account is the fact that the completion of the Single Market makes it possible for products to move across borders in a free and open manner. This would make a system of levies on fertilisers itself harder to implement without introducing problems associated with this freedom of movement.

Impacts on Trade

The effect of Minas on the amount of animals in Dutch agriculture has been estimated by Nieuwenhuize et al. (1995). Compared to 1992/1993, in 2000 the number of cows will

decrease by 17%-19%, the number of fattening pigs by 9%-16%, and the number of sows from 5%-12%. However, this is not only due to the levy system. Without a levy system there would be a decrease in the amount of animals between 4% (sows) and 17% (cows).

Therefore, due to Minas itself, a small decrease in the amount of animals was expected in addition to that which is occurring anyway. There are no empirical data available yet to check this estimate.

It is important to find the 'right' levy level. The levy should be high enough to be effective in attaining environmental standards. However, a levy which is set 'too high' overcompensates for environmental costs, and this can lead to undesirable changes in trade patterns. For nitrogen emissions from agriculture the 'right' level is not so clear. The impacts of nitrate emissions may be quite location specific so that discussions in respect of the 'optimal level' for such instruments become rather awkward.

Impact on Employment

Nieuwenhuize et al. (1995) also estimated the effects of Minas on employment. In 1990, 116,000 people were working in primary agricultural businesses. Without Minas this was estimated to decrease by 22,000 people. Due to Minas they expect an effect on employment compared to this autonomous development in the range of +700 jobs to -15,400 jobs. This range is the result of 4 different scenarios, with different levy-free amounts. Next to the primary sector they estimate that the employment in related industries could decrease by 500 to 8300 jobs (on a total of 140,000 jobs).

These changes in employment are based on changes in the volume of the production. Next to that, jobs will be created to administrate the tax, to control the system, to work out the mineral balances, and to advice farmers how to reduce mineral surpluses. A rough estimate is that 0.5 person days are needed for each mineral balance to work this out completely. In addition to that, 0.5 person days might be necessary per farm for advice and control. In 1998, 55,000 farms had to work out their mineral balance. One can estimate that 55,000 person days of extra work would be generated, equivalent to about 250 jobs.

Impact on Consumers

Agricultural productivity will increase over time. On average this will result in a decrease of price of the agricultural products. Nieuwenhuize et al. (1995) assumed that due to Minas there might be a slight improvement in the image of agricultural products ('environmental friendly'). Due to that, part of the costs of Minas can be passed through to the consumers if consumers are willing to pay more for such products. In this case, Minas might indirectly lead to an increase in the price of consumer products – but this has not been the case to date. and the effect of such a change in image is hard to predict. Nieuwenhuize et al. (1995) estimated that between 0% and 40% of an increase in productivity might be profitable for the producer (and paid by the consumer), dependent upon the sector. There were no consumer concerns regarding the effect of Minas when it was introduced.

9.6 Summary

In the mid ’80s Finland, Sweden and Austria had a tax on nitrogen fertilisers. However, Finland and Austria abolished the tax when they joined the EU. Swedish calculations show that the tax on fertilisers would have to be 6 to 8 times as high as the current level to achieve the future environmental goals and farmers are concerned that the current policy is an inefficient mechanism for meeting the goal of reducing nitrate pollution.

Instead of a tax on fertiliser, the Netherlands introduced a levy on mineral surpluses in 1998 for intensive dairy farms. In future this will be compulsory (in the Netherlands) for all farm types and tax levels will be higher, to achieve environmental goals (Nitrate Directive). The move to taxation of surpluses reflects a desire to tax the cause of pollution rather than fertiliser use, which may be a poor proxy for environmental damage.

A tax on minerals in fertiliser can result in substitution of fertiliser by other mineral sources. This is not the case for levies on mineral surpluses. Consequently, the levy on surpluses appears to be a far better-targeted instrument. Interestingly, many countries (including Finland) appear to be moving away from tax-based (polluter pay) systems towards subsidy (provider gets) schemes. It is not clear that this will improve the situation unless the subsidy is targeted at the nutrient surplus.

Administrative costs of a tax on fertiliser are about 1% of the revenues or less. The administrative costs for levies on mineral surpluses are much higher. However, not all systems have the same goals. Taxes and charges on fertilisers were primarily meant to raise money for export subsidies or to fund programmes for the provision of advice. The price incentive of the instrument to generate environmental gain was not always the primary aim, and where it was, it was not the only mechanism. Levies on mineral surpluses were explicitly intended to reduce mineral surpluses.

In Austria, Sweden and Finland, prior to joining the EU, a levy was used to fund export subsidies. It is difficult to see how such a levy could have been accepted under Single Market rules since this would appear to fall foul of state aid rules (Article 92 of the Treaty of Rome and now Article 87 of the Amsterdam Treaty), though the rules in respect of agriculture are somewhat exceptional in the EU.

Apart from this, impacts on the internal market of a tax on fertiliser or a tax on mineral surpluses are expected to be low. There is no issue here regarding impediments to the free movement of goods. There may be issues in respect of the avoidance of the taxes through own-use imports where tax rates are high (in the different countries, the levies occasioned a price increase of fertilisers of 8% to 72% in the different countries). Again, the mineral surplus model makes this impossible.

In those countries where the tax was funding exports of grain (before accession to the EU), the tax effectively helped reduce grain surpluses and fund the export of those which were produced. It is clear that the fertiliser industry became less competitive when a tax on fertiliser was introduced, but for other sectors or industries there were only small or no effects at all to be expected on competitiveness. Of those levies still in place, in the Swedish case, the nation appears to have viewed 'environmental credentials' as a factor that could increase competitiveness. In the Netherlands, it would seem that the scheme has a strong educational effect which can improve efficiency in nutrient applications (possibly leading to savings, albeit at the cost of the scheme's administration).

Not much information is available on the effects of taxes on fertiliser or on mineral surpluses on trade. Some countries used the revenues for grain exporting subsidies. So, indirectly the tax influenced the grain market. As far as known, levies on minerals in fertiliser or on mineral surpluses have little or only marginal effects on employment.

Demand for fertiliser is believed to be rather inelastic. So, the direct price effects of the tax are expected to be relatively small. However, in different countries it is shown that tax has a psychological effect as well: the tax initiated an increasing awareness of environmental issues among farmers. In any case, it is difficult to disentangle the price effects from effects of advice and research and development. In combination, the two seem to generate reductions in use that are quite significant. In general, there seems to be a view that combining an environmental tax with a good advisory system will be much more effective than the tax as a stand-alone policy (as discussed in the cases of pesticides taxes).

A positive aspect of tax on mineral *surplus* compared to a tax on fertilisers (instead focusing on nutrient *input*) is the following. A tax on mineral surplus is based on the 'Polluter Pays Principle' by stimulating efficient use of minerals (despite high mineral input efficient use means that many nutrients appear in the final product and not in the environment). A tax on fertilisers makes it possible to avoid paying tax by using less minerals as input. However, the farmer can still cause environmental pollution by *inefficient* use of minerals (all nutrients are found in the environment despite a low mineral input).

Most farmers still have possibilities to improve their profits by a more efficient use of fertiliser and feed. Taxes on minerals in fertiliser as well as a levy on mineral surpluses stimulate the farmers to increase efficiency of fertiliser use. A levy on mineral surpluses also stimulates a more efficient use of other sources of minerals, such as feed. A negative aspect of a levy on mineral surpluses compared to a tax on fertiliser is the extra time and money a farmer (or his accountant) has to spend on setting up a mineral balance for the farm.

Arguably, the issue here is not so much whether any instrument itself is set at an 'efficient' or 'optimal' level. It will not be. The concern is to maximise the efficiency with which nitrate is used. This is another good reason to support the view that the use of complementary advice programmes is likely to be important in increasing the efficiency of fertiliser / mineral use.