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The article should be on 2-3 pages + references, to answer specified questions in questionnaire.

# Experiences with taxes / levies on fertilisers and biocides in Sweden

All monetary amounts in the report are stated in Swedish crowns, SEK, of the actual year. The exchange rate in December 20, 2003 is 1 EUR = 9.05 SEK.

## 1. Nitrogen in fertilizers

### 1.1 Design and administration of the policy instruments

There have been two kind of economic policy instruments directed on nitrogen (N) in fertilizers, a levy and a tax. Both are based on the content (kg) of N in the fertilizer. No charge applies if the total weight of the sold product is less than 10 kg or its concentration of N is  $< 2\%$ .

The levy was introduced in 1982, but abolished in 1992. It was increased in four steps from 0.72 SEK/kgN to its maximum of 1.75 SEK/kgN in 1991-1992. The environmental tax on fertilizer nitrogen has been increased from 0.3 SEK/kgN when it was introduced 1/7 1984, to its present tariff of 1.8 SEK/kgN; see further Table 1 in Appendix 1. The tariffs have not been settled to optimise the N-use or the leaching effects, but rather considering what has been feasible and needed to get revenues.

The tax plus the levy constituted 35 % of the N-price when they peaked, but the tax is at present less than 20 % of the price. It amounts to 300 – 350 MSEK/year (365 MSEK in 2001, of which agriculture pays 350 MSEK). Obtained tax payments have mainly been used for financing environmental research and programmes that conduct advisory services on nutrient management, subsidize manure storage facilities, etc.

The levy and the tax are paid on all fertilizers that are imported or produced in the country. Importers and producers are obliged to register as such, and every month to declare and pay the tax on the delivered quantities for sale. In 2001 there were registered 2 producers, 54 importing retailers and 17 importing users. The levy was administered by the Swedish Board of Agriculture, while the tax is administered by the tax authorities.

Exemptions or special terms do not exist. All fertilizer nitrogen is uniformly taxed, independent of type or concentration of N, field of application, region, or farm type.

### 1.2 Objectives of the policy instrument

The aim of the environmental tax is to reduce the environmental damage of nitrogen leaching. A direct impact is aimed at by increasing the N-price and thus the consump-

tion of nitrogen. There is an intention to obtain further, indirect effects by financing the environmental programmes.

The levy was implemented without any environmental objective, but instead to finance export subsidies and other measures to control the surplus production of grain.

### 1.3 Effects on the use and on the environment

The impact of the N-tax on the consumption of N-fertilizers has been limited. Many factors determine the total use: the acreage of different crops, the agricultural commodity prices, the fertilizer prices, other environmental regulations, etc. Hence, it is difficult to estimate the effects of a change in the tariff and what has other causes. By increasing the N-price and price ratio N/product, a tax will still reduce the optimal N-application. This was illustrated when the total N-charges decreased drastically from 1991/92 to 1992/93, and the purchases of N dropped by 16 %.

Although the levy did not have any environmental objectives, it had of course similar direct effects on the N-use (and accordingly on the leaching).

The estimated short run price elasticity varies between -0.3 – -1.1 in Swedish catchment areas, or -0.2 – -0.4 for all Sweden. If correct, it would imply that the present tax reduces the total application of fertilizer-N by 5 – 10%. Other calculations show that the tax reduced the optimal application in winter wheat, 1994, by 10 kgN to 135 kgN/ha. These calculations estimate the effect on the total N-use to -10 %.

#### *Environmental effects*

The N-tax mitigates the harmful leaching in two ways: directly by increasing the N-price and reducing the use of fertilizers, but more important at present tariff levels, indirectly by financing other agri-environmental measures. The direct price impact is estimated to reduce the leaching from agricultural land by c. 1,500 ton N/y (2003). If the tax is abolished, the total agricultural leaching would increase to c. 60,700 ton N per year.

The indirect effects are significant. A tax gives incentives to better manure handling. It has a symbolic value, signalling the negative aspects of N-use. Psychological effects have been observed, as farmers have reduced their applications more than is economically motivated when the tax was introduced. The largest positive environmental effects of the tax come from their financing other measures, such as better manure handling.

### 1.4 Economic and other effects

The social cost in 1997 to increase the tax with another 15 % was estimated to 10 – 20 SEK per kg N less that is leaching, or 15 – 30 SEK/kgN (not leached) if the tax is increased by 30 %.

To administer the fertilizer and biocide taxes requires 1 man-year per year. The state's total transaction costs for these three taxes is c. 375,000 SEK/year (2002), also including premises and IT-costs.

The international competitiveness of Swedish agriculture is hampered by the N-tax, but only in moderate extent. As agriculture's total costs for fertilizers was 2,230 MSEK in the N-season 2000/2001, the tax burden of 350 MSEK is discernible but limited.

There are indications that the illegal import of fertilizers is about 5 % of the total consumption. It would correspond to c. 15 MSEK/y in lost tax revenues.

## 1.5 Overall evaluation

The N-tax is an instrument having low precision, since the correlation between fertilizer use and environmental damage is quite diffuse. The harm varies drastically depending on soils, crops, cultivation technique, climate, sensitivity of recipient, etc. A tax is consequently not efficient at any level. Farming incomes and competitiveness are also slightly hampered. The Swedish, general experience is still that the tax is a good and important supplement to other measures, reducing the N-use somewhat, signalling that it is desirable to reduce the leaching, and raising funds for other measures. It is simple and easy to administrate. Apparently it will stay in the foreseeable future.

## 2. Phosphorus in fertilizers

### 2.1 Design and administration of the policy instruments

Phosphorous in fertilizers have been charged by an environmental tax and by a levy for market regulations. The tax was based on the content (kg) of P in the fertilizer. At the introduction 1/7 1984, the tariff was 0.60 SEK/kgP. Later it was increased to 1.20 SEK/kgP. The tax was abolished 1/1 1994, replaced by a tax on cadmium in phosphorous fertilizers. A levy on the content of phosphorous (P) in fertilizers was charged in the period 1982 – 1992. Its tariff varied over the years, between 1.4 – 3.8 SEK/kgP in the fertilizer. For more details about the administration and the tariffs, see chapter 1 above and Table 1 in the appendix.

### 2.2 Objectives of the policy instruments

The tax was introduced with the aim of reducing the harmful leaching of nutrients, partly by increasing the price of phosphorous and partly by getting means for agri-environmental programmes. The objective of the levy was to raise funds for measures to regulate the surplus production of grain.

### 2.3 Effects on the use and on the environment

Since phosphorous is largely tied up in most soils, the crop yields and the leaching are little related to the P-application of the year. Consequently, the combined price increase of the levy and the tax decreased the P-fertilization significantly, as yields could be maintained by accumulated phosphorous in the soils. Other factors contribut-

ed to the reduced use, but there was a clear increase in the consumption 1993 when the charges were abolished. It is possible that the price effect would have been less strong in the long run.

Environmentally, the direct effects are assessed to be quite modest, while the indirect effects of raising funds for agri-environmental programmes were positive.

## 2.4 Overall evaluation

The harmful leaching of P is little correlated with how much that is applied by fertilizers, but rather determined by other factors such as manure handling and erosion control. A tax on fertilizer-P is consequently not any efficient instrument to mitigate the leaching problems. It also involved a financial burden for the farm sector. Phosphorous is a non-renewable resource without substitutes for biological processes, and the world stocks are limited. A general tax on all consumption of P in the society with the aim of reducing the non-sustainable withdrawal of resources is assessed to be more efficient.

## 3. Tax on cadmium in fertilizers

Cadmium (Cd) is an extremely noxious, natural pollution contaminating some phosphates at various degrees. Other sources are not contaminated. It is technically and economically feasible to remove the Cd from contaminated fertilizers.

### 3.1 Design and administration of the policy instrument

The tariff is 30 SEK/g Cd on the content above 5 mg Cd/ton P. It is hardly possible to get below that background level, existing in most soils. The Cd-tax was introduced 1/1 1994. Its administration is carried out by the tax authorities at low transaction costs.

In the beginning, the state's revenues were 3.7 MSEK/year. Owing to less contaminated products they have declined to 2.5 MSEK in 2001. There are no exemptions to the tax.

### 3.2 Objectives of the policy instrument

The objective of the Cd-tax is to reduce the contamination of Swedish arable land with cadmium, and thus reduce the risks to health of food consumers and to the natural environment.

### 3.3 Effects on the use and on the environment

The tax has a significant reducing impact on the Cd-contamination of Swedish fields. The average content decreased from 35gCd/kgP before the tax to 20 g Cd per kg P in 1995. Per hectare of arable land is the contamination by fertilizers reduced from 1,4 g Cd/ha/y in 1985 to 0.07 gCd/ha/y in the year 2000. Voluntary measures by the industry have contributed to the impact.

Fertilizers is not the only source of Cd-contamination of soils, although potentially important. Together with other measures, the tax has managed to reduce the net accumulation of Cd in cultivated soils to low level. It gives short and long run positive effects, mainly on the public health but also for the environment.

### 3.4 Economic and other effects

The Cd-tax involves fairly small costs for the Swedish agriculture and society. By increasing the average price of phosphorous, it may have a small restraining effect on the use of such fertilizers.

### 3.5 Overall evaluation

The tax on cadmium is considered as an effective and efficient instrument, which serves an important role of reducing the risks of the heavy metal.

## 4. Potassium in fertilizers

There is no environmental tax on potassium, since it is considered to not have any negative ecological or health effects. A levy for financing the grain market regulations operated in 1982 – 1992; see further Table 1.

## 5. Biocides

### 5.1 Design and administration of the policy instrument

There is an environmental tax on all biocides used in Sweden, that is, on herbicides as well as pesticides (fungicides, insecticides). Raised from 4 SEK/kg active substance when introduced in 1984, it became 8 SEK 1/7 1988 and the present 20 SEK 3/11 1994. There was a parallel fee on biocides from 1/7 1986 to 2/12 1992. It was charged with a uniform amount per standard dose, which could differ from preparation to preparation depending how much of it that was normally used per treatment and hectare. The tariff varied between 29 - 46 SEK/dose. Table 2 in the appendix give more details. The administration is similar to that of the fertilizer tax, see chapter 1.1 above.

The revenues from the biocide tax varied between 32 MSEK/y – 42 MSEK/y in 1995 – 2001.

No exemptions to the tax or the levy exist. Also forestry and horticulture are charged, besides agriculture. Products used in the production of medicine, when processing food, or that are part of paint, varnish or suchlike, are not considered as biocides.

### 5.2 Objectives of the policy instrument

The tax' objectives are to reduce the health and the ecological risks related to the use of biocides. Increasing the price of biocides shall give economic incentives to reduce

the use. A double effect is aimed at by using the obtained tax revenues for research and agri-environmental programmes to restrain the applications.

The levy was implemented to finance export subsidies and other measures to control the surplus of agricultural products.

### 5.3 Effects on the use and on the environment

The biocide use in Sweden has decreased considerably since the levy and the tax were implemented, especially if measured in kg active substance. Much of the reduction is explained by other causes, such as new preparations that are used in smaller quantities per dose, generally lower doses, and reduced crop acreages. It is thus difficult empirically to state how much of the reduction that is due to the charges.

The tax corresponds in average to 7 % of the biocide price to the user. The higher price has reduced the biocide use a little, but the tax is too low to have any major or lasting impact. Similar effects were received by the levy, increasing the price and somewhat reducing the consumption of biocides.

The major effects of the tax are indirect. Signalling that society finds the biocides harmful has been giving a psychological effect. Most important are that the tax revenues finance research, development and advising to reduce the biocide hazards.

Health and ecological risks are mitigated in proportion to the reduced use of biocides. The positive impact is limited. A part of the shift towards more modern, less harmful low-dose preparations is probably due to the tax.

### 5.4 Economic and other effects

Swedish agriculture is presently not too burdened by the tax, as it implies that the total costs for biocides have increased by c. 35 MSEK to 613 MSEK (year 2000). Of total cultivation costs per hectare the tax constitute less than 1 %. Some crops' profitability is hardly affected; the tax' part of the cultivation costs is 0.3% for winter wheat, 0.5 % for spring barley and food potatoes, 0.6 % for sugar beets and 0.7 % for winter rape. The tax increase the cultivation costs by 20 SEK/ha in the normal grain production and by 60 – 100 SEK/ha in the normal potato or sugar beet production.

At present tariff levels, the tax has negligible effects on the international competitiveness of Swedish agriculture.

The administration of the tax is reported to be uncomplicated having low costs. In the cultivation year 1994/95, its total state transaction costs were merely 4,000 SEK, corresponding to 0.01 % of the tax revenues.

Illegal import of biocides is relatively easy. There are indications that it exists, but it concerns more the smuggling of preparations that are forbidden in Sweden but not in continental Europe, and hardly attempts to avoid the tax. High prices and pesticide taxes in neighbour countries partly explain that the problem is considered as small.

The design of the tax, per kg, has promoted farmers to turn to low-dose preparations.

## 5.5 Overall evaluation

The tax is an important policy instrument supplementing other measures to reduce the risks. At present levels are its direct impacts through the price mechanism limited, while the fund raising effect for other measures is more important. The present design is not very efficient, so increased tariffs would reduce the profitability in crop production. A risk differentiated tax would be far more efficient.

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## Appendix 1

**Table 1. Levies for price regulations and environmental taxes on fertilizer nutrients in Sweden 1985 - 2003.** SEK per kg of nitrogen (N), phosphorous (P) and potassium (K)

Period	Levies for price regulations			Environmental taxes		Total		
	N	P	K	N	P	N	P	K
1985.01.01–	.72	1.38	.43	.30	.60	1.02	1.98	.43
1985.07.01–	.93	1.79	.56	.30	.60	1.23	2.39	.56
1986.07.01–	1.12	2.43	.76	.30	.60	1.42	3.03	.76
1988.07.01–	1.12	2.43	.76	.60	1.20	1.72	3.63	.76
1990.11.06–	1.46	3.16	.99	.60	1.20	2.06	4.99	.99
1991.08.03–	1.75	3.79	1.19	.60	1.20	2.35	3.63	1.19
1992.07.01–	1.12	2.43	.76	.60	1.20	1.72	1.20	.76
1992.12.02–	0	0	0	.60	1.20	.60	1.20	0
1994.01.01–	0	0	0	.60	0	.60	0	0
1994.11.03–	0	0	0	1.80	0	1.80	0	0

**Table 2. Levies for price regulations and environmental taxes on herbicide and pesticides in Sweden.** Tax in SEK/kg active ingredients; levy in SEK/standard dose

Period	Environmental tax	Price regulation levy
	SEK/kg a.i.	SEK/dose
1984.07.01–	4	0
1986.07.01–	4	29
1988.07.01–	8	29
1990.11.06–	8	38
1991.03.08–	8	46
1992.07.01–	8	29
1992.12.02–	8	0
1994.11.03–	20	0