ASSESSING THE INCENTIVE FUNCTION OF ENVIRONMENTAL FEES: CASE STUDY – THE DISTRICT OF SILESIA

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Abstract

The environmental effectiveness of fees for using the environment ("environmental fees") charged in Poland is demonstrated by their incentive function, which motivates organisations using the environment to behave in the appropriate, environmentally-friendly way. The purpose of this paper is to assess how well the fees fulfil this function. The incentive function is evaluated by analysing the quantity of pollution emitted into the air, water and soil, the quantity of waste landfilled and of water taken in within the context of changes to unit fee rates in 2005-2011. This study was conducted using data obtained from the Marshall's Office of the Silesian District (Śląsk) of Poland, which transferred the highest environmental fees over the period of 2008-2011 [NFOŚiGW (National Fund for Environmental Protection and Water Management), Informacja ...]. Substances and processes for which the amount of pollution emitted or water taken in was significant, were chosen for the analysed sample. The assessment of the incentive function based on the figures from one district, (Voivodship), is illustrative in nature and one can only presume that the trends observed in this area, which uses the environment to a large extent, will also be true for data from the entire country and thus significantly impact the national average. However, for the sample to be more representative, it is necessary to carry out the same analyses for subsequent districts and to aggregate the data. The author intends to extend the research by doing so and this should be the purpose of separate publications.

Keywords: *environmental fees, cost, emission quantity, environment, incentive function*

1. Introduction

Environmental fees represent one of the tools used by Poland to implement constitutional assumptions of sustainable development [Art. 5 of the Polish Constitution]. Fee rates are expressed in PLN per one unit which expresses the release of a pollutant into the environment or the use of natural resources

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in the best way. [Małecki, Opłaty…2009]. The ability to freely supervise their effectiveness should constitute one of the fundamental tools which the State can use to assess the solutions it applies to implement the sustainable development policy. However, as mentioned in literature [Małecki, System…, 2012], the last detailed analysis of this subject was completed in 2003. This study is an attempt to assess the environmental effectiveness of environmental fees as illustrated by Silesia District as an example. This district, even though it is one just one selected area of Poland, is apparently quite representative, as the use of components of its environment in the operation of organisations is significant on the national scale.

2. A brief description of environmental fees

Environmental fees are paid by organisations conducting business activity, institutions (schools, municipalities etc.) and in strictly defined cases also by natural persons running no business. In Poland, the payable fees are split into 4 components: gaseous and particulate air emissions, water intake, sewage disposal, waste landfilling. Rates per unit of pollutant or of water taken in are set by the Minister of Environment or by a decree of the Council of Ministers. Every organisation is obliged to calculate the due fee and to pay it to the account of the Marshall's Office with jurisdiction over the location where the environment is used.

The obligation to calculate the fee arises, for example, during the following processes:

- space heating with boilers fired with coal, coke, petroleum, gas, wood,
- poultry production,
- fuel reloading,
- emissions from installations used to produce charcoal,
- emissions from installations used in food mills,
- abstraction of underground water and intake of surface water for sanitation/consumption and other purposes,
- discharge of salty water, cooling water and other pollution into the soil or waters,
- running landfills.

The above activities implying the use of the environment are just a few examples of multiple processes which lead to the duty of calculating fees [Environmental Protection Law].

3. Functions of environmental fees

Environmental fees are principally assumed to have the following three functions ranked as below (in decreasing order of importance) [Małecki, System…2012]:

- incentive function,
- revenue function,
- information function.

The incentive function motivates organisations obliged to pay the fee to take action to restrict operations harmful to the environment. This result can be achieved by various technical and organisational measures implemented within their business, which should ultimately lead to, for instance, a reduction of harmful air emissions, curtailing excessive water intake or sewage discharge [cf. Małecki, Opłaty…2009]. The incentive function can be defined as an action consisting in setting fees at a level which is significant from the perspective of costs, profit and prices applied by entrepreneurs [Fiedor, Podstawy…2002].

The revenue function is understood as the collection and then the secondary distribution of funds which are used to finance (co-finance or subsidise) projects protecting the environment and (or) rationalising the scope within which public and private organisations use environmental resources and the method by which they use them [Małecki, System…2012].

The information function consists in signals about significant environmental hazards coming from the quantity of pollution or environmental use reported by entrepreneurs [Małecki, System …2012]

4. Analysis of changes in the use of environmental components resulting from the change of environmental fee rates

To achieve, *inter alia*, the purpose of this study, in January 2013 an application was sent to the Marshalls' Offices for environmental data including annual information about: the quantity of air emissions, of substances discharged in sewage, the quantity and type of landfilled waste , the quantity of water taken in. A pilot analysis was conducted using data received from the Silesian District Marshall's Office concerning the change in the quantity of pollution emitted and water taken in depending on the rate of current fees, including their changes. This area was chosen due to a significant scale at which its environment is used. The substances and processes - for which rate changes were presented in Table 1 and the scale of pollution emission changes is analysed - were principally chosen due to the quantity of air emissions, of pollutants emitted, the quantity and type of waste or the quantity of water taken in in the analysed period. Items characterised by high parameters were chosen. The time range selected is due to the availability of information stored in the IT system of the Silesian Marshall's Office since 2005. By January 2013, the quantities of pollution emitted and water taken in in 2012 had not yet been entered into the system. The data was collated globally (the total emission/ intake of all reporting organisations) for the Silesian District, and also the emission/consumption was determined for each organisation which reported in every year of the analysed period lasting from 2005 to 2011. The organisations reporting every year were distinguished to analyse the behavioural trend of organisations for which the use of the environment forms a long-term part of their business and which should take action to reduce the fees as a typical item pushing their costs up. In the remaining part of the publication, these organisations are referred to as the "permanent organisations".

From 2005 to 2011, the rates of environmental fees changed insignificantly (usually by the inflation rate), with the exception of selected substances, and in particular rates for unsorted waste. The rates presented in Table 1 are basic rates exclusive of differentiating ratios which are applied to sewage, for instance.

Table 1. Unit fee rates in 2005-2011 and the 2011/2005 rate change in per cent

Unit fee rates								
Emission [substance/ installation/activity]	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	2011/2005 change in %
sulphur dioxide (SO2) [PLN/kg]	0.41	0.42	0.43	0.43	0.44	0.46	0.48	17.07%
carbon monoxide (CO) [PLN/kg]	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.00%
nitrogen oxides (NO2) [PLN/kg]	0.41	0.42	0.43	0.43	0.44	0.46	0.48	17.07%
fixed grate boiler, natural draft, heat capacity <=5 MW [PLN/Mg of hard coal]	23.38	24.2	24.71	24.96	25.58	26.65	27.58	17.96%
methane PLN/Mg	0.22	0.23	0.23	0.23	0.24	0.25	0.26	18.18%
particulate from fuel combustion [PLN/kg]	0.27	0.28	0.29	0.29	0.30	0.31	0.32	18.52%
Filling underground tanks [PLN/MG of fuel]	2.40	2.48	2.53	2.56	2.62	2.73	2.83	17.92%
Waste type	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	2011/2005 change in %
200301 – unsorted municipal waste [PLN/ Mg]	14.87	15.39	15.71	75	100	104.2	107.85	625.29%
191212- other waste (includes mixed substances and objects) from mechanical waste processing, containing no hazardous substances [PLN/Mg]	14.87	15.39	15.71	60	61.5	64.08	66.32	346.00%

200399 – Municipal waste, not listed in other subgroups [PLN/Mg]	14.87	15.39	15.71	15.87	100	104.2	107.85	625.29%
Sewage – substance, pollution type	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	2011/2005 change in %
BOD5 [PLN/kg]	3.24	3.35	3.42	3.45	3.54	3.69	3.82	17.90%
COD [PLN/kg]	1.29	1.43	1.37	1.38	1.41	1.47	1.52	17.83%
Cl+SO4 [PLN/kg]	0.038	0.039	0.04	0.04	0.041	0.043	0.045	18.42%
cooling water with discharge temperature above +26°C and under 32°C [PLN/1 dm3]	0.51	0.53	0.54	0.55	0.56	0.58	0.6	17.65%
rain- or meltwater from tightly surfaced roads and car parks [PLN/m2/year]	0.043	0.045	0.046	0.046	0.047	0.049	0.051	18.60%
Water intake	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	2011/2005 change in %
Averaged water intake rate (for underground and surface waters) for the following purposes [PLN/m3]:								
other	0.065	0.0675	0.069	0.0695	0.071	0.074	0.0765	17.69%
sanitation and consumption	0.041	0.0425	0.0435	0.044	0.045	0.0465	0.048	17.07%

Source: own development based on announcements and decrees on fee rates.

Graphs (1, 2) and Tables (2, 3) present the change between the average emission in 2006-2011 and in 2005 collated with the average change of unit rates for particular substances/activities in the same period. Figures shown in Graphs 1 and 2 as well as Tables 2 and 3 show that for the majority of items selected for analysing, the emission of air pollution fell (except for carbon monoxide and methane) while the rates increased. The emission of carbon monoxide increased while the fee rate per unit of gas emitted did not increase. This trend was noted for both all organisations in the district and those that reported in the entire period under analysis. In the analysed period from 2006 to 2011, the average carbon monoxide emission in the whole district rose by 126,000 Mg, with the maximum of 139,000 Mg recorded in 2010, and the minimum of 95,000 Mg in 2009. The same applied to methane (emission grew), even though the unit rate for emission was rising in the analysed period. In 2006-2011, the average methane emission amounted to 428 Mg, the minimum to 406 MG (2011) and the maximum to 441 Mg (2006) in the entire district.

Emission from boiler houses with the thermal capacity up to 5 MW for all organisations in the Silesian District increased slightly in the analysed period, but fell clearly for permanent organisations.

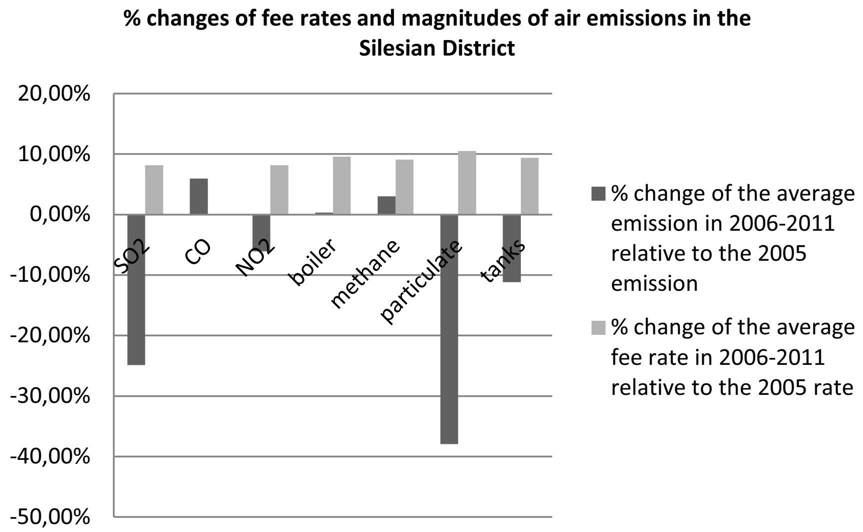

Figure 1. Changes of fee rates and magnitudes of air emissions

Table 2. Source data for Figure 1

Substance/activity	% change of the average emission in 2006-2011 relative to the 2005 emission*)	% change of the average fee rate in 2006-2011 relative to the 2005 rate
Sulphur Dioxide (SO2)	-24.89%	8.13%
Carbon Monoxide (CO)	5.97%	0.00%
Nitrogen Oxides (NO2)	-6.08%	8.13%
Fixed grate boiler, natural draft, heat capacity <=5 MW	0.33%	9.55%
Methane	3.00%	9.09%
Particulate from fuel combustion	-37.95%	10.49%
Underground tank filling	-11.16%	9.38%

*) negative values represent a drop, positive values – an increase

Source: own development based on long-term reports from the Marshall's Office.

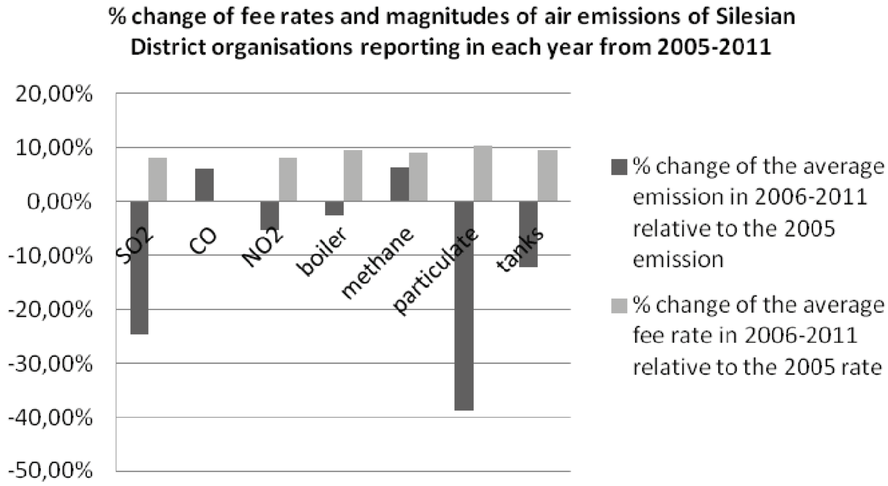

Figure 2. Changes of fee rates and magnitudes of air emissions for permanent organisations

Table 3. Source data for Figure 2

Substance/activity	**% change of the average emission in 2006-2011 relative to the 2005 emission*)**	**% change of the average fee rate in 2006-2011 relative to the 2005 rate**
Sulphur Dioxide (SO2)	-24.75%	8.13%
Carbon Monoxide (CO)	6.13%	0.00%
Nitrogen Oxides (NO2)	-5.33%	8.13%
Fixed grate boiler, natural draught, heat capacity <=5 MW	-2.60%	9.55%
Methane	6.21%	9.09%
Particulate from fuel combustion	-38.86%	10.49%
Underground tank filling	-12.06%	9.38%

A very clear trend quantity decrease trend is seen relative to the waste fees. As the unit rates for waste go up, the quantity of waste landfilled goes down. Data in Table 4 demonstrates that in 2005-2008, while the unit rates for waste landfilling changed only slightly, the quantity of waste kept growing.

Starting with 2008, when the rates for the analysed waste types increased drastically, the quantity of waste, particularly unsorted municipal waste, dropped significantly.

Table 4. Rates for, and quantities of landfilled waste for selected waste types from permanent organisations

	Waste type					
Period	**200301 – unsorted municipal waste [PLN/ Mg]**		**191212- other waste (includes mixed substances and objects) from mechanical waste processing, containing no hazardous substances [PLN/Mg]**		**200399 – Municipal waste, not listed in other subgroups [PLN/Mg]**	
	fee rate	**waste quantity [Mg]**	**fee rate**	**waste quantity [Mg]**	**fee rate**	**waste quantity [Mg]**
2005	14,87	740 321,58	14,87	19 284,86	14,87	6 747,83
2006	15.39	792,216.43	15.39	30,073.41	15.39	8,946.87
2007	15.71	801,852.94	15.71	45,338.10	15.71	10,911.21
2008	75.00	617,292.97	60.00	120,301.71	15.87	14,483.64
2009	100.00	490,742.61	61.50	176,573.97	100.00	12,158.80
2010	104.20	332,868.30	64.08	233,029.47	104.20	5,095.80
2011	107.85	197,179.14	66.32	210,516.24	107.85	5,773.33

Source: own development based on long-term reports from the Silesian District Marshall's Office.

The quantity of other waste from the mechanical processing of waste containing no hazardous substances - for which the rates did not grow so rapidly and ultimately stopped at a level lower than for the remaining two analysed types of waste - kept growing steadily. This may be due to the intention to save on waste in an unorthodox way, which motivated organisations to act so as to make shifts between waste types and thus decrease the quantity of the type subject to the highest rate (200301) while increasing that of the type for which the unit rate is the lowest (191212).

In 2006-2011, the average quantity of landfilled waste amounted to:

- waste code 200301: 675,000 Mg,
- waste code 191212: 261,000 Mg,
- waste code 200399: 22,000 Mg;

which, compared to the 2005 quantities, represented respectively: a 25% drop, a 521% increase and a 70% drop for all organisations from the Silesian District.

With regard to the sewage discharged, the analysis of selected substances demonstrates a successive quantitative decrease. Graph 3 and Table 5 indicate that for permanent organisations, the quantity of sewage (substances) follows a downward trend. When the average sewage quantities in 2006-2011 are compared to those of 2005, there is a percentage decrease of most analysed items for all organisations from the Silesian District. The only exception is COD, whose quantity [kg] was 3.87% greater in 2006-2011 than in 2005. In the same period, the unit rate increased by 10.85% compared to that of 2005. In 2006-2011, the quantity of COD in sewage averaged 11,225 tons, with the maximum of 11,806 tons in 2010 and the minimum of 8,892 tons in 2006 for all organisations from the Silesian District.

The Cl+SO4 indicator was also slightly higher, on the average, in 2006-2011 than in 2005.

However, it should be noted that it is the figures for permanent organisations that should suggest the direction of change, as they show whether these organisations took any preventive measures between 2005 and 2011. On the contrary the figures for the entire district are distorted by data from organisations which, for instance, reported in 2005-2008 and then discontinued their business, or those that started operations in 2010 and reported in 2010-2011.

Figures on water intake also indicate a fall in the quantity of water taken in. For water, the analysis was conducted as follows:

- unit rates of fees for consuming underground and surface water were averaged for the following purposes: sanitation/consumption and other,
- the abstraction/intake of underground and surface water [m3] was averaged as divided into the following purposes: sanitation/consumption and other,
- the average consumption [m3] in 2006-2011 was calculated for the water consumption determined by the method under b. above,
- the average unit rate in 2006-2011 was calculated for the rate determined by the method described in a. above.

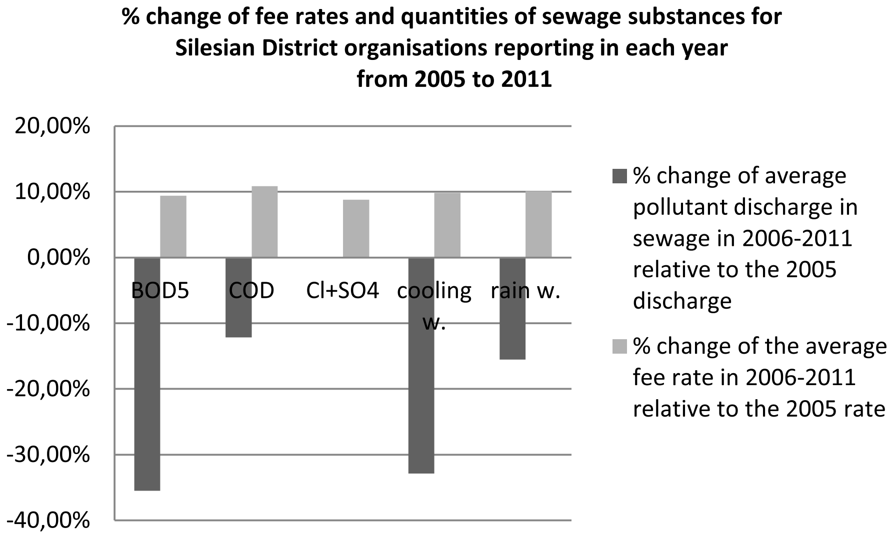

Figure 3. Changes in fee rates and quantities of sewage substances

Table 5. Source data for Figure 3

	% change of average pollutant discharge in sewage in 2006-2011 relative to the 2005 discharge	**% change of the average fee rate in 2006-2011 relative to the 2005 rate**
BOD5 *)	-35.49%	9.41%
COD **)	-12.17%	10.85%
Cl+SO4 ***)	-0.06%	8.77%
cooling water, discharge temperature above +26˚C and up to +32˚C [PLN/1 dm3]	-32.84%	9.80%
rain- or meltwater from tightly surfaced roads and car parks [PLN/m2/yr.]	-15.54%	10.08%

*) BOD5 – five day oxygen demand: the quantity of oxygen consumed in five days to oxidise substances (mainly organic) contained in sewage).

**) COD – chemical oxygen demand: the quantity of oxygen consumed in the process of chemically oxidizing sewage.

***) Cl + SO4 - the total of chlorides and sulphides.

Source: own development based on long-term reports from the Silesian District Marshall's Office.

The data presented in Figures 4 and 5 justifies the statement that in the case of water, its average intake in 2006-2011 was smaller than in 2005.

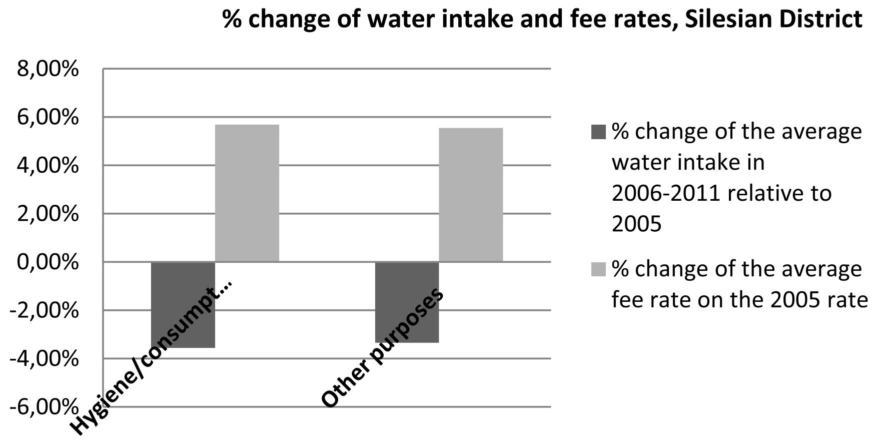

Figure 4. Change in the water intake and unit fee rates for all organisations from the Silesian District.

Table 6. Source data for Figure 4

	% change of the average water intake in 2006-2011 relative to 2005	**% change of the average fee rate relative to the 2005 rate**
Hygiene/consumption purposes	-3.56%	5.69%
Other purposes	-3.34%	5.56%

Source: own development based on long-term reports from the Silesian District Marshall's Office.

The decreasing trend of water consumption is observed both among permanent organisations and all those reporting in the Silesian District in 2005-2011.

Table 7. Source data for Figure 5

	% change of the average water intake in 2006-2011 relative to 2005	**% change of the average fee rate relative to the 2005 rate**
Hygiene/consumption purposes	-3.72%	5.69%
Other purposes	-2.91%	5.56%

Source: own development based on long-term reports from the Silesian District Marshall's Office.

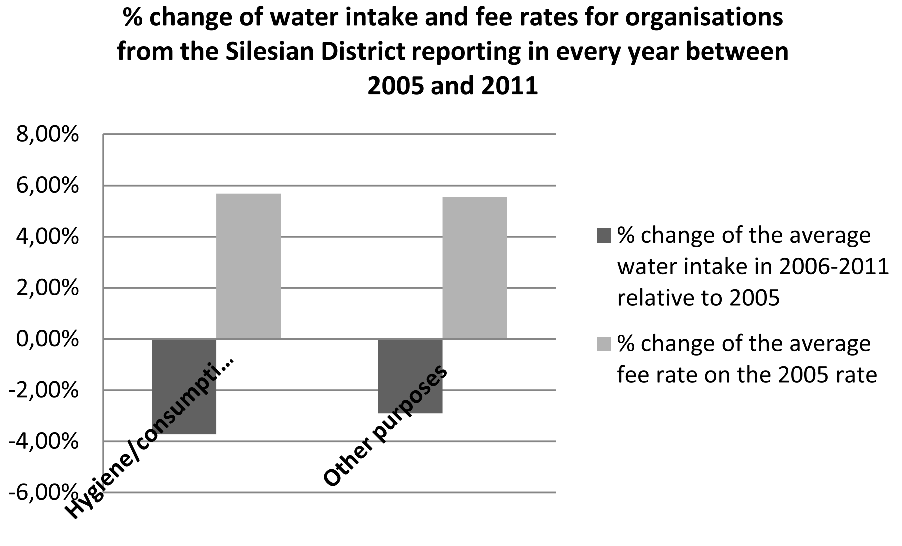

Figure 5. Change in water intake and unit fee rates for permanent organisations
Source: own development based on long-term reports from the Silesian District Marshall's Office.

5. Assessment of the incentive function of fees

The analysis of figures on pollution emission into the air, water and soil, on waste landfilling or water consumption allows at least a preliminary assessment of the incentive function of environmental fees. The author believes that fees act as a factor forcing organisations to take action to reduce the harmful environmental impact of their operations. They do so by reducing the quantity of emitted pollution, landfilled waste or water taken in. Obviously, there may be drivers other than fees, but the financial aspect seems to play a leading role in the majority of economic activities.

A decreasing trend of the quantity of the analysed substances/activities is observed. This analysis seems to be confirmed by the amount of fees due for 2005-2011 as shown in reports filed by the obligated organisations with the Silesian District Marshall's Office. This is because a decrease in the emission of pollution or the intake of water is reflected in the value of fees paid for particular years. Table 8 shows that the fee value does not exhibit a constant growing trend for the same organisations. Neither does the increase in individual types of fees correspond to the growth caused by inflation.

Table 8. Amount of due environmental fees from permanent organisations, PLN

	Fee for an environmental component			
Period	Air emissions	Waste	Sewage	Water
2005	121,795,793.24	13,631,569.99	56,577,225.06	22,372,917.86
2006	137,131,644.16	15,780,996.00	61,712,485.00	22,879,194.00
2007	144,416,005.10	16,814,920.00	63,431,985.00	22,772,846.00
2008	104,553,608.00	65,421,163.00	55,579,581.00	22,000,803.00
2009	102,554,424.06	73,364,417.00	64,166,465.49	21,465,040.00
2010	121,519,074.41	62,107,326.00	71,215,934.00	22,541,551.00
2011	122,221,058.36	53,608,986.00	63,493,879.00	23,232,415.00

Source: own development based on long-term reports from the Silesian District Marshall's Office.

With regard to air emissions, the data for years 2008 and 2009 should not be included in this analysis, because in those years organisations which received emission allowances did not pay fees for carbon dioxide emissions to the Marshall's Office [art. 25.1 of the Act of 22 December 2004 on emissions trading...]. They paid them directly to the account of the National Fund for Environmental Protection and Water Management (NFOŚiGW). In the case of waste, the increase in fees is particularly due to a dramatic increase of unit fees for individual waste types. However, it should be noted that after the sudden increase of fees in 2008-2009, the following years saw a clear decreasing trend, which would confirm the reduction of the quantity of landfilled waste.

6. Conclusions

Environmental fees seem to fulfil one of their main intended functions, namely the incentivising one. Obviously, the research should be extended geographically, i.e. data from reports of other Marshall's Offices should be analysed, trends studied and the magnitude and range of variances determined. The fulfilment of the revenue function should also be studied. For example, the state environmental policy for 2009-2012 calls for PLN 24.4 billion of environmental spending financed by national public funds, while the revenue from fees for polluting the environment amounted to PLN 5.6 bn [NFOŚiGW, Informacja…2011] and represented 23% of all planned expenditure. If fee revenues in 2012 were the same, one can expect that they would cover about 30% of the spending.

To summarise: the figures for just one district do not unambiguously justify the claim that the incentive function, which is a criterion of environmental effectiveness, is fulfilled. However, a conclusion can be drawn that organisations using the environment seem to behave rationally, which is proven by their appropriate reaction (a reduction in pollution quantity) to environmental fees (including their increase), and their constant tendency to reduce the magnitude of their detrimental environmental impact.

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