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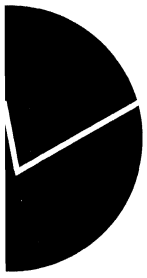

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Waste Water Treatment and Waste Management Expenditure in Norway

Department of Economic Statistics / Division for Environmental Statistics

1. Introduction

1.1 Summary

Statistics Norway's (SSB's) work on environmental protection expenditure dates back to the middle of the 1980's. After examining the need for data and earlier work in this area, we have now started collection of economic data for municipal waste water treatment and municipal waste management. Data on municipal waste water treatment is collected in the electronic questionnaire "SSB-AVLØP" while data on waste is collected in the paper questionnaire "Municipal Waste". The results for 1994 are ready with regards to waste water treatment. As regards waste management, we have results for the studies carried out in 1993 and 1994. On the whole, we can assert that the studies have come out with satisfactory results. We experienced that the collection of data on environmental protection costs posed many challenges even for areas like waste water treatment and waste management which are both relatively demarcated environmental areas.

The total investment in municipal waste water treatment in Norway for the period 1974 to 1993 was about 25 milliard 1993-kroner. In 1993, the total expenditure on municipal waste water treatment was 3.1 milliard kroner. The charges which were collected by the municipalities (in the form of connection charges and annual charges) covered 80% of these costs. The municipalities' total cost for handling waste was 1.9 milliard kroner in 1994. This averages out to about 440 kroner per capita.

1.2 Background

Norway has keenly followed the work of Eurostat on environmental protection expenditures in *Sub-groups on economic data* for the Public sector and Manufacturing industry. In connection with this, Statistics Norway has mapped out the need, earlier experiences, plausible sources and earmarked areas for statistics on environmental expenditures in Norway (Austbø 1994). In these notes, earlier experiences from work with statistics on environmental protection expenditures have been discussed. In addition, the notes present Statistics Norway's experience and results from the collection of data on environmental protection expenditures in the waste water treatment and waste sectors.

Earlier work

At the start of Statistics Norway's work on environmental protection expenditures in the middle of the 1980's, a sample study of environmental protection investments in manufacturing industry was carried out (SSB 1987). Experiences from the collection of data in this study were quite discouraging culminating in the fact that SSB has not repeated a comparable study since then. However, in 1992, the Confederation of Norwegian Business and Industry (NHO) carried out a registration of environmental protection expenditures in the manufacturing industry.

In the 1980's, data for investments and operational costs of municipal waste water treatment was extracted from the municipalities' accounts statistics and presented in the report series "Natural Resources and the Environment".

With regards to state administration, the efforts geared towards the environment are collocated and presented in the "Green Book".The juxtaposition has been done yearly beginning with the 1989 budget by the Ministry for Environmental Protection. This has been done with the co-operation of other ministries.

The problems encountered in the studies and comparisons done in Norway are of similar nature to the problems encountered in many other countries during similar studies. One of the major problems for the manufacturing industry was that, it was difficult for the firms to calculate additional investment as investment in new or modified production processes (integrated investment) and to apportion environmental protection expenditures among different environmental areas. Costs of investment in cleansing plants (end of pipe) were much easier to ascertain. Due to the fact that, over the years an increasing portion of environmental protection investments are integrated in the process, it seems that a mapping out of the industry's environmental protection investments would probably be much more complicated now than it was in the 1980's.

During the compilation of the "Green book" it was very difficult to demarcate the concept of "environmental efforts". In a similar vein, it has been more common to include environmental protection considerations when carrying out projects in the public sector. This is due to "inter alia" stricter requirements from the authorities. Consequently, many projects have as a sub-objective environmental protection.This problem corresponds directly to the problem of integrated environmental protection in the manufacturing industry.

New Earmarked Areas

There is the need for data on environmental protection expenditures as a basis for planning and controll of results at both the national and international levels.

Environmental protection differentiates itself from many other statistical areas due to the fact that it does not stand out as a sector by itself. Environmental protection and consequently environmental protection costs encroach on other sectors.With regards to the environment, sector encroachment and integrated environmental protection are much more effective solutions than the end of pipe solutions.The other side of the coin is that, collection and systematization of data on environmental protection expenditures and environmental protection technology become more complicated with integrated solutions. One must therefore take into consideration the features of sector encroachment and integration when one is compiling statistics on environmental protection. It is an understatement that one must seriously consider whether environmental protection expenditures or at least certain types of environmental protection expenditures are suitable for compilation of statistics.

With particular reference to Norway, we assess the situation as very resource demanding to follow up Eurostat's work with reference to the collection and juxtaposition of data with the objective of preparing complete statistics over environmental protection as expressed in SERIEE. Certain types of environmental protection expenditures will probably be almost impossible to identify. Moreover, it might be difficult to see the rationale behind the compilation of a so detailed work as SERIEE sets itself up to. It would therefore be more appropriate if the objective and the planned use of SERIEE are much more clarified. As a result of demarcation problems as mentioned above and limited resources, Norway has had to limit work on environmental protection expenditures to a few priority areas.

Norway wishes to collect and collocate data on environmental protection expenditures for limited areas where the need for data is crystal clear. It is therefore natural to pick upon the public areas: municipal waste water treatment and municipal waste management which in Norway fall under the technical sector in the municipalities and form a substantial portion of the municipal environmental protection work. We presumed that the areas; waste water treatment and waste are clearly demarcated in their totality as environmental areas. Moreover, data on these areas are of interest to us due to a couple of reasons. First, there is the need for a better overview of the expenditures on waste water treatment and waste. Second, these costs presumably form a substantial portion of environmental protection expenditures.

2. Objective

Data on expenditures and incomes in the areas municipal waste water treatment and waste will establish a basis for statistics and simultaneously give coverage to the Ministry of environmental protection and the Norwegian Pollution Controll Authority's (SFT) need for data in this area. Waste water treatment and waste management are two substantial public environmental areas where relatively large amounts of money are used locally. There is therefore the need for a better overview over investments and present day cost levels which will come in handy during result control analyses and future planning.

3. Method

3.1 Collection of data

The alternative methods for collection of data were:

A. Extraction from municipal accounts
Statistics Norway receives annual accounts from all the municipalities in Norway. Statistics on the accounts are available for all years as far back as 1972 and give information on operational costs and investments. Municipal accounts statistics do not however include all economic data which we would wish to collect data for under under waste water treatment and waste.

B. Collection of data through specific studies
As regards waste water treatment and waste management, Statistics Norway already had established methods for collection of physical data. Physical data on waste water treatment such as data on cleansing plants, discharges and sludge treatment have been collected in the electronic questionnaire "SSB-AVLØP" annually from 1990. On the other hand, physical data on waste such as data on quantities of waste and recycling have been collected through the paper questionnaire "Municipal Waste" annually from 1992. It was therefore quite straightforward for "SSB-AVLØP" and "Municipal Waste" to be expanded with questions on economic data.

The Ministry for municipalities has come out with guidelines on how the municipal accounts and budgets should be done. In addition, the municipal accounts have a separate sub-chapter on waste water treatment and waste management respectively. Nevertheless, there are several issues of uncertainty linked to the municipal accounts for waste water treatment and waste management. The municipalities in many cases, have a large degree of discretion with regards to how expenditures are handled. For example, expenditures under waste water treatment and waste management could be classified under other areas such as administration, new constructions, roads and waterworks. A case in hand is that, a municipality with equipment used for both waterworks and waste water treatment could categorize the total costs of these two areas under any one of these areas instead of apportioning them under these two. Moreover, the municipalities could classify large investments under operational expenditures. During the 1990's, the amount of resources apportioned to the revision of municipal accounts has been reduced. The technical sector under which waste water treatment and waste management fall are therefore no longer priority areas in this regard (SSB 1990). The figures for the technical sector do not therefore give a very correct picture of the expenditures on waste water treatment and waste mangement.

Due to the considerable degree of uncertainty linked to the data from from the municipal accounts for the technical sector, we decided to collect data on waste water treatment and waste expenditures through specific studies. As a result, in 1994 'SSB-AVLØP' and 'Municipal Waste' were extended to include economic data.

3.2 Execution

Waste water treatment
SSB-AVLØP is distributed to the county governors' environmental agencies which are the state's administrative organs in the counties. The environmental protection agencies have the responsibility to report data annually for all the municipalities under the county. The data is then sent to Statistics Norway on floppy disc and is controlled and reviewed here. The results from the study carried out in 1994 are available while results from the study carried out in 1995 will be ready in Autumn 1995.

The county governers' environmental protection agencies normally use different methods to collect economic data from the municipalities. Some do collect data by the help of questionnaires and telephone, others use registers and annual reports from the municipalities and some do use a combination of both. Due to the inadequacy of economic data which Statistics Norway received from the environmental departments in 1994, Statistics Norway had to send out paper questionnaires with the partly inadequate data back to the municipalities for control and completion.

Waste management
The questionnaire "Municipal Waste" is sent to the municipalities through the environmental protection agencies in the counties. In 1993, the study covered the whole population while in 1994 and 1995 sample studies were carried out. In 1996, the study would cover the whole population. The results for the economic data are available for both the study carried out in 1994 and 1995.

The questionnaires, with guidelines were sent to 49 out of a total of 435 municipalities in 1994 and 1995. However, it is noteworthy that these 49 municipalities comprised about half the population of Norway. From each county, the number of municipalities which participated varied from 1 to 4. The municipalities returned the filled in questionnaires to the environmental protection agencies in the various counties which then sent them to Statistics Norway. The environmental protection agencies sent out the first round of reminders to the municipalities while Statistics Norway sent out the second if there was the need.

The filled in questionnaires were then manually controlled and revised at Statistics Norway. In case of inadequate answers or if there was the need for elucidation with regards to possible misunderstandings or mistakes, the contact person in the municipality was given a phone call. The majority of the municipalities were called both in 1993 and 1994.

3.3 Contents of the questionnaire

Waste water treatment
The following economic data were supposed to be reported for each municipality in 1994:

- Number of households and industrial or business units connected to the municipal pipe network system.
- Rates for waste water treament charges for the present year.
- Collected charges, operational expenditures and investments, previous accounting year.
- Investments (exclusive subsidies) which form part of the basis of the charges for the last twenty years.
- Planned investments for each year up to the year 2000.

Operational costs were supposed to be apportioned among: a) administration b) operation c) maintenance and d) inter-municipal co-operation. In the study carried out in 1995, b) operation and c) maintenance have been put together.

Investments in 1993 and planned investments were to be apportioned under the categories: a) new pipes b) rehabilitation of existing pipe network c) cleansing plant without the removal of nitrogen facility d) sludge treatment e) nitrogen removal.

Waste Management
The following economic data were supposed to be reported from the sample municipalities for the previous accounting year (that is from the year before the study).

- Operational expenditures, operational income (excluding collected waste water treatment charges)
- Capital costs and income from the sale of capital equipment
- Expenditures on the building up of the investment fund
- Investments

Operational expenditures should be apportioned among: a) wages, sosial security, pension b) maintenance and operation of equipment c) maintenance and operation of buildings and plant d) costs linked to the contract

Investment was supposed to be apportioned among a) collection and transport b) reloading stations c) recycling plants d) processing plants e) miscellaneous or unspecified

Net costs here refer to Operational costs + Capital costs + Costs attached to the building of the investment fund minus Operational income (excluding collected waste water treatment charges) minus Income from the sale of capital equipment.

3.4 Calculation of the degree of coverage

The degree of coverage refers to the proportion of the expenditures which are covered by collected charges. A municipality cannot (according to the directives from the Ministry of environmental protection) demand higher waste water treatment charges than its total costs of waste water treatment. However, the the municipality is not obliged to cover its total costs through charges (MD[1] 1995).

With regards to waste management, the municipalities are from the year 1995 obliged to cover net costs through charges paid by the subscribers and others who deliver waste to the municipal plant.

Degree of Coverage = Total Collected Charges / Net Costs.

3.5 Calculating Capital Costs

Waste water treatment
The municipalities capital costs are calculated by Statistics Norway with the data on investments as the basis.

In this project, it was necessary to choose a method for calculating capital costs which made it possible to compare the municipalities and which at the same time was not so demanding in terms of effort. Capital costs are calculated on the basis of the annuity principle. The life span of the investments are assumed to be 20 years. The interest is set in accordance with the annual average interest rate obtaining on loans with 20 years pay back period from the municipal bank + 1 percent. The additional percentage is to take care of any risk factor. In the calculations, we have assumed the following interest rates.

For 1993, the interest rate is given as 10% (that is 9% +1%) which results in an annuity factor of 0.1175. For 1994 and the later years, the interest rate is given as 7.5% (that is 6.5% + 1%).which gives the annuity factor of 0.0981.

The above method was recommended by the Ministry of Environmental Protection for the calculation of capital costs in the waste water treatment sector.

[1] This refers to the ministy for environmental protection.

Waste management
With regards to waste mangement, the capital costs are calculated and reported by the municipalities themselves. The calculation is based on the annuity principle and the municipalities were advised to use the the obtaining interest rate on loans from the municipal bank with twenty years pay-back period. This corresponds to the method used for the calculation of capital costs in the waste water treatment sector.

3.6 Estimation of Country-wide Figures

Waste water treatment
In order to be able to present country-wide figures, expenditures and collected charges were estimated for the municipalities which failed to report data. For the municipalities which reported data, there was no clear relationship between population and the economic data. However, due to the fact that the municipalities which reported data comprised 90 percent of the total population and due to the inavailability of a better approximation method, we have made estimates for those which did not report economic data by the help of population and average figures. Due to the fact that the North Sea counties have bigger cleansing capacities and higher expenditure levels than the other counties in the country, we placed the municipalities in two groups during the process of calculating figures for the whole country: A) the municipalities in the North Sea counties (counties 01-10) and B) the remaining counties (counties 11-20). The population as at 01.01.93 is used in the estimation of the 1993 data.

Table 3.1 Number of municipalities registered in SSB-AVLØP with economic data and the proportion of the population this corresponds to.

Data in SSB-AVLØP	Total number of municipalities	Number of municip. reg. in SSB-AVLØP	Perc. regist. in SSB-AVLØP of tot. pop.
Investments	439	431	99.7
Counties 01-10	177	177	100
Counties 11-20	262	254	99.4
Costs for the year and collected charges	439	394	95
Counties 01-10	177	170	98
Counties 11-20	262	224	92

Waste management
During the sampling process, the municipalities were grouped in four strata. The municipalities were categorized on the basis of population and data variables from the complete study carried out in 1992. The first stratum was composed of the ten most populated municipalities in the country. All these municipalities were included in the sample study.

A graphical presentation revealed that, in each of the sub-samples from the four strata, there was a clear relationship between the population in the municipality and the expenditures on waste handling in that municipality. The country-wide figures were arrived at by extrapolation

on the basis of the population as at 01.01. in that particular year. This process could be depicted symbolically as :

$$Y_S = y_S / x_S * X_S$$

where Y_S denotes the estimated expenditures for the population in strata s, y_S is the registered expenditure in the sample from strata s. X_S refers to the population in strata s and x_S refers to the population in the sample from strata s. It is noteworthy that the numbers were estimated for each strata by itself and afterwords summed up for the whole country.

4. Evaluation

4.1 Resource input

Waste water treatment

It was very resource demanding to collect economic data on waste water treatment from the environmental protection agencies. Statistics Norway used about 6.5 man-labour months on the economic aspect. In addition, there was a great amount of effort on the part of the environmental protection agencies and the municipalities to obtain the data. The process entailed sending many rounds of reminders. There were big variations among the various counties with regards to the speed with which data were reported, the degree of completeness of the questionnaires and the amount of work put in to obtain and control the data.

Table 4.1 Use of resources for the 1994 study: Economic data on municipal waste water treatment 1994 (in man-labour months)

Activity	Plan	Execution
Planning, trials and establishment of routines	1.5-2.0	2.0
Sending of reminders and revision of data	2.0	1.5
Processing of data	1.5-2.0	1.5
'Extra work' (sending of data back to the municip.)	-	1.0
Preparation of reports	0.5	0.5
Total	5-6	6.5

There were many contributory factors to the demanding nature of this project:
- necessary accounts and reports did not include data we asked for.
- there were some deviations between definitions used in SSB-AVLØP and those used in the municipalities.
- some environmental protection departments and county-municipalities were hard pressed with time. They were therefore unable to set aside adequate time for SSB-AVLØP.

We however reckon that, with the passage of time there would be a decline in the amount of resources devoted to this project due to the fact that lots of the processes would then be routinized.

Waste management
The collection of economic data on waste management occurs simultaneously as the collection of physical data on waste. The economic aspects constitute about a third of the questionnaire but it is difficult to ascertain how big the resources spent on the economic aspects are. A total of 9.5 man-labour months work were used on the project carried out in 1994. It is noteworthy that, the processing of the sampling plan, sampling and the processing of the registration forms on computer are included in this figure. The amount of resources for the project in 1995 was reduced to about 5 months work. In 1996, a study covering the whole population would be carried out (that is, all the municipalities would participate). We therefore reckon that, this would entail a substantial increase in the resources used over the 1994 and 1995 levels.

4.2 The Quality of Data

Waste water treatment
The municipalities operate different systems as regards the calculation and setting of waste water treatment charges. The unit charges are fixed with area in square metres and or measured water use or type of residence as the basis of the calculation. The municipalities use different concepts, definitions and limitations in the fixing of the unit charges. The questions and the directives or instructions were not precise enough to result in totally unambiguous and comparable municipality data. The collection of data in 1995 has undergone a marked improvement in this respect.

The municipality accounts formed the basis of the questions on the municipality's costs in the waste water treatment sector. As mentioned in Chapter 3, the municipalities are given quite a good deal of freedom as regards the preparation of accounts. Many municipalities do not possess routines for the calculation of the proportion of administration costs which should be apportioned the waste water sector. Consequently, these costs are excluded for some municipalities.

Another important issue is that, investments in earlier years were supposed to be reported excluding subsidies. However, a number of environmental agencies and municipalities did not have a good overview of investments in earlier years or they were not willing to go back into the archives or old records. A majority of environmental protection agencies were unaware as to whether the investment figures were given inclusive or exclusive of subsidies, but assumed that it incuded elements of both.

Costs of planned investments were supposed to be reported up to the year 2000. However, some of the municipalities did not possess plans which stretched so far into the future. The figures for 1994-1996 are assessed to be much more reliable than those for the later years.

Waste management
The municipalities' response to the questions were based on the municipalities' accounts. As mentioned earlier under waste water treatment, the instructions or directives on the preparation of these accounts allow a substantial degree of freedom. For example, costs of administration in the waste management sector could be categorized elsewhere such as "general administration". In addition, many municipalities do not have established routines for the calculation of costs of capital.

5 Results

5.1 Waste water treatment

Approximately 40 municipalities (of a total of 435) did not fill completely the questionnaires and one municipality failed to fill in any data at all. The degree of coverage is therefore calculated for 394 municipalities.

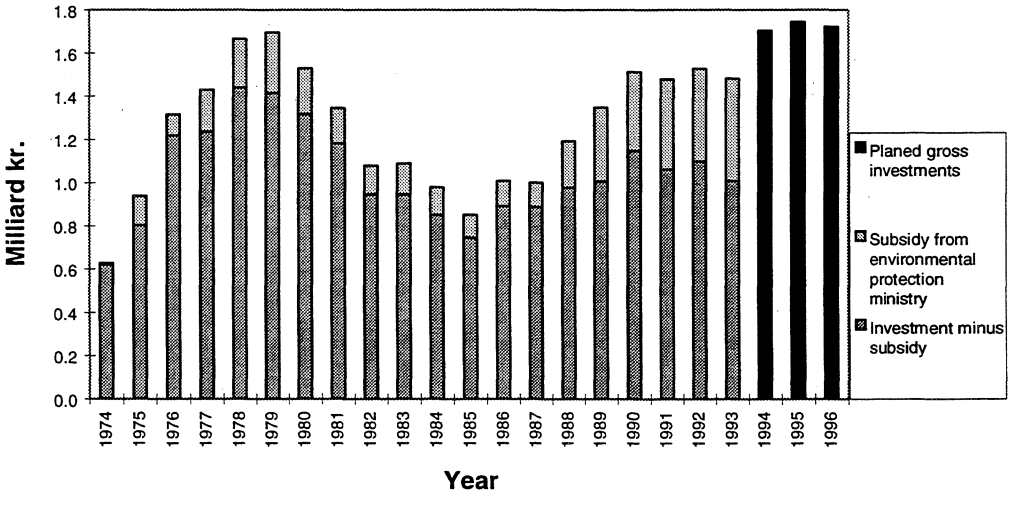
Annual costs and unit charges

In 1993, the total expenditure on municipal waste water treatment was 3.1 milliard kr. Of this amount, 1.5 milliard kr. could be attributed to operational costs while 1.6 milliard kr. could be attributed to capital costs. The charges which were collected in the form of connection charges and yearly charges covered 80 percent of these costs. The average annual charge in the municipalities for a residence of 100 square metres was 1165 kr. in 1994. The arithmetical average of the degree of coverage in the municipalities was about 70 percent.

Investments

The total investments in municipal waste water treatment from 1974 to 1993 was about 25 milliard 1993 kr. (figure 5.1). In addition to this, there could have been smaller investments which are covered by private subsidies etc. Approximately 4 milliard kr. was covered by state subsidy. Investments hit a top level at the end of the 1970's and have started increasing again in the 1990's. The municipalities are planning towards high investments up to the year 2000.

Figure 5.1 Investments 1974-1993 in municipal waste water treatment expressed in fixed 1993 kroner[2]. In addition, planned gross investments 1994-1996 (whole country).

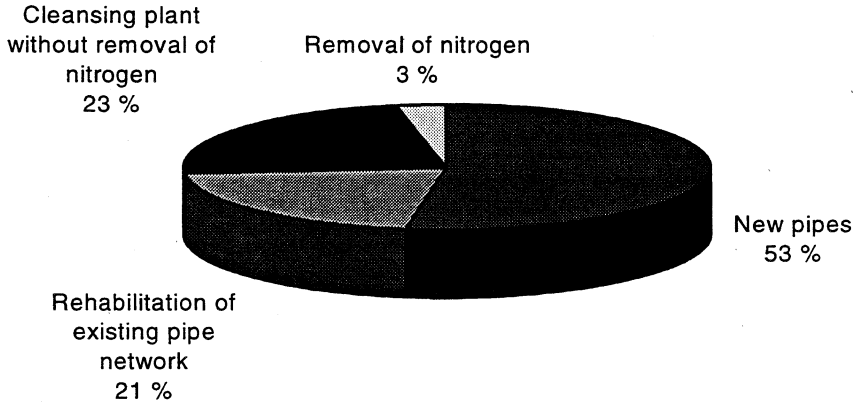


Source: *Statistics Norway and the Environmental Protection Ministry.*

[2]As regards the calculation in 1993 - kroner, the construction costs index (for residential blocks as a whole for the period 1978-1993) has been used. It is noteworthy however that, this index was not processed before 1978. We assume therefore a constant increase in price levels in the period 1974-1978.

In 1993, building and rehabilitation of pipe networks accounted for about 74% of the total investment in municipal waste water treatment. The remaining 26% was accounted for mainly by investments in cleansing and sludge-proceesing plants.

Figure 5.2 Investments in Waste Water Treatment for the Whole Country Categorized on the Basis of Type.



***Source**: Statistics Norway .*

5.2 Waste management

Both in 1994 and 1995, we received filled in questionnaires from more than 95% of the municipalities.

Expenditure for The Year
The municipalities "net costs" stemming from waste management were about 1.9 milliard kroner in 1994. Calculated as costs per capita, we arrive at a figure of about 440 kr. A comparison of the total figure to that of 1993 reveals that the municipalities' costs of handling waste increased by about 7%. The cost per ton of waste is also interesting. In 1994, the cost per ton was around 810 kr. which equals the 1993 figure. According to a study carried out by the Norwegian Pollution Control Authority, the municipalities collected about 1.7 milliard kr. as waste handling charges in 1993 (SFT 1994) while the costs of capital were about 171 million kr. (Table 5.1). These two figures represented increases over the 1993 figures of about 5% and 11% respectively.

Table 5.1 (in million kroner)

Post	1993	1994
Operational costs	1632	1716
- Operational incomes	23	71
+ Capital costs	154	171
+ Amt. set for Investmt. fund	57	100
- Incomes from sale of capital	25	1
+ Miscellaneous	0	1
= Net Costs	1796	1916

The increase in costs from 1993 to 1994 stems from "inter alia" that the municipalities have set aside a bigger sum for the Investment fund. The increase could also be ascribed to the upgrading of waste plants, increased quantities of municipal waste and the fact that the municipalities have now got a better overview of waste handling costs.

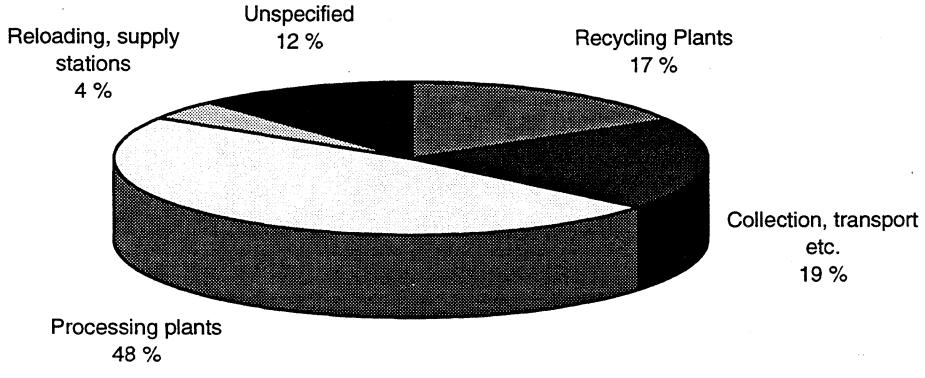
Investments

The investments in the waste management sector are partly carried out by the municipalities and partly by inter-municipal firms. A common arrangement is that, the municipalities which participate in the inter-municipal firms pay an annual amount to the firm. This amount covers the costs of operation and capital and is posted under operational costs in the municipalities' accounts.

The study by Statistics Norway in 1995 took care of only investments undertaken by the municipalities. Investments in processing plants made up 48% of total investments while investments in recycling plants made up 17% of the same. In addition, we have investments undertaken by the inter-municipal firms which were also quite substantial. Processing plants comprise surveying-, combustion-, composting- and destruction plants. Also included are waste landfills.

Due to the fact that a municipality's investment can vary very much from year to year and also the fact that the calculation of the figures for the whole country involves extrapolation based on the sample, there is a greater amount of uncertainty attached to the figures for investments than those for operational and capital costs.

Figure 5.3 Investments (in Percentage) Categorized According to the Type of Activity for the Whole Country. 1994



Source:Statistics Norway

6. Conclusion

We would like to reiterate that the studies on municipal waste water treatment and waste management have on the whole given satisfactory results. The collection of data on environmental protection expenditures posed lots of challenges even for these relatively clearly demarcated areas: waste water treatment and waste management.

In the questionnaires "Municipal Waste" and "SSB-AVLØP" and also the instructions for the questionnaires, we have a prescription of how various expenditures should be posted.The municipal accounts are the source for the municipality's figures on costs and incomes. However, in many municipalities, the accounts are not strictly done according to sectors and objectives and do not include data on capital costs and investments in past years. In addition, we have cases where the classification in Statistics Norway's questionnaires do not correspond directly to the classification in the municipality's accounts. Consequently, it could be very difficult and resource-demanding for the municipalities to deliver the data Statistics Norway demands and which the state environmental authorities demand.

In the long run, we ought to work towards getting the directives for the municipal accounts to be formed in a way such that the information the environmental authorities require could be obtained directly from the municipal accounts.

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