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Water accounts by water district

Key-words: water use, water emissions, costs, disaggregation to water districts, driving forces, regional domestic product, employment

Aim

The aim of this presentation is to reflect on the use of the water accounts. We will argue that the data and the methods are suited for a simplified table presentation and that the outflows from agriculture land are of vital importance to make the information system relevant for the users.

Introduction

This paper is based on experiences from a study (Report 2003:2 Water accounts 2000 with disaggregation to sea basins available at www.scb.se) and concerns further development of the Water accounts according to the tables proposed by the Eurostat task force on water Satellite Accounting.

Water satellite accounts have been presented earlier for Sweden for the year 1995 containing both physical and monetary data on water abstraction, water-use, discharge and direct emissions of pollutants to water, but on a national basis. The accounts were presented in a hybrid flow account(NAMEA)-type framework.

The EU Water Framework Directive (WFD) was adopted by the European Parliament in 2000. The aim of the WFD is to prevent further deterioration of all waters and to achieve their 'good status'. The measures specified in the WFD will be coordinated at the level of river basin district (RBD). The WFD will require more data for river basin districts and the water satellite accounts and the combined economic and environmental data by river basin have proven very useful. For that purpose the water satellite accounts are most useful presented at the level of river basin district.

In October 2001, the Government appointed a one-man committee to draw up a proposal on an organisation for the implementation of the EC framework directive in Sweden (Dir 2001:78). The committee took the name "The Committee on Swedish Water Administration". Its assignment also included analysing the prospects of introducing water charges in Sweden,

proposing forms for environmental cooperation on water bodies and submitting a proposal regarding responsibility for supervision of contingency measures for water supply.

The objective of this project was to test methods of disaggregating data from the national water accounts to water districts. When the project started (spring 2002), it preceded the investigation on using the division to water districts in the project. After discussion with the Swedish EPA, we decided to use a division into eight basins that have been commonly used when presenting data on water issues.

In the proposal from the committee in Dec. 2002, Sweden is to be divided into five water districts. These districts are based on the river basins' connection with the major Sea basins.

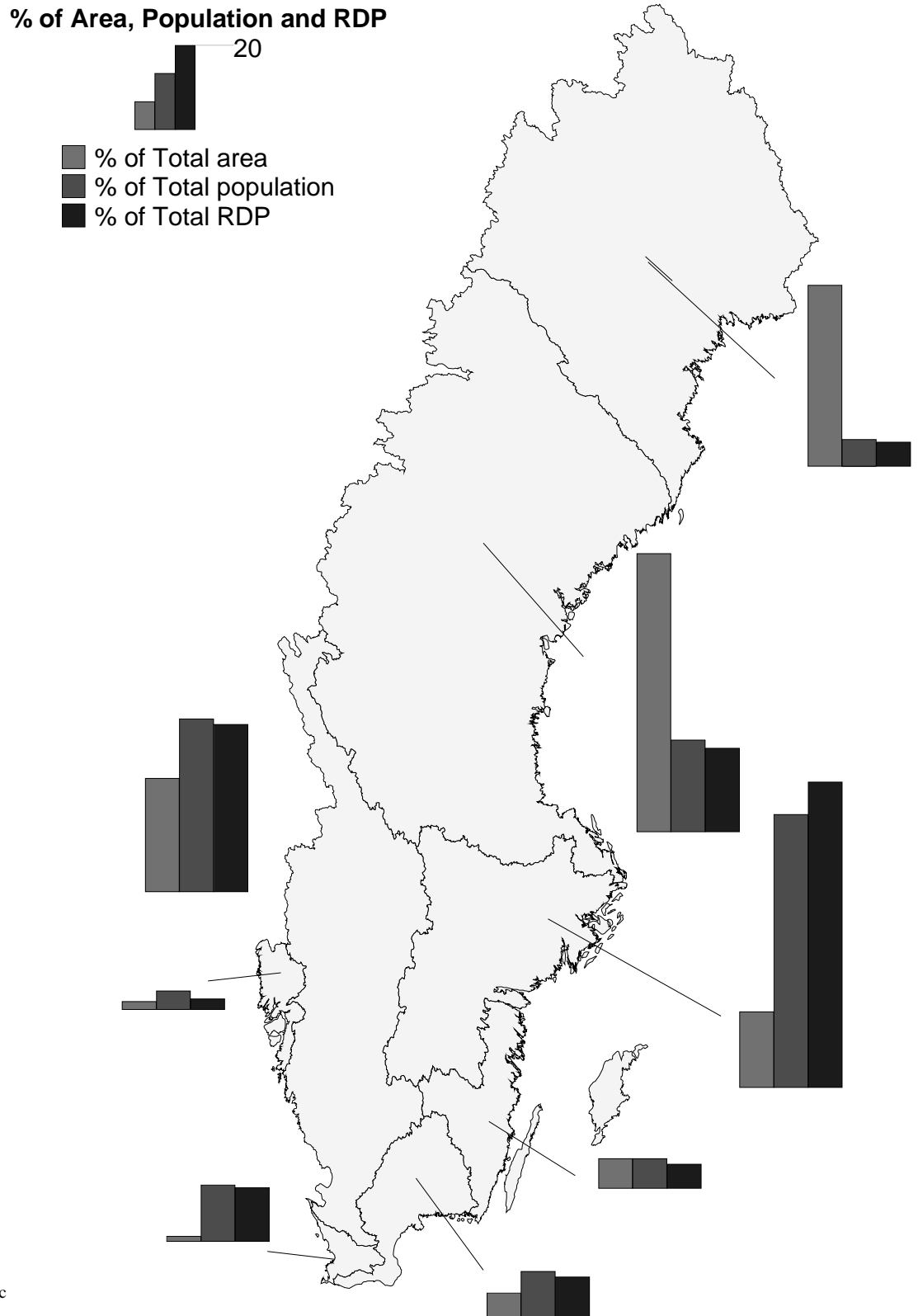
Some basic information about the eight Sea Basins is shown below.

Sea Basin	Total area, km ^{2,1}	Population	Regional GDP, million SEK
Bothnian Bay	114 249	344 000	69 283
Bothnian Sea	177 239	1 134 000	237 223
Baltic proper, north	48 560	3 397 000	855 270
Baltic proper, middle	19 582	374 000	70 021
Baltic proper, south	15 432	556 000	116 112
The Sound	2 939	696 000	153 881
Kattegat	71 150	2 134 000	468 694
Skagerrak	5 207	248 000	32 738
Total	450 295 ²	8 883 000	2 004 652

¹ Data source: Statistical report Na 11 SM 9701
www.scb.se/statistik/mi0999/mi0999tab1.xls

² Data Source: Statistical report MI 65 SM 0201
www.scb.se/sm/MI65SM0201_ikortadrag.asp

Figure 1. Percentage of total area, total population and Regional Domestic Product by Sea Basin



Method and data sources

Physical data

Water abstraction and water use

Market-produced water from public, municipal waterworks

The trade association for Swedish water utilities, the Swedish Water and Waste water Association (Svenskt Vatten AB) has been collecting yearly statistics on municipal waterworks and municipal sewage treatment plants until 1997. Data collection began again in 2003.

Since there are no data for 2000, Statistics Sweden did set up an internal database to estimate data for 2000 for the purposes of this project. The database covers all municipalities and contains data on abstraction and use of water. The main information was retrieved from the Svenskt Vatten survey from 1997 covering:

- total population
- population connected to public water system
- population connected to public sewage system
- water abstraction from groundwater or surface water
- purchase or sale of water to other municipalities
- use of water in industry, households, public use e.g. schools or recreation purpose, own use in waterworks and losses

Non-market produced/self supply

Manufacturing industry

A special survey was carried out by Statistics Sweden on water use in the manufacturing industry in 2000. The survey covered the abstraction, use and discharge of water. A detailed postal survey was distributed to about 900 establishments who were asked to report data on water abstraction, use and discharge. These establishments belong to industries, which are known to be large water users from the 1983 and 1995 censuses. Water abstraction by other establishments was reported by a simplified postal survey.³

Households

In the real estate assessment register concerning one- and two-dwelling buildings and weekend and holiday homes, it is possible to retrieve information on whether a property is connected to the public water/sewage system or not. Furthermore, there is information on whether the property has private water supply/treatment of sewage water or lack water/wastewater facilities. Combining information from the real estate assessment register with the population register provides information on the number of people who are not connected to the public water and sewage system. For

³ See www.scb.se/sm/MI16SM0101_inEnglish.asp and www.scb.se/sm/MI16SM0201_inEnglish.asp

households not connected to public water systems, mostly outside urban areas, estimations on the quantities of abstracted/used water are made using the average use (189 litre /day⁴) by those connected to public water supply.

Agriculture

Agriculture uses water for irrigation and for livestock. In the European water account guideline, nitrogen and phosphorous flows from agriculture land are also included as supplementary data.

Water for irrigation

A survey on water used for irrigation in Swedish agriculture was carried out in 1985. No full-scale surveys have been carried out since then. In 1991, the Swedish Board of Agriculture was commissioned to investigate the future need of irrigation in agriculture and a questionnaire was sent to about 800 farming enterprises. The result from the last survey indicated only limited changes in the quantities used for irrigation compared to 1985, so we have therefore used the data from 1985. The data refer to quantities needed in a dry summer.

Water for livestock

The water needed for livestock is estimated by looking at the number of different animals and their yearly water needs. Data on the number of animals are taken from agricultural statistics. The data in the report refer to 1999, which is the year the latest survey covering all enterprises with more than 2 hectare of arable land or holdings with stocks of animals was conducted.

TRK – Transport, retention and source apportionment

In Sweden, a special project was performed in connection with the reporting to HELCOM, PLC-4, Recommendation 19/04. Yearly emissions of nitrogen and phosphorus were estimated for all known point sources, even those which do not produce environmental reports. Also diffuse leaching from various types of land was estimated based on very detailed data. Incorporating weather data for 30 years, model calculations of leaching and transport were performed and calibrated to most known measurements in Swedish rivers during this period. The “gross” (average) load, emissions and leaches, of phosphorus and nitrogen, was calculated for drainage areas larger than 1 000 km². For nitrogen, “net” loads were also calculated using a special hydrological nitrogen retention model, HBV-N. The project is presented on the Internet at <http://www-nrciws.slu.se/TRK/index.html>.

⁴ The average use per person connected to the public waterworks. Water withdrawal and water use in Sweden 1995 www.scb.se/sm/MI27SM9901.pdf

Wastewater and wastewater treatment

The information on this subject has been taken from the database connected to the publication MI 22 SM 0101 *Discharges to water and sludge production in 2000 – Municipal wastewater treatment plants and some coastal industry*. The report was made by Statistics Sweden on behalf of the Swedish Environmental Protection Agency (Swedish EPA) ⁵

Under Swedish environmental protection law, special permits are required to perform certain activities which are potentially harmful to the environment. Establishments with these activities – which are more than 2 000 in number – are also required to report their emission data to the supervisory agency once a year. Estimates are usually based on results of measurement programs. The primary data for the statistics stem from these reports.

Some pollution sources not included in these statistics should be mentioned: No measurements of emissions are known for smaller plants but it is estimated they account for less than 10 percent of municipal wastewater and could therefore be assumed to make a similar contribution to emissions.

Slightly more than one million people are living outside urban areas. They usually depend on self-supplied water and use septic tanks or similar devices to dispose of their wastewater.

Monetary data

Public water supply and wastewater treatment

In Sweden, as in many other countries, the pricing system for freshwater and wastewater services is combined into one price for both services. Enterprises and households are normally charged one fee related to the amount of water they use, and in that fee the price for wastewater management is included. The fact that expenditure for both freshwater and wastewater is mixed together makes dividing the costs for each type of service difficult.

There are several sources of information on monetary data for the supply and use of water and wastewater treatment. There is no data source that provides all the necessary information, so a combination of several data sources is needed together with information on the physical volumes of water and wastewater.

The main statistical sources were:

The municipal accounts

The municipal accounts are based on a yearly survey of all 289 municipalities in Sweden. The municipalities are asked to report their

⁵ The report is available (in Swedish) at <http://www.scb.se/publkat/publikation.asp?plopnr=239>.

revenues, investments and expenditure for different domains (e.g. for production of water and wastewater treatment). The statistics are however aggregated so that a division between data for municipal waterworks and MWWTPs is not possible.

Business statistics

Business statistics at Statistics Sweden provide among other things information on costs and revenues within NACE 41 (Collection, purification and distribution of water) and 90001 (Sewage disposal). Among those companies, corporate municipal plants, either private or wholly owned by the municipality, are included.

The national accounts

In the national accounts (NA) there is information in the I/O matrix on the supply and use of water and wastewater services. In Sweden, compilations are made for the aggregated sector NACE 41 and 90001. The NA has so far used an older I/O model. When comparing costs for water and wastewater with quantities, the implicit price showed a considerable variation between different industries, which implies, that the data sources for this must be checked and improved.

Municipal tariffs for water and wastewater

The trade association for Swedish water utilities, the Swedish Water and Wastewater Association, Svenskt Vatten AB, has been collecting yearly statistics on tariffs (fixed price and variable) for an average household in a one-family building charged by each municipality. There is also information of the percentage of the tariff that will cover the cost for water and the percentage that will cover the cost for wastewater treatment. There is no collection of information on tariffs for industries. According to a quick Internet search, the tariff for industries differ a lot depending on the amount of water, size of the meter and in some municipalities also on the content of pollutants in the wastewater delivered to the municipal wastewater treatment plant.

Expenditure for self-supply of water and of wastewater treatment

There is no information about expenditure for self-supply of water. When it comes to wastewater treatment, information on own-produced services for own use is difficult to obtain, other than for the manufacturing industry. The data in the report refer to "Environmental protection expenditure in industry 1999/2000"⁶.

⁶ Environmental protection expenditure in industry 2000, MI23SM0101

Allocation to sea basins

Allocation of national data to sea basins was done mainly using four methods, listed here in the order of increasing complexity.

1. Environmental statistics are compiled for sea basins

In Sweden, there are 114 main drainage areas with outflow to the sea. The 114 drainage areas and coastal areas situated in between can easily be aggregated to sea basins. The basic statistics concerning the 'Abstraction and use of water in the manufacturing industry' and 'Discharges to water and sludge production in 2000 by municipal wastewater treatment plants and some coastal industry' are compiled for drainage basins.

2. Information on real estate and population with geographical location of the basic data

The self-supply of water for households not connected to the public network was estimated using information from the real estate assessment register and the population register. The real estate register contains information on x, y coordinates, which by using geographic information systems (GIS) can be allocated to a sea basin.

3. Allocation of municipality data to Sea basins

In Sweden, there are 289 municipalities and 85 per cent of the population live in localities/urban areas covering 1.5 per cent of the total land area. By using GIS, it is possible to combine digital maps for municipalities, localities and sea basins. 119 municipalities were entirely within one sea basin, 165 municipalities intersected with a minor part and 5 municipalities were split between two sea basins (Norrtälje, Heby, Nässjö, Uppvidinge, Tierp). For these 5, data were disaggregated according to the percentage of the population in urban areas. This method was used for data concerning the supply and use of distributed water, both physical and monetary data.

4. Using national data together with distribution keys

The survey on environmental expenditure in the manufacturing industry contains data on investments and expenditure for wastewater. The data refer to companies. One company can have several establishments in different sea basins. To disaggregate the national data, information from the special survey on water use in the manufacturing industry was used. The survey also contained information about the quantities of wastewater directly discharged to water bodies. That information was available by sea basin and industry. The total expenditure for each industry was allocated to sea basins in relation to the quantities of discharged water.

Results

Overview of the flows of water

Figure 2 shows the most important flows of water related to the technosphere. It also gives an idea of the many different data sources that must be used to give an overview of the supply and use of water. The many question marks also show the scarcity of detailed data.

The role of water resources in groundwater, surface water and sea-water as reservoirs for water abstraction are shown at the top of the figure. At the bottom of the figure, their role as recipients of (more or less) polluted water is illustrated. Flows between the boxes are measured in Mm^3 and refer to the year 2000.

There are a few boxes in-between, representing the main human activities relating to water. These are classified according to NACE codes. Two of the activities are directly based on the qualitative treatment of water: NACE 41 (Collection, purification and distribution of water) abstracts raw water, produces and distributes tap water and sells it to customers. NACE 90.001 (Sewage disposal) represents Municipal Waste Water Treatment Plants (MWWTP), which produce the service of wastewater removal and treatment.

Raw water for tap water production is taken both from groundwater and surface water. Public waterworks serve about 90 per cent of the population. It is mostly in rural areas that households have private water abstraction. Public waterworks supply 6 per cent of the freshwater used in the manufacturing industry and also supply water for public use. In total, there are around 2 000 public waterworks, of which 375 are responsible for 86 per cent of the water abstraction.

There are around 2 000 municipal waste water plants (MWWTPs), to which about 90 per cent of the population are connected. Almost 500 plants, which serve more than 2 000 people, treat about 90 per cent of the total wastewater. Standard sewage water is of course produced in every economic activity and it is usually taken care of by the MWWTPs. In addition to this, some process water is delivered from factories to MWWTPs.

The abundance of water in Sweden is apparent from the large industrial abstraction of water, especially surface water - $1\,400\ \text{Mm}^3$ in 2000. These activities are concentrated to a few water-intensive process industries, notably the pulp and paper industry. Some large mining, steel and chemical plants are also quite water-intensive.

Point sources versus total load from diffuse sources of nitrogen

On a national basis the nitrogen net contribution to the sea has been estimated to 123 400 tonnes of nitrogen per year (TRK-report). This calculation is made based on measurement between the period 1985-1999. The total nitrogen load from waste water plants was 19 000 tonnes, or 15 % of the total load.

The TRK-project has also presents that 36 200 tonnes of nitrogen per year as modelled to be coming to Kattegat. Of these, 1 725 tonnes, slightly less than 5 percent, are estimated to be coming from the point sources to the coast.

The presentation according to guidelines

The data was first tested in the format for tables that was suggested in the European guideline. However, in some tables there were on two figures, showing the lack of detailed data in this rather complicated system. Therefore, it was chosen to present the data in a simplified form by aggregating the information. As a consequence, the information also became more condensed and easier for the interested to use. In this way it is easier to get an overview of the situation.

It is also evident that it is a long way before a water accounting system could be based on yearly data. Some flows such as the discharge of pollutants are more likely to be measured yearly, since there are environmental goals which are to be evaluated.

Further use of the data

After the report was finalised and spread, several people involved in preparing for the water directive have taken an interest in the figures. The Swedish EPA has asked SCB to participate in the work of setting up data structures for evaluating the management of the water district. In this work there has also been discussions on linking the data to an economic/demographic model of the Swedish counties. In this way it would be possible to simulate how the water use and discharges may vary depending on economic structure and population changes in the water districts.

Figure 2 Flow of water in the Swedish technosphere

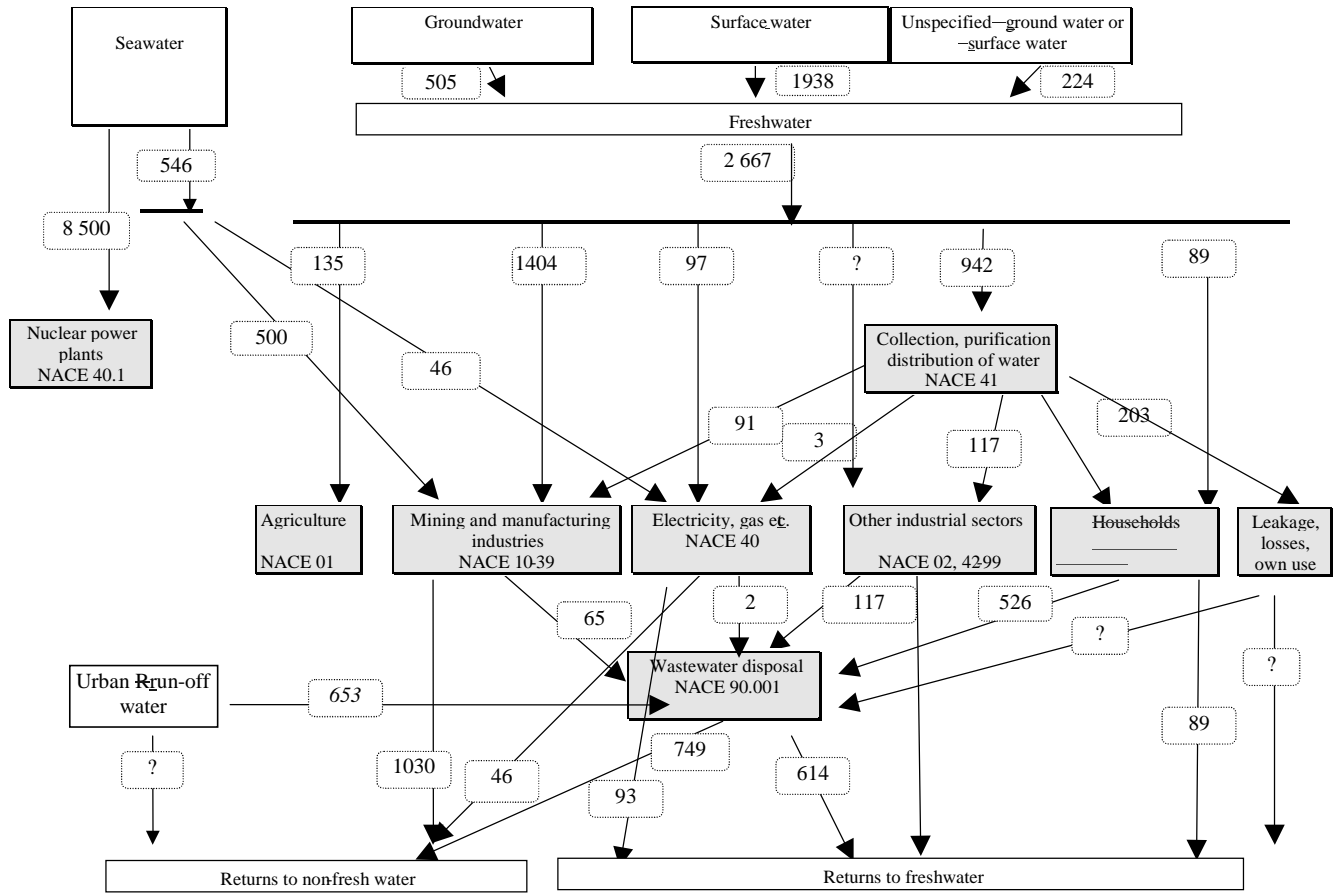
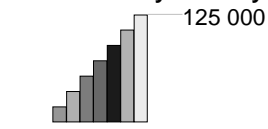


Figure 3 Use of water by Sea basin and industry 2000

Use of water by industry 2000



- Agriculture
- Pulp and paper NACE DE
- Basic metals NACE DJ
- Chemical NACE DG
- Electricity NACE 40
- Other
- Households

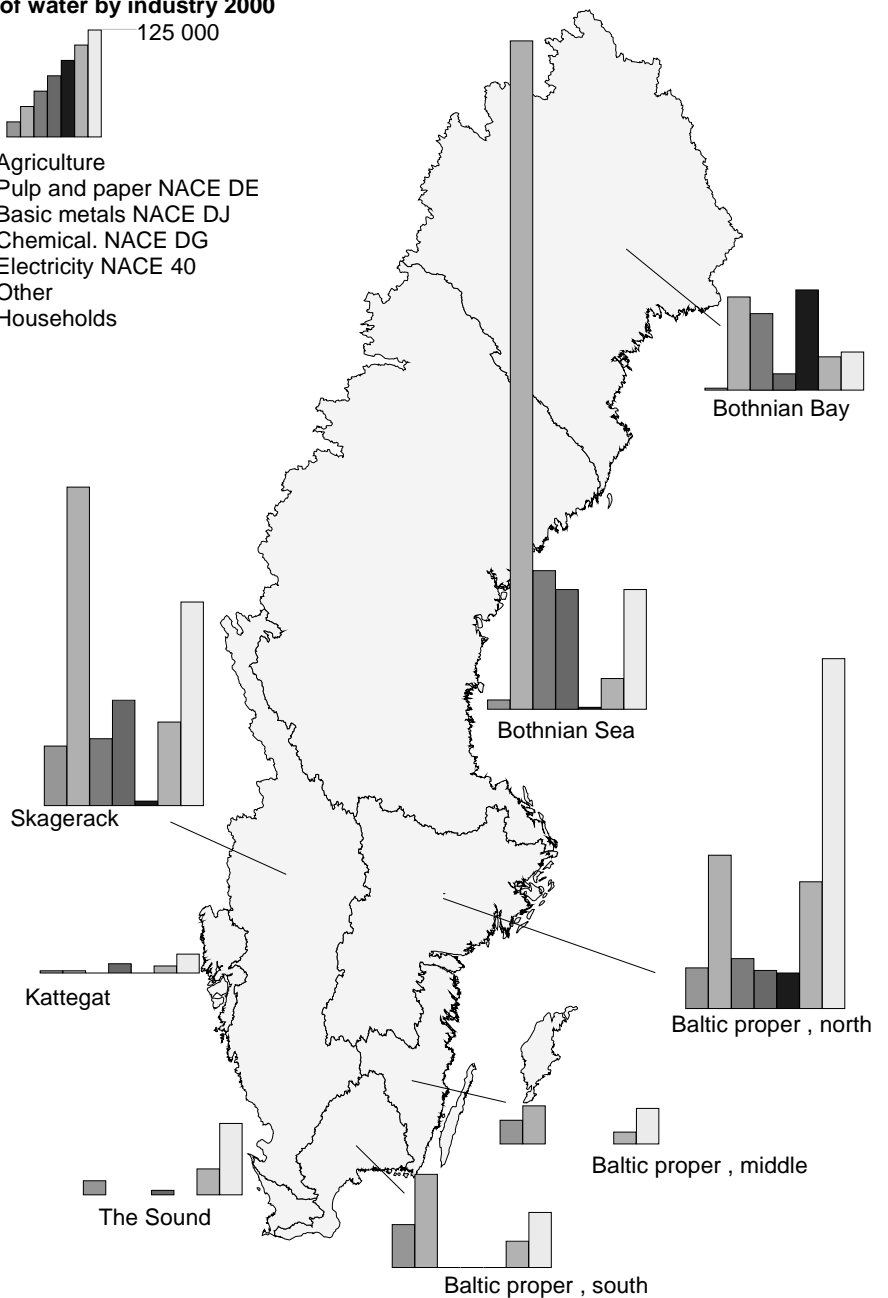
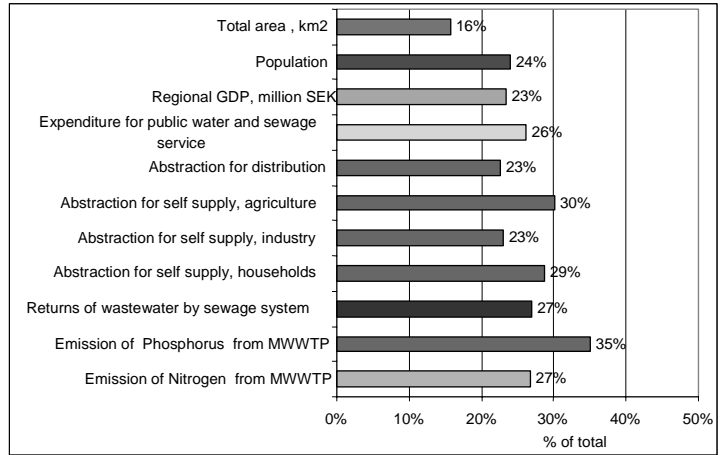
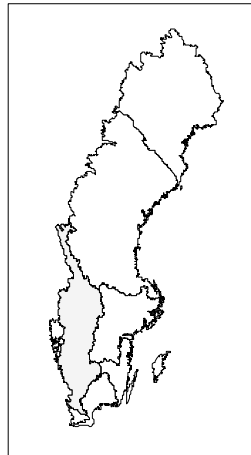


Figure 4. Profile for Kattegat

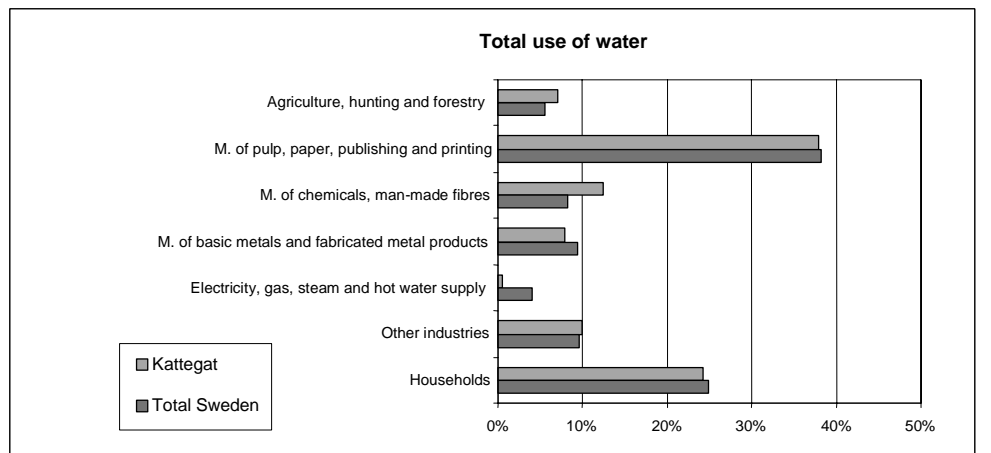
Kattegat



	Use of distributed water, 1000 m ³	Sell supply, 1000 m ³	Total use, 1000 m ³
A* Agriculture, hunting and forestry		40 734	40 734
DE M. of pulp, paper, publishing and printing	1 806	217 609	219 415
DG M. of chemicals, man-made fibres	1 826	70 741	72 567
DJ M. of basic metals and fabricated metal products	4 035	42 044	46 079
40 Electricity, gas, steam and hot water supply	474	2 671	3 145
Other industries	44 357	12 920	57 277
Total industries	52 496	386 719	439 217
Households	114 917	25 619	140 536
Total	167 415	412 338	579 753

Total expenditure for distributed water: 3422 Million SEK.

Waste water treatment service in the manufacturing industry:
Current exp.: 315 million SEK
Investments: 156 million SEK



Summary

1. Regionalization of the data to water districts is important to the users.
2. Simplified tables give a better overview of the situation and is more adapted to the actual supply of data.
3. The need for data collection on water use is not every year, but in a period of 3-5 years.
4. Point sources are not covering the main impact on the water quality. Therefore it is important to supplement the data with diffuse sources such as leakage of phosphor and nitrogen from agriculture land and deposition from traffic.
5. There is an interest to couple the physical data to driving forces in the same areas and thereby model the situation in the future.