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Computerized system for collection of environment statistics

- Some Norwegian experiences

av

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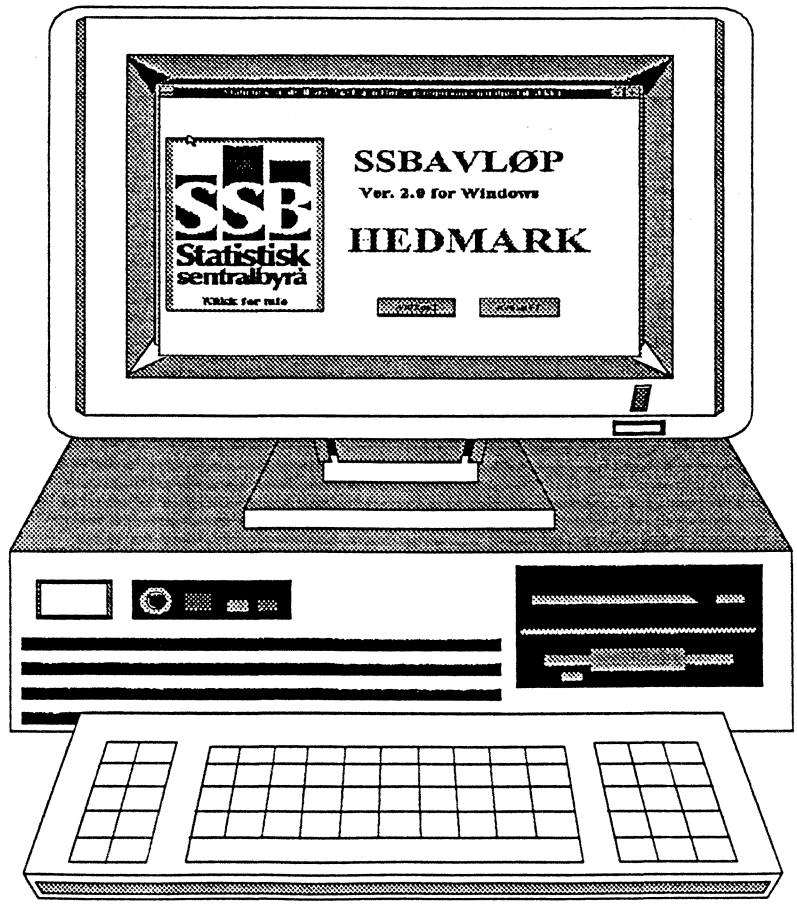

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Computerized system for collection of environment statistics - Some Norwegian experiences[1]

Content

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[1] This paper has been prepared by Arne Knut Ottestad and Hans Viggo Sæbø, Statistics Norway.

1. Introduction

The objective of environment statistics is to provide and disseminate relevant information on natural resources and the environment. In this context information means compiling data and statistics to a level of generalization which is sufficient for understanding and decisions.

Technology provides much better possibilities today than before for the collection, storage, compilation, analysis, presentation and dissemination of data and environment statistics. The work of a statistician comprises all these steps and has been more and more computerized during the last few years. Key words are automatic monitoring, remote sensing, databases, electronic data interchange and analysis tools such as statistical packages and geographical information systems. Tools for better presentations in the form of graphics and maps are also widespread.

However, the different tools are most often used independently; a statistical survey still consists of different steps linked together by some manual operation. Even if technology is available, most statistical data are collected and exchanged on paper (i.e. by questionnaires and publications). Another consideration is that in spite of the technological revolution, it seems that an expected gain in better information and more rational decisions has not been reached. We have a situation where there is an affluence of data and statistics, but where we still lack relevant information.

This paper presents an overview of the status in Norway with regard to the computerized integration of the different steps in environment statistics from data collection to presentation. A special consideration is given to an integrated system for collection, storage and presentation of statistics on waste water treatment. Experiences are discussed with emphasis on problems encountered. These problems are believed to be relevant for other possible applications of such a system as well. Such applications in environment statistics are considered briefly.

2. Environment statistics in Norway

A statistical institution compiles comprehensive statistics in many areas of considerable significance for the environment. This includes the extraction and use of natural resources and statistics on factors exercising environmental *pressures,* such as population, agriculture and industry. Statistics on pressures like emissions and discharges are to a large extent based on these statistics, and a statistical institution has obvious advantages in compiling statistics on the borderline between society and the environment. Data on environmental *quality* are largely collected by other institutions (environmental monitoring), and the role of Statistics Norway is limited to further presentation of information on environmental quality, often placed together with its own statistics on pressures.

The priorities of Statistics Norway within environment statistics are based on the main environmental problems, our role and our target groups within administration and the public. The work in this field started in the mid seventies, when the first Norwegian environment statistics report was published. At the same time resource accounts were developed for energy, minerals, forest, fish and land use. Today, environment statistics and resource

accounts are worked out by the same unit within Statistics Norway (Division of Resource accounts and Environment Statistics with 15 employees). Another unit is responsible for modelling and research on economy/ecology interactions based on the resource accounts and macroeconomic models.

Resource policy and planning in general were larger issues in Norway in 1980 than today. Both managerial and public interests have gradually shifted towards environmental issues, like changes in global climate and the depletion of the ozone layer. This has led to less interest for natural resource accounts, and accounts in their original form are today only worked out annually for energy. For fish and forest only the reserve or stock part of the accounts are regularly updated. On the other hand, the energy accounts have been supplemented by tables on emissions of polluting components to air. These emissions are calculated mainly on the basis of energy consumption figures in the energy accounts.

Over the last few years, environment statistics in general have been given increased priority within Statistics Norway. A development strategy for these statistics has been established in cooperation with important users, such as the Ministry of Environment and the State Pollution Control Authority. Main priority areas are:
- Resource accounts for energy
- Resource accounts for fish (stocks)
- Resource accounts for forest (stocks)
- Emissions to air
- Discharges to water (in particular from population and agriculture)
- Waste and recycling.

We will also review and possibly start developing statistics on environmental expenditures.

Statistics on environmental pressures are typically calculated on the basis of statistics on natural resources (i.e. energy consumption) or sector activitiy figures (such as agricultural practices). Some data are collected from administrative registers. Such calculated or transferred data are already computerized. Relatively few environmental data have to be collected from scratch by Statistics Norway. Among the priority areas listed above, this is the case only for data on waste water treatment plants and waste. Most of this paper is dedicated to statistics on waste water treatment plants, which so far represents the only area where we have experiences with computerized collection of raw data.

3. System for statistics on waste water treatment plants

Over the last 20 years, large investments have been made in waste water treatment plants in Norway. Treatment capacity of such plants has grown from less than one million population units (p.u.) in 1972 to more than 4.5 million p.u. in 1992 (figure 2). This corresponds to more than one p.u. per inhabitant (plants receive waste water also from other sources than households). This has led to a need for data and statistics for waste water treatment plants, including capacity, cleaning principles, ownership etc. Data have been collected four times over the period 1978 to 1988 by questionnaires. However, statistics based on these registrations have been incomplete. The need for better statistics became urgent around 1990, when the North Sea Treaty committed Norway to reduce the discharge of nutrients

(phosphorus and nitrogen) by 50% by 1995. Statistics Norway has planned to develop a complete set of statistics for waste water and other sources of polluting nutrients. A total survey of waste water treatment plants will constitute an important part of these statistics. Developing a statistical survey of this kind from scratch, provides an opportunity to use new methods for the collection and compilation of statistics. In this chapter, the system for computerized collection of statistics on waste water treatment plants is described. Some results from these statistics are also given.

3.1 Description of the system

In Norway, the Ministry of Environment is responsible for setting up strategies and overall objectives for environmental policies. Several directorates under the Ministry are responsible for the practical follow-up of these strategies. The State Pollution Control Authority is responsible for waste water cleaning, but it is the environmental agencies in each county which carry out control of treatment plants. Governmental environmental authorities decide the level of waste water cleaning and set the standards, but the municipalities are responsible for the construction and for the operation of the treatment plants. Thus, the municipalities know all the details of the plants. However, since the County Environmental Agencies have a controlling function, most data are stored here as well. This makes it possible to select these agencies as the principal statistical unit for the collection of data on waste water treatment plants.

In Norway there are 19 counties and 439 municipalities. All the County Environmental Agencies had personal computers by spring 1991. Some of them had only recently acquired such computers, others had long experience with computerized systems, and some had already built their own environmental information systems. So the differences between the counties were large. Most, but not all the municipality administrations have computers.

By choosing the county as the data source, we had the possibility to develop a computer based system for collecting data on the waste water treatment plants.

A range of possibilities exists with regard to the functionality and the complexity of a computerized data collection system. We could have chosen a simple system consisting only of a diskette with questions, or we could build a more complicated system with database facilities, data controlling and presentation routines and information on cleaning standards to facilitate control of the plants' performance. By using only a computerized questionnaire the County Environmental Agencies each year would have to fill in new information for the plants and return the diskette to Statistics Norway, where data would be controlled and further processed. This solution would give Statistics Norway good control with data quality and the use of the resulting statistics. On the other hand, data quality could suffer since this solution would not motivate for filling in the questionnaires. Since the counties are responsible for the control of all plants, a system with integrated routines and some compilation of statistics and comparisons with standards could be useful for them, provided that data quality is satisfactory. We therefore decided to go for a more technically complicated, integrated solution.

In 1991, Statistics Norway and the State Pollution Control Authority (SFT) jointly developed an electronic registration form (SSBAVLØP) for collecting information on Norway's waste water treatment plants. The system has been installed and is now in use at all the County Environmental Agencies, which are responsible for updating the information each year. The data are sent to Statistics Norway on a floppy disk.

The registration covers data on time of establishment, geographical location, ownership, capacity, load, chemicals, purification principles, analysis results, sludge treatment methods, sludge disposal (including various forms of use) and recipients. The registration has now been carried out for three years (1990 - 1992). As mentioned, smaller scale surveys based on paper questionnaires have been carried out for 1978, 1982, 1983 and 1988.

The system integrates data collection with some data controlling routines, data storage, searching and selection of data, simple tables and comparison of cleaning capacities and other parameters with standards set by the authorities.

The system has been built with CLIPPER 5.1 (a dBase like programming language in MS-DOS). The entry screen picture of the MS-DOS version is shown in figure 1.

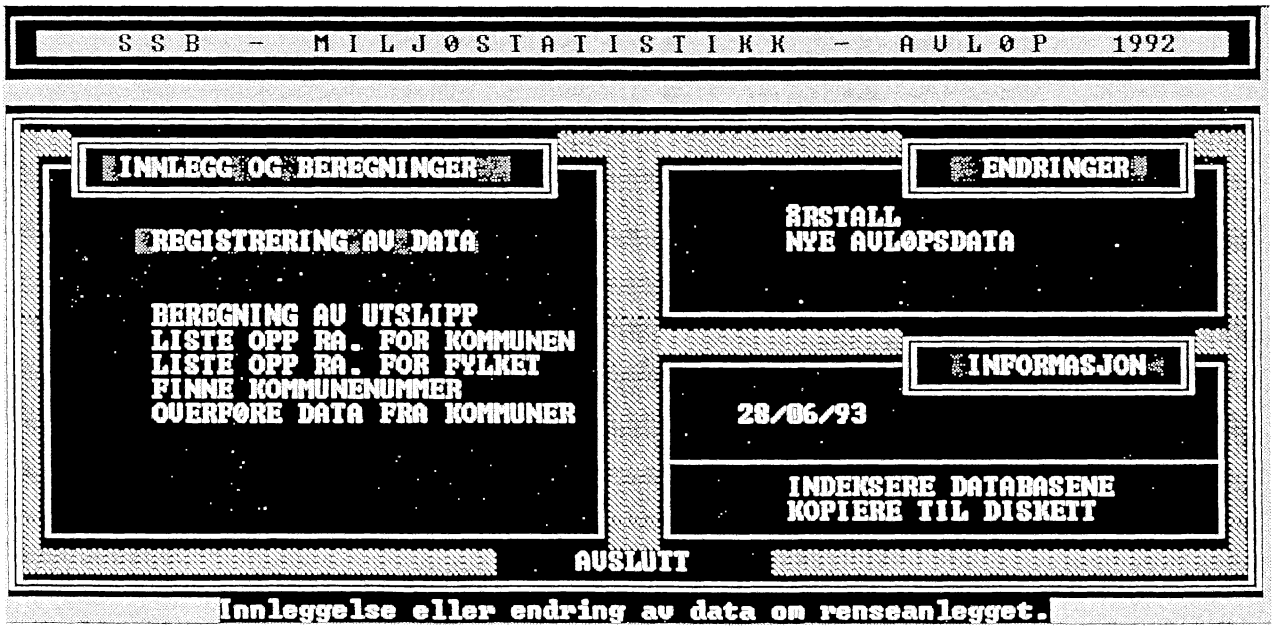

Figure 1. Introduction picture to SSBAVLØP for MS-DOS.

During the first 3 years with development and use, Statistics Norway has used about one manyear of work each year on the system and the resulting statistics. The project expenses include a portable personal computer for demonstration purposes ond some inland travelling.

3.2 Main results

Capacity of waste water treatment plants

Most of Norway's waste water treatment plants have been built during the last 30 years. The first methods of treatment were based on either mechanical or biological cleaning principles. Since the beginning of the 1970s, it has become more common to build treatment plants with a chemical cleaning stage, and from the end of the 1970s, chemical or biological/chemical cleaning plants have dominated.

Figure 2 shows the development of treatment capacity for the different treatment methods from 1962 to 1991. The main reason for the increase in capacity of mechanical plants at the end of the 1980s is a change in the definitions of plant types.

In the early 1960s the waste water treatment plants had a total capacity of about 0.5 million population units (p.u.). The capacity has now increased to about 4.5 million p.u. More than 1600 plants were registered i 1991, of which 125 had a capacity of more than 5000 p.u. The registration includes only plants with a capacity of more than 50 p.u.

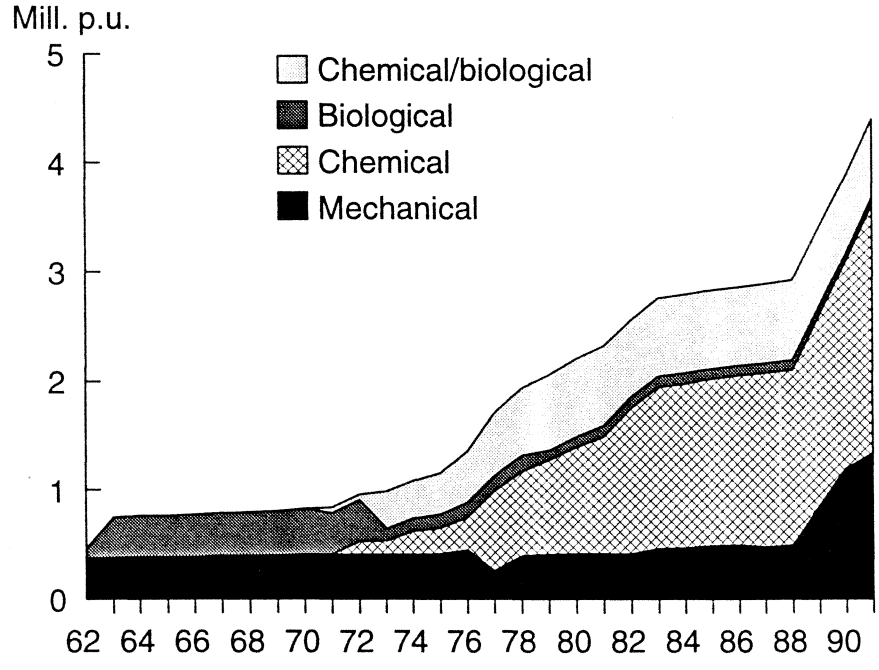

Figure 2. Treatment capacity by treatment principle. 1962-1991. Million population units

Figure 3 shows the location of the different large waste water treatment plants in the part of Norway which drains to the North Sea, their capacity and which purification process they employ (mechanical or other, so called "high-grade"-processes). The figure includes only plants with a capacity of 5 000 p.u. or more.

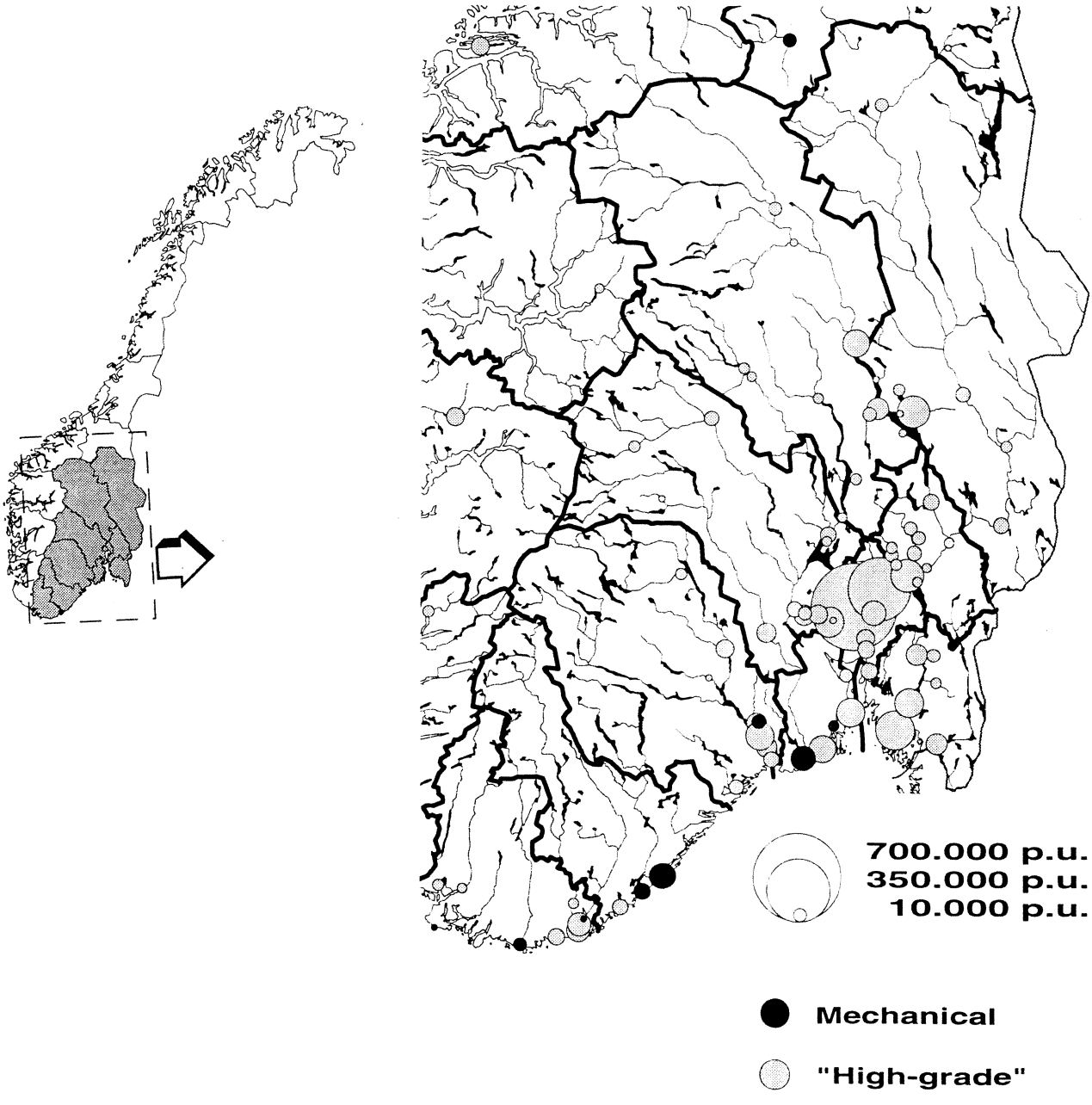

Figure 3. Waste water treatment plants in South-Eastern Norway. Location and capacity of mechanical and "high-grade" plants. Plants with a hydraulic capacity of 5000 p.u. or more in 1991

Discharges from waste water treatment plants

The results on discharges are based on reported figures (values from laboratory analyses of water samples) from the plants, and on estimated values for plants which have not reported such figures. For such plants values have been calculated on the basis of the hydraulic load, a consumption of water of 400 litres per person per day, a specific quantity of pollution for each person, e.g. 1.7 grammes phosphorus per person per day, and the purification efficiency of the treatment plant based on the type of plant (table 1).

A large number of the plants have reported discharge values for phosphorus (P), so that the estimated values refer to discharges from only 20 per cent of the hydraulic load for the country, the rest are reported figures. In the case of suspended substances (SS), the values have been estimated for 38 per cent of the hydraulic load. For nitrogen (N) the discharge figures for 68 per cent of the load are estimated values, whereas for chemical oxygen demand (COD) discharges are estimated for 83 per cent of the load. For the last two components, there is substantial uncertainty in the estimated discharge figures.

Table 1. Waste water treatment plants in Norway 1991. Assumed specific amount of pollution, efficiency by type of plant and estimated discharges

Substance	Specific amount of pollution	Percentage reduction by type of plant				Discharge
	gramme/person/day	mech.	chem.	biol.	biol/ chem.	tonnes
Phosphorus	1.7	15	90	30	95	526
Nitrogen	12.0	15	20	20	25	10360
COD	94.0	30	80	90	95	39740
SS	42.0	50	90	90	95	14910

There are large variations among the counties with regard to how large a percentage of the discharges is stated in terms of estimated values. It is mainly West Norway and North Norway that report only few values from the results of analyses. For the counties bordering the North Sea, the values are mainly based on laboratory analyses.

4. Problems

4.1 Organizational setup

Data on municipal- and intermunicipal waste water treatment plants are reported to the County Environmental Agencies, which are responsible for the supervision of the plants. The counties have been asked to report data from all the plants to The State Pollution Control Authority (SFT), which finally reports to the Ministry of Environment.

Statistics Norway could have collected some data on waste water treatment plants from SFT, but we would then have no influence on these data and their quality. By collaborating with SFT in collecting data, we can incorporate our own questions, control data quality and ensure that useful statistics are provided to all users.

During the development of the system SFT has been responsible for the technical information in the database, and Statistics Norway for (statistical) classification and grouping of the data and for the construction of the system. Using a system for both the collection of statistics and for administrative purposes such as pollution control may cause problems with data quality. Data cannot be confidential and there is a danger that the questionnaire will be uneccessarily long and complicated. However, data from municipal waste water treatment plants are in principle non-confidential, and Statistics Norway has emphasized simplicity, the statistical needs and proper data quality control and use.

The deadline for reporting data has been set to the first of June for the preceding year. So far, this has turned out to be too optimistic. In the first two years of data collection (1991 and 1992), we had to visit a number of counties during the autumn. We helped them with the registration, and noted how much time they spent on the job. A typical County Environmental Agency with about 120 plants spent about eight hours on the registration work.

We completed data collection for all counties for the first registration year in December 1991 (deadline first of June). In 1992 we were able to finish this task by October, whereas this year we received the last data in June (deadline has been put forward to April).

There have been some problems in getting the CEA's officer in charge to understand the importance of giving correct data to Statistics Norway (even if the same data are to be used by SFT). Sometimes we had to contact the superior to obtain the data. Since then, the process has been much easier. This emphazises the point that to succeed with data collection and in particular collection by computerized systems, the management of the institution providing data must understand the usefulness of the resulting statistics and actively support the work.

During the first 3 years with development and use of the computerized system for statistics on waste water treatmwnt plants, Statistics Norway has used about one manyear of work each year on the system and the resulting statistics.

4.2 Technical problems and professional skills

Two examples will be given to illustrate typical technical problems encountered. These problems are in general easy to solve, but often arise because people usually "do not have time" to follow instructions and are less able to use new software or new computer routines than which is generally believed by people more familiar with computers.

The first problem we met was during installation of the system. We made a description of how to install the system, and an installation file. By starting this file the system would be copied into the computer. The only information the system asked for, was where to install the system.

Some counties did not understand how to do this, or had not read the manual. This problem was solved by a telephone call where we told them what to do step by step.

The next problem was that some counties had "Windows", and tried to run the program as a MS-Windows program. This worked until they tried to use the copy function in the program. This function uses a DOS statement, and did not work under Windows.

A typical problem with computerized systems in general is that within one institution there is often one or a few persons who in particular are responsible for the computers and use of these. Computerized routines in the institution are often developed by one person, and lack of documentation or "personal ad-hoc solutions" makes the institution dependent on this person. If the person starts in another job, or if he or she is not available, it is difficult to introduce new systems such as our data collecting system, which should easily fit into existing systems in the institution. Some institutions may have all their data computerized, but may be unable to extract information in an efficient way!

5. Future prospects

5.1 Better user interface and compatibility

As mentioned, some County Environmental Agencies had "Windows" installed in their computers, and had discovered the advantages of using Windows programs. They could share information between programs, and make their own statistics and reports from other systems such as spreadsheets.

To facilitate standardization and meet future demand, we decided to develop a Windows version of the program (figure 4). We are now building the new system with "Visual basic for Windows", and are linking the program to the existing database with "Q+E Multilink VB".

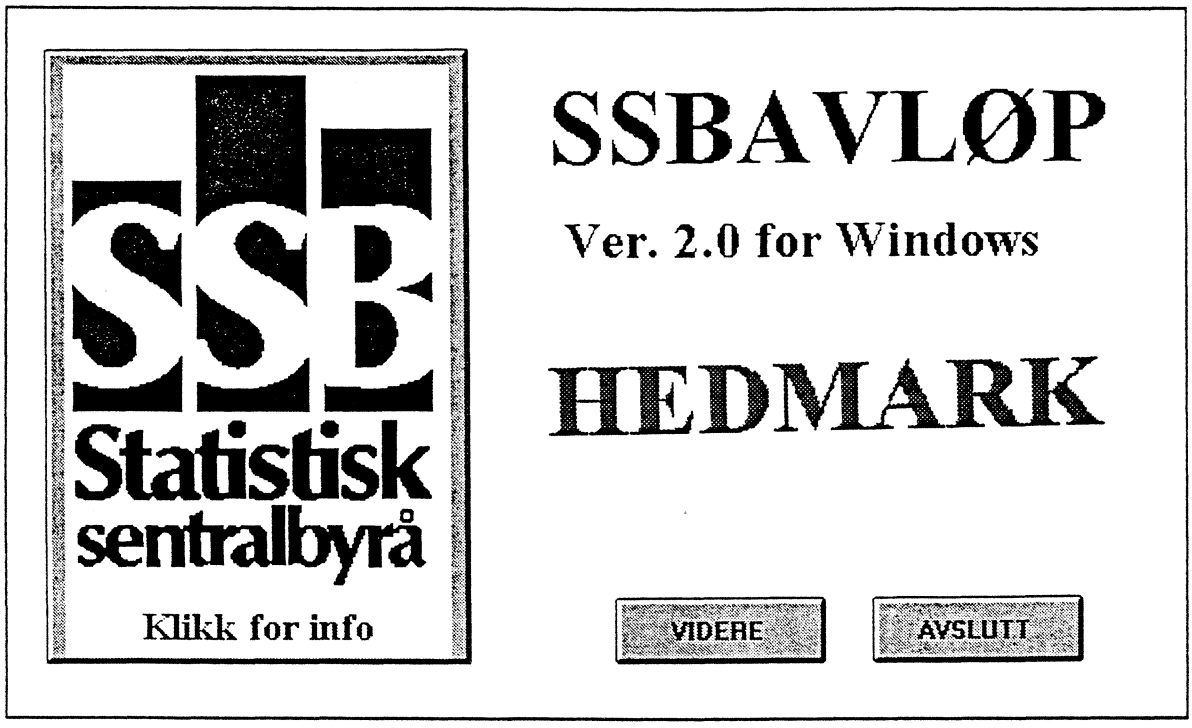

Figure 4. Introduction picture to SSBAVLØP for Windows.

5.2 Further development and integration

When building the new system, we decided to expand the program with new applications. The first expansion is to include the drainage system in the program, and the second is to develop a registration system for discharges from houses in sparsely populated areas not linked to water treatment plants. In Norway, about 20 percent of the total population falls into this category.

By adding this to the existing registration system for waste water treatment plants, we will get a better total overview of the discharges from the whole population.

The new version of the system will have improved possibilities to set up tables. The program can for example make an aggregation or a list of data for one or more regions for different parameters. This could for example be a list of all the plants in the northern part of Norway with capacity and purification principles, or an aggregation of capacity for each purification principle for four counties.

We could have integrated a module for graphics and a module for presenting information on a map to SSBAVLØP, but then the program might be unnecessarily complicated. We decided not to integrate such modules into the system because there are many available programs with these possibilities running under Windows. If we can transport data from SSBAVLØP to a standard spreadsheet, then the spreadsheet can produce graphics and transport data to systems for statistical thematic mapping (such as MapViewer which has been used to make the map in figure 3) or a geographical information system.

5.3 Other areas of environment statistics

As mentioned, since a large part of environment statistics is based on data and statistics collected for other purposes, there are few areas where statistics on environmental pressures have to be established by the collection of new raw data.

In Norway, statistics on waste and recycling has been given priority. The first total survey of municipal waste and waste treatment has been carried out this year. In addition a pilot survey on industrial waste has been carried out. As for hazardous waste, statistics are based on an administrative register operated by a company with responsibility for handling such wastes.

Electronic collection of waste data from both municipalities, waste treatment plants and industry has been considered. However, none of the mentioned data suppliers are expected to have the necessary equipment and skills by now. Even if most of the 439 Norwegian municipalities use computers for solving simple tasks (mainly word processing), traditional data collection by using questionnaires has been chosen so far. This decision is based on the experiences with data on waste water treatment plants from 19 counties considered in this paper. However, there is no doubt a future potential for electronic data collection of waste statistics.

Data from administrative registers are already computerized, and are in most cases transferred by floppy disk. In Norway, such environmental data comprise data on emissions and discharges from large industries which need concession from the State Pollution Control Authority and the data on hazardous wastes already mentioned. Poor quality of register data from other institutions has until now prevented regular and comprehensive use of register data for environment statistics.

The Norwegian Ministry of Environment and its underlying Directorates and County Environment Agencies are working to establish a common network for exchanging mail and data, and to utilize the same computerized tools for databases and data handling. Ambitious plans exist for common databases, environment information and managing systems. As an institution organized under the Ministry of Finance, Statistics Norway is not directly involved in these plans. However, our coordinating role with respect to statistical data and standards in general, implies that we have to follow this process closely. Shared and official environmental databases will affect our work in two ways: We will have to supply these systems with our own statistical data, and we can use other data stored here for establishing new statistics. We are planning to establish a link to the environment network in order to facilitate the exchange of data and statistics between Statistics Norway and the various institutions working with environmental issues. Since these institutions include the County Environmental Agencies, future updating of data on waste water treatment plants will hopefully take place on line over the network.

6. Conclusion

Experiences from a system which integrates collection, control and presentation of statistics on waste water treatment plants show that there is a potential for computerized integration of routines in the production of environment statistics. However, the implementation of such systems presupposes good knowledge and widespread use of computers among data suppliers. The management of the institution providing data must understand the usefulness of the resulting statistics and actively support the work. Computerized systems should be introduced gradually, starting in areas where data suppliers are few and with programs based on questionnaires on floppy disks. Initially the system may also include routines for data control and simple table presentations. The system has to be adapted to computers and data systems used by the data suppliers. Development in the direction of more user friendly software platforms which integrate different functions (i.e. Windows), enables further integration of the system with standard software for analysis and presentation.