Environmental Statistics and Sustainability Indicators: the Work of Statistics Canada

A consideration of Statistics Canada's effort to provide statistical information for the purpose of environmental policy development, monitoring, assessment and research within a framework of government policies increasingly focused on sustainable development.

For discussion by the National Statistics Council
at its November 16-17, 1995 meeting.

Philip Smith
National Accounts and Environment Division
System of National Accounts Branch
Statistics Canada
November 1, 1995

1. Introduction

Resource depletion and environmental degradation are widely recognized today as serious and growing problems. To understand and address these problems, governments and citizens need good environmental statistics. Yet the world's statistical systems were not designed with this requirement in mind. They were set up primarily to provide information about human population and socio-economic development, rather than about the environment. Only within the last decade or two, as environmental issues have risen in prominence, have statistical agencies in Canada and elsewhere started to reorient their focus.

The term 'environmental statistics' encompasses many subjects. It refers, in the first instance, to *quantitative information about the physical environment:* pollutant concentrations in air, water and soil, the size and character of forest, fish, wildlife and mineral stocks and the extent of biodiversity. But it also applies to *economic, or value data*: expenditures by businesses, households and governments for pollution abatement and control facilities and equipment, spill cleanup costs, land, lumber, fish and mineral market values and so on. Moreover, the phrase can refer to *a variety of other related socio-economic data*: on modes of transport, energy intensities, packaging, recycling behaviour, the extent of fertilizer and pesticide usage, cancer incidence and so on. Environmental statistics of these various kinds provide us with an evolving picture of the physical world and connect the main elements in that picture to human behaviour.

Statistics Canada compiles and publishes integrated environmental information of all these kinds. Broadly speaking, this information is obtained in four ways:

- by exploiting administrative and regulatory databases maintained by federal, provincial and municipal government departments as part of their normal responsibilities;
- by recasting existing household and business survey information, collected for other purposes, in order to make the data more useful for the analysis of environmental issues;
- by launching new surveys and enhancing existing ones to directly address questions that are of interest from an environmental perspective; and
- by constructing new time series estimates by combining data from multiple sources and making use of scientific and technical coefficients.[1]

Federal and provincial ministries of forestry, fisheries, energy, mines, agriculture, health, transportation, industry, parks and environment, as well as municipal waste management departments, are a rich source of environmental data. Likewise, the Censuses of Population and Agriculture and many of the annual economic and social surveys conducted by Statistics Canada provide highly relevant information. As will be discussed, some of the most important data gaps and inconsistencies are now being filled by new surveys, by new geographical information systems and by environmental accounting. An integrated system of Canadian environmental statistics is beginning to come together.

---

1. For example, annual time series estimates of industrial greenhouse gas emissions, by type of gas and by emitting industry, have been developed by applying engineering coefficients to output statistics. See "Canadian Greenhouse Gas Emissions: An Input-Output Study," ***Environmental Perspectives, 1993***, Statistics Canada cat. no. 11-528E, pp. 9-18.

However, the environmental indicators and information systems available today are still well short of what is required. If Canada is to pursue seriously the goal of sustainability as set out by the Brundtland Commission in 1987 – to promote "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[1] – a richer database is essential. The National Round Table on the Environment and the Economy made this point in its recent Report to the Prime Minister:

> *Is Canada progressing toward sustainable development? If so, how fast – and is it fast enough? If not, why not? Without the means of measurement, without relevant information, progress cannot be charted, goals cannot be set, existing situations cannot be assessed, plans cannot be laid – cannot, that is, with any degree of composure or assurance ... In short, Canada needs to develop a system of measuring and reporting sustainable development performance in a meaningful and credible way.*[2]

This paper examines the history, current priorities and future directions of Statistics Canada in the field of environmental statistics. The main elements of the current program – administrative data, surveys, geographical information and environmental accounts – are discussed. The paper concludes by speculating about future requirements, driving forces and possibilities in the field of environmental statistics.

2. A brief history

Work on environmental statistics began at Statistics Canada in the mid-1970s. Efforts concentrated initially on making use of existing survey data to shed light on how human activities exert stress on natural ecosystems. The results of this early work were published in March 1978 in a compendium called ***Human Activity and the Environment***.

A new geographical framework based on watersheds (drainage basins)[3] was adopted. This framework is useful for environmental analyses because water is vital for all life and flowing water conducts human and industrial pollutants between ecosystems. By reorganising existing data within watershed regions instead of the more usual census enumeration areas or political boundaries of provinces and municipalities, the information was cast in a different light. This first edition of ***Human Activity and the Environment*** presented a collection of statistics on population, agriculture, forests, fisheries, transportation, manufacturing and energy.

The environmental statistics program moved in some new directions during the early and mid-1980s. Several new administrative data sources were explored and the "Stress-

---

1. World Commission on Environment and Development, ***Our Common Future***, Oxford University Press, Oxford, 1987, p. 43.
2. National Round Table on the Environment and the Economy, "Toward Reporting Progress on Sustainable Development: Report to the Prime Minister," reprinted in ***Pathways to Sustainability: Assessing Our Progress***, edited by Tony Hodge, Susan Holtz, Cameron Smith and Kelly Hawke Baxter, Lowe-Martin Printing, Ottawa, 1995.
3. Watersheds are the heights of land which divide drainage basins, river basins or valleys, which in turn refer to surface drainage catchment areas. For example, a mountain range can form a drainage basin boundary separating two catchment areas. Drainage basins form a hierarchy, with five major basins at the top, draining into the Atlantic Ocean, Hudson Bay, the Arctic Ocean, the Pacific Ocean and the Gulf of Mexico. Beneath these five major basins are 218 sub-drainage basins and 917 sub-sub-drainage basins.

Response Environmental Statistical System"[1] was developed as an organisational framework.

The second edition of ***Human Activity and the Environment***, issued in March 1986, had chapters on population, harvesting, extraction and depletion of non-renewable resources, environmental restructuring, the generation of waste products, the responses of biological species to environmental stress, and collective and individual human responses. Tabulations were arrayed by watershed, as in the first edition, and also by ecozone[2] and by province.

The year 1986 also marked the publication of the first ***State of the Environment Report for Canada***, a joint effort by Statistics Canada and Environment Canada. This volume provided a wide-ranging assessment of the condition of Canada's farmlands, forests, waters, wildlife and other natural resources and of the implications of changes in those conditions for Canadians. It adopted the ecozones framework and made considerable use of the statistical information presented in ***Human Activity and the Environment***. The report was widely acclaimed and gave birth to the state of the environment (SOE) reporting function in Canada.

In the late 1980s, Statistics Canada announced the establishment of a new spatially referenced database known as the Environmental Information System (EIS). Structured as a geographical information system, this database contains socio-economic and biophysical microdata from the Censuses of Population and Agriculture, from the surveys of manufacturing and mining and from a number of other sources. The EIS can be used to analyse, through mapping techniques and cross-tabulations, environmental problems on various scales ranging from national issues to local watershed concerns. Some examples of EIS applications have been an analysis of the impact of creeping urbanization on the Jock River Valley near Ottawa,[3] a study of land use change around Riding Mountain National Park in Manitoba,[4] an assessment of population exposure to air pollutants in metropolitan Toronto and a study of environmental change around Waterton Lakes National Park on the Alberta-British Columbia border.[5] Some EIS data are available on E-Stat, Statistics Canada's educational CD-ROM product.

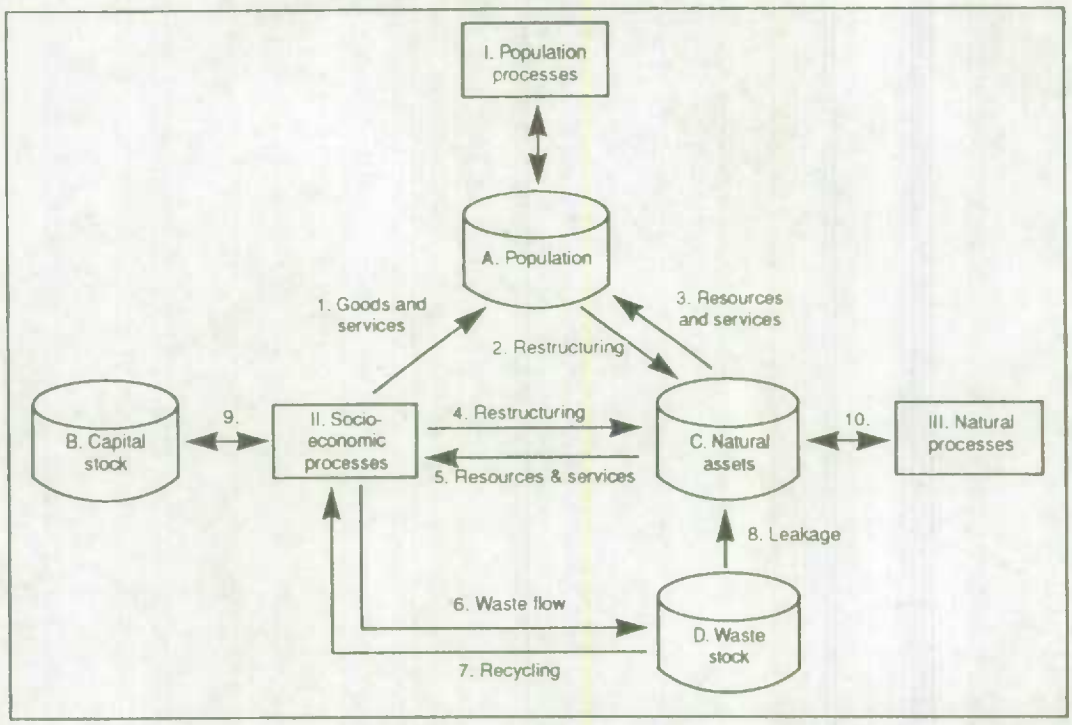
The third edition of ***Human Activity and the Environment*** was published in September 1991. It updated the statistics presented in the previous edition with data from the 1986 census and introduced new tables to address emerging environmental issues, notably greenhouse gas emissions and the spread of the zebra mussel in the Great Lakes. The book was structured around the Population-Environment-Process (PEP) framework (see Figure 1).

---

1. See ***Towards a Comprehensive Framework for Environmental Statistics: A Stress-Response Approach***, Statistics Canada cat. no. 11-510, May 1979 and "Conceptual Frameworks and a Unified Approach to Environmental Statistics," ***Canadian Statistical Review***, Statistics Canada cat. no. 11-003E, October 1981. The Organisation for Economic Co-operation and Development, in Paris, and statistical agencies in some other countries adopted the stress-response framework for their environmental statistics as well.
2. Ecozones are natural regions delineated by distinctive sets of biotic resources (flora and fauna) and physical resources (soils, bedrock, physiography, climate). They constitute fairly homogeneous geographical spaces that are useful for monitoring the impact of natural and human stresses on the environment. At the highest level, there are 15 ecozones. Beneath these are 47 ecoprovinces, divided into 177 ecoregions, divided into 5,395 ecodistricts. Ecozones, like drainage basins, transcend provincial and national boundaries and there is a need for better inter-governmental statistical standards in this area.
3. This study was reported in ***Human Activity and the Environment, 1991***, Statistics Canada cat. no. 11-509E, pp. 224-230.
4. This study was reported in ***Environmental Perspectives, 1993***, Statistics Canada cat. no. 11-528E, pp. 33-45.
5. This study was reported in ***Environmental Perspectives, 1995***, Statistics Canada cat. no. 11-528E, pp. 11-26.

In the PEP framework, the key elements are the population, the socio-economic system and the natural environment. Each element is characterized by stocks, processes and interactions with other components. There are four state variables in the system: (A) the population, (B) the produced capital stock, (C) natural assets (the non-produced capital stock) and (D) the stock of waste products. Three kinds of processes affect these state variables: (I) population processes (such as birth, death and migration), (II) socio-economic processes (such as production and consumption) and (III) natural processes (such as storms, earthquakes and photosynthesis). Finally, interactions occur among the states and processes in the form of flows (ground water withdrawals, harvest of forests, sport fishing) and restructuring (the impact of human visits to wilderness areas, agricultural development, dam-building).

Figure 1
The PEP Organizational Framework



An annual publication entitled ***Environmental Perspectives***[1] made its début in March 1993. It contains articles reviewing recent survey and analytical work at Statistics Canada in the general area of environmental statistics.[2]

The fourth edition of ***Human Activity and the Environment*** was published in June 1994, containing fresh data from the 1991 census. The PEP framework continued to provide the organising structure for the book. Results from several pilot surveys designed to fill important environmental data gaps were also included and there were new chapters outlining recent work in the area of environmental accounting and providing international and interprovincial comparisons.

---

1. ***Human Activity and the Environment*** is normally published at five year intervals, following the quinquennial census, and ***Environmental Perspectives*** is published in the four intervening years.
2. Starting with the 1995 edition, ***Environmental Perspectives*** also includes a collection of environmental time series indicators, including interprovincial comparisons.

Recently, a ***Teacher's Kit*** has also been developed for use in conjunction with ***Human Activity and the Environment***. Through a series of three classroom-tested role-playing activities, high school students explore the implications of human activity as part of a process that includes economic development and the environment (using the PEP framework, described in the book). The kit includes a detailed instruction booklet, three copies of ***Human Activity and the Environment*** itself and a diskette containing all the statistical tables in the book, in spreadsheet format.

3. The need for environmental statistics

Environmental issues have grown in importance over the past two decades and this trend is likely to continue. The demand for environmental information arises from government policy makers and program administrators, as well as from students, educators and researchers. This section of the paper provides an overview of the various policy areas of concern and an assessment of how Statistics Canada can shed light on them. The major themes underpinning national environmental policy are discussed and important data gaps are identified.

The "sustainable development" motif has been central to environmental policy in recent years, particularly since the United Nations Conference on Environment and Development (UNCED) in 1992. At that conference, 179 nations agreed on an ambitious plan of action – Agenda 21 – addressing broad environmental and developmental issues. Canada's Agenda 21 commitments have shaped its environment-related policy-making in the 1990s.[1]

Agenda 21 laid out a vast work program touching on virtually all aspects of socio-economic development. Of all the agenda items, those toward which the environmental statistics program can make a significant contribution include:

- protecting the atmosphere;
- managing solid wastes, sewage and hazardous wastes;
- managing land, including agricultural, forest and mountain land, in a sustainable manner;
- managing the exploitation and consumption of metals and minerals;
- protecting and managing the oceans and sources of fresh water;
- conserving biological diversity; and
- making environmental education widely available.

Canada has set a number of concrete goals and put policies in place that are intended to address each of these concerns.

There is a national commitment to stabilize emissions of carbon dioxide (CO_2) and other greenhouse gases at 1990 levels by the year 2000. The Liberal Party Red Book further

---

1. For information about Agenda 21 and the Rio de Janeiro meeting that gave birth to it, see for example ***The Earth Summit's Agenda For Change***, written by Michael Keating and published by the Centre for Our Common Future, Geneva, April 1993. For details on Canada's progress on Agenda 21, see the recent report drafted by the Department of Foreign Affairs and International Trade and Environment Canada, ***Report of Canada to the United Nations Commission on Sustainable Development***, Third Session of the Commission, April 11-28, 1995. Minister of Supply and Services Canada, Cat. No. E2-136/1995. Also available on the World Wide Web at http://ekn.sid.ncr.doe.ca/.

proposes to reduce emissions 20% by the year 2005, compared to the 1988 level. Emissions were not measured systematically in the past, but Canada is one of the world's highest *per capita* producers and there is an obvious need for regular, authoritative estimates. It is particularly important that such estimates be linked directly to industrial output and consumption measures, to facilitate their use in policy development. Similarly, data are needed on the use of chlorofluorocarbons (CFCs) and other major ozone-depleting substances, and on the quantities of sulphur dioxide (SO_2) and other acid-rain-related emissions by industry. Canada has also undertaken to reduce solid waste by 50% by the turn of the century. This implies using less packaging, recycling more goods and services, and altering consumption patterns. However, as with gaseous wastes, solid waste flows are not measured systematically in Canada at the present time. There is a need for time series information about waste generation and management by households, governments and businesses (depicted as flows 6 and 7 in Figure 1).

Canadian governments have pursued the objectives of healthy agriculture, forestry, mining and fishing industries for a long time, but the shift in emphasis toward *sustainable* resource management has been relatively recent.[1] It implies a need for better and more extensive information about the available stocks of fertile land, timber, sub-soil minerals and fish, and about the factors causing these stocks to change over time. The traditional approach to measuring Canada's wealth (flow 9 in Figure 1) ignores these elements (flows 3, 5 and 10 in Figure 1).

A national strategy to conserve biological diversity and to ensure the sustainable use of biological resources – goals elaborated in Chapter 15 of Agenda 21 – is presently being developed through a national working group involving all provincial and territorial governments plus several federal departments. Among other things, the strategy focuses on improving Canadians' understanding of ecosystems and their resource management capacity. Central to this effort is the need for a detailed land database, recording where households and businesses are located and indicating the extent to which their presence impinges upon wildlife habitat (mainly via flows 2, 4 and 8 in Figure 1). While much information is already available on Canadian land resources, these data are widely scattered and poorly integrated.

Governments are also seeking to make environmental information and education widely available to the population and thereby to promote more environment-friendly behaviour. In this regard, the state of the environment reporting function, established since 1986, is an area where environmental statistics are used extensively. The point of SOE reporting is to systematically monitor, assess and describe the evolution of Canada's natural environment and the ways in which it is affected by human activity. Detailed geographically-based information is needed about land, water and air quality, and about the health of wildlife populations. Information about the key driving forces – pollution flows, land use change, harvesting of natural resources and so on – is also needed. Feedback information on relevant household and business activities is required as well, to determine what effect SOE information is having on public behaviour.

The federal government has also sought to promote the development of an innovative and globally successful 'environmental industry' for Canada, in which environment-

1. The Natural Resources Canada paper ***Sustainable Development and Minerals and Metals***, Supply and Services Canada, September 1995, also available via the World Wide Web at http://www.nrcan.gc.ca/nrcanhp_e.html, is a good illustration of this new policy emphasis.

friendly products and services are conceived, produced and marketed. There is a growing need for statistical information about the economic characteristics of this industry.

In September 1994 the federal Ministers of Industry and Environment jointly announced a new environment industry policy, linking the government's economic and environmental strategies.[1] The 'environment industry' is actually a rather ill-defined mixture of activities not explicitly defined in the Standard Industrial Classification (SIC), comprising environmental monitoring and assessment, pollution prevention, pollution control and clean-up and restoration. There is no 'environment industry' as such in the SIC. However, as part of the next SIC revision, planned for 1997, new and growing industries of particular interest from an environmental perspective, such as the waste management industry, should be more fully delineated.

4. Current priorities

Statistics Canada's current development priorities in the field of environmental statistics reflect national requirements, as outlined in the previous section. Some of these needs can be met through administrative and regulatory data sources. For others, existing or new surveys are used. Often a combination of administrative and survey data offers the best solution.

User demands for a more consistent, unified statistical database have led to the building of an integrated system of environmental accounts, linked to the traditional system of national accounts. To meet the need for more detailed information about resource use and biodiversity at the provincial and local level, a comprehensive geographical database on Canadian population, land and environmental characteristics is being organized.

4.1 Administrative data

There is a wealth of detailed environmental information in administrative and regulatory data banks held by federal, provincial and municipal departments and agencies. Data of this kind is particularly valuable in the areas of forest management, fisheries and some aspects of solid waste flows and land management. However, such data also have important limitations.

On the one hand, administrative data are often comprehensive and highly detailed. Collected originally for specific administrative reasons, such data can frequently be made available for a range of other purposes with little or no additional expense or response burden. On the other hand, administrative data are usually subject to few statistical controls. Typically they do not conform to standard industry, commodity or geographical classification systems, for example. It can be difficult, therefore, to use such data in conjunction with other statistics, or to build up a comprehensive national picture. In some cases the units covered may constitute a non-representative sample of the underlying population. Administrative data are a good means for answering some, but certainly not all questions.

1. See "Federal Environmental Industry Strategy Announced to Boost Canada's New Economy," Industry Canada News Release, September 22, 1994 and "Ottawa to Throw Green at Green," ***Toronto Globe and Mail***, September 23, 1994, p. B4.

Environment Canada's regulatory and other programs are a very important source of environmental information. ***Human Activity and the Environment*** includes a wide range of statistics drawn from databases such as the Municipal Waterworks and Wastewater Database (MUNDAT), the National Air Pollution Surveillance Database (NAPS) and the National Water Quality Database (NAQUADAT). The National Pollutant Release Inventory (NPRI) survey, also developed and conducted by Environment Canada, collects data on emissions by type of material and by industry. Statistics Canada also obtains administrative data from the Canadian Forestry Service, Fisheries and Oceans Canada and several other agencies.

All of these data sources, however, have serious flaws from a statistical perspective and they need development work. Moreover, there is an enormous wealth of environmental information remaining in administrative databases that has not yet been brought to light and exploited for statistical purposes. Transforming all this information into useful statistics is not a simple task, since the datasets are widely dispersed within and among government departments and are stored in a variety of often poorly documented formats, using differing concepts.

With the collaboration of Environment Canada and the provincial environment departments, Statistics Canada has conducted two exhaustive searches, one of federal government departments and another of provincial government departments, to catalogue administrative databases relevant for environmental monitoring and analysis. The results of these searches are published in two volumes, ***Databases for Environmental Analysis: Government of Canada*** and ***Databases for Environmental Analysis: Provincial and Territorial Governments***. These 'meta' databases contain characteristic information about each database: a description of the contents and purpose, the name and address of contact persons, the geographical coverage, the data acquisition method, the update frequency, the period for which data are available, the database hardware and software configuration, the output formats, the language(s) used, any restrictions on access and pricing information. These two 'databases of databases' are being maintained in electronic form,[1] which facilitates rapid keyword searching, and they will kept up-to-date in the future.[2] They point to rich information lodes from which new environmental indicators can be developed.

4.2 Environmental surveys

Statistics Canada's economic and social surveys focus on specific populations of households, businesses or government bodies in order to obtain answers to particular questions. They are the best available vehicle for obtaining information about household behaviour vis-à-vis the environment, about the location and characteristics of the population and about business environment-related expenditures.

Surveys have several advantages over administrative data. They can be targeted to fill important data gaps. Samples can be scaled to yield results of whatever quality is required (and can be afforded). Conducted within a controlled statistical framework, survey data can easily be made to conform to established classification systems and can be readily compared with other data. However, surveys are costly and they impose a

1. Diskette versions are included with each printed publication. An integrated diskette product, combining the updated federal and the original provincial databases, will be available in a 'Folioviews' version in November 1995. In addition, an abbreviated version of this 'meta' database will soon be available on Statistics Canada's World Wide Web site (http://www.statcan.ca).
2. The federal database, assembled and published initially in 1992, was updated in mid-1995.

response burden on the sampled units. They are the best vehicle to obtain statistical information in some cases, but not in others.

Few of the well-established surveys conducted by Statistics Canada have an explicitly environmental focus, yet many provide information that is quite valuable for environmental studies. The Census of Population shows where the environmental stresses associated with urban growth are most keenly felt. The Census of Agriculture yields important data about land use change, and about pesticide and fertilizer use, that, organised by watershed or by ecozone, can be associated with changes in water quality, biodiversity and human health. Other social and economic surveys of family expenditures, transportation, trade, industrial production, health and a host of other subjects are also relevant.

In the past few years, Statistics Canada has put increasing emphasis on the development of new surveys to fill key environmental data gaps. Surveys are now being conducted in several areas.

4.2.1 Households and the environment

An important data gap until fairly recently related to household behaviour vis-à-vis the environment. What proportion of households have access to and use recycling facilities? To what extent do households modify their purchasing patterns for environmental reasons? Information of this kind is sought in the Households and the Environment Survey. Individuals are asked about their access to and use of recycling and composting, special waste disposal programs, disposable diapers, lawn and garden pesticides and fertilizers, programmable thermostats, energy-efficient lighting, low-flow shower heads, water purifiers, bottled water, public transit and other items. The survey is conducted as an adjunct to the labour force survey.

Two full editions of the survey have been conducted so far, one pertaining to 1991 and the other to 1994.[1] Consistent time series information of this kind is needed to gauge how rapidly attitudes and behaviour are changing.

4.2.2 Environmental protection expenditures

The purpose of the Environmental Protection Expenditures Survey is to gather information from businesses about the costs imposed on industry by environmental protection through regulations and conventions. Information is sought concerning annual capital and operating expenditures on (i) environmental monitoring of emitted pollutants, (ii) environmental assessments and audits of current operations and of proposed projects, (iii) site reclamation and decommissioning, (iv) protection and restoration of wildlife and habitat, (v) environmental charges such as permits, fees, fines and penalties, (vi) pollution abatement and control (PAC) facilities and equipment and (vii) other environmental-protection-related activities such as administration of an environmental affairs division or training and information programs.

The first full edition of this new survey, for reference year 1994, is currently in progress. Statistics Canada also conducted a more limited survey of environmental protection expenditures, focused on 'end-of-pipe' pollution abatement and control costs, for reference year 1989 and released the results in January 1992.[2]

---

1. ***Households and the Environment,*** Statistics Canada cat. no. 11-526, editions published in July 1992 and May 1995.

4.2.3 Surveys of waste management practices

Two of the general needs referred to in Section 3, one being for information about solid waste management and the other being for descriptive data about the 'environment industry', can be met partly by taking better advantage of administrative data sources. However, to derive a comprehensive picture, including data that are comparable across local areas, a survey approach is essential. Two new surveys have been launched to fill this data gap, one pertaining to local government waste management practices and the other to the private sector waste management industry.

In the Local Government Waste Management Survey (LGWMS), municipalities are questioned about their practices and associated costs with respect to the collection, transportation and disposal of garbage, recycling and the handling of hazardous waste. Some municipalities contract out for waste management services while others provide the services directly. Therefore, the survey is paired with the Private Sector Waste Management Industry Survey (PSWMIS), which gathers data pertaining to the operating revenues, expenses, employment, capital expenditure and tonnage of waste material processed by business establishments engaged in the collection, haulage, disposal and recycling of waste products.

A pilot edition of the LGWMS was conducted for reference year 1991, covering 83 municipalities each with a population greater than 50,000.[1] The survey was conducted again for reference year 1993, this time covering 642 municipalities, each with a population greater than 5,000, and results were released in August 1995.[2]

The PSWMIS was first conducted for reference year 1989 and results were released in November 1992.[3] A new edition of the survey, for reference year 1994, is currently in progress.

4.2.4 Packaging

The National Packaging Survey collects information from business establishments in all major industries on the use, reuse, recycling and disposal of industrial packaging. Some 32 packaging categories are defined in the survey, spanning six broad groups of materials: plastic, wood, textiles, glass, metal and multi-material packaging. The first edition of the survey was for the reference year 1990.[4]

The packaging survey is sponsored by the Canadian Council of Ministers of the Environment on behalf of the National Task Force on Packaging. The survey is an outgrowth of the National Packaging Protocol, the objective of which is to ensure a 50% reduction in the amount of packaging waste by the year 2000, compared to the 1988 estimated level. A second edition of the survey was conducted for reference year 1992 and the next edition of the survey will cover reference year 1996.

---

2. ***Analysis of the 1989 Pollution Abatement and Control Survey***, Statistics Canada, Investment and Capital Stock Division, uncatalogued publication, January 1992.
1. "Local Government Waste Management Practices Survey," ***Environmental Perspectives, 1993***, Statistics Canada cat. no. 11-528E, pp. 69-73.
2. "Local Government Waste Management Survey 1993," Statistics Canada, National Accounts and Environment Division, uncatalogued publication, August 1995. Available on Statistics Canada's World Wide Web site (http://www.statcan.ca).
3. ***1989 Waste Management Survey***, Statistics Canada, Industry Division, uncatalogued publication, November 1992.
4. "Packaging Use and Disposition," ***Environmental Perspectives, 1993***, Statistics Canada cat. no. 11-528E, pp. 63-66.

4.2.5 Other surveys

Statistics Canada also conducts a Survey of Water Use in Canadian Industry and a Survey of the Importance of Wildlife to Canadians, both on a five-year cycle and both under the sponsorship and close collaboration of Environment Canada.[1] In addition, existing economic survey vehicles are used to collect environment-related information. Two examples are the Survey of Consulting Engineers and the Survey of Scientific and Technical Services, which have been modified to collect information about revenues generated by the provision of environment-related services (a part of the environment industry). Statistics Canada also collects information about the environmental spending of governments, through its public institutions statistics program.[2] These data are, in a sense, a counterpart to the private sector environmental protection expenditures survey (Section 4.2.2 above) since they show the public sector financial burden associated with environmental protection and conservation activities.

4.3 Environmental accounts

The growing need for more tightly integrated, comprehensive, time series information about natural resources, waste flows and the costs of environmental protection led the government, in 1991, to ask Statistics Canada to develop a new system of natural resource and environmental accounts, consistent with the existing Canadian national accounts. The project was initiated as part of a broad policy initiative, referred to as the Green Plan.[3]

Work has been under way on the environmental accounts for about four years now. Particular effort has been concentrated on building natural resource accounts, for both renewable and non-renewable resources.[4] First priority has been given to oil and gas reserves[5] and timber assets,[6] two of Canada's most important natural resources. These accounts take all of the available administrative and survey data, adjust them for classification, timing and other differences, and weave the results together to form a consistent time series picture. Developmental work also has been done on reserves of metal ores and other minerals, on land accounts and on wildlife accounts. Pollution and waste statistics and their linkage to economic activity have also received attention, particularly in the areas of greenhouse gas emissions and solid waste flows. Resource use accounts for energy, water and some other items are under development and a comprehensive set of environmental protection accounts is planned. Information on the 'environment industry' is also part of these latter accounts.

---

1. See ***Water Use in Canadian Industry, 1986***, Environment Canada, Economics and Conservation Branch, Minister of Supply and Services Canada, Ottawa, 1992 and ***The Importance of Wildlife to Canadians: Highlights of the 1991 Survey***, Environment Canada, Canadian Wildlife Service, Minister of Supply and Services, Ottawa, 1993.
2. See "Government Expenditures on Environmental Protection," ***Environmental Perspectives, 1995***, pp. 89-100.
3. See Government of Canada, ***Canada's Green Plan for a Healthy Environment***, Minister of Supply and Services Canada, Ottawa, 1990. The Green Plan is a comprehensive, multi-year government policy initiative involving actions in the areas of human health protection, water care and restoration, smog and other waste reduction, sustainable development of forest, agriculture and fishery resources, protection of unique ecological areas and wildlife, the reduction of global warming pressures, improved handling of environmental emergencies and provision of more complete public information about Canada's environment.
4. For a fuller description of the environmental accounting project see "The Canadian National Accounts Environmental Component: A Status Report," ***National Income and Expenditure Accounts, Annual Estimates 1982-1993***, Statistics Canada cat. no. 13-201, July 1994. The final chapter of ***Human Activity and the Environment, 1994***, provides another summary.
5. See "Preliminary Estimates of the Value of Crude Oil and Natural Gas Reserves in Alberta," ***Environmental Perspectives, 1993***, pp. 79-91.
6. See "Measuring Ontario's Timber Resource," ***Environmental Perspectives, 1995***, pp. 33-46 and "Valuing Ontario's Timber Resource Stock," ***Environmental Perspectives, 1995*** pp. 47-54.

The environmental component is a 'satellite'[1] of the existing Canadian national accounts. This means it is linked directly to the central national accounts, using compatible concepts and the same classification systems, but it does not entail changes to that central system. This satellite approach permits an expansion of the analytical capacity of national accounting in a flexible manner, without overburdening or disrupting the well-established central system. There are four distinct components to the environmental satellite accounts:

- *natural resource stock accounts*, recording the known size and composition of Canada's natural resource assets as they evolve over time, in both physical and monetary terms;
- *natural resource use accounts*, recorded in physical terms, showing when and how non-produced goods and services are brought into the economic sphere and used in production and consumption activities, and highlighting the role of selected produced goods that are important in analyses of certain environmental issues;
- *waste output accounts*, recorded in physical terms, reporting the types and quantities of waste products that are generated in the economy and relating these to the flow of output; and
- *environmental protection accounts* identifying current and capital expenditures, by businesses, governments and households, that are intended to conserve or protect natural resources and the environment.

The natural resource stock accounts, expressed in monetary terms, are an addition to the national balance sheet (and pertain to item C in Figure 1). In the past the Canadian national balance sheet and flow accounts have included only financial and produced assets (item B in Figure 1). Physical and monetary natural resource stock and flow accounts are being developed according to the classification suggested in the newly revised SNA,[2] that is, for each of the following asset categories:

Tangible non-produced assets
- Land
  - Land underlying buildings and structures
  - Land under cultivation
  - Recreational land and associated surface water
  - Other land and associated surface water
- Subsoil assets
  - Coal, oil, natural gas and crude bitumen
  - Metallic mineral reserves
  - Non-metallic mineral reserves

1. The notion of satellite accounting systems has been applied in other areas as well. Two other examples are tourism and household work. See ***System of National Accounts, 1993***, published jointly by the United Nations (ST/ESA/STAT/SER.F/2/Rev.4, New York, 1993), Commission of the European Communities—Eurostat (catalogue CA-81-93-002-EN-C), International Monetary Fund (catalogue SNA-EA), Organisation for Economic Co-operation and Development (catalogue 30 94 01 1) and World Bank (catalogue 31512), 1993. Chapter XXI contains a discussion of satellite accounts in general and environmental satellite accounts in particular.
2. *Ibid*, annex V, part D.

Non-cultivated biological resources
Forest timber
Wildlife
Water resources

This broader definition of national wealth, a stock concept expanded to include non-produced (natural) as well as produced assets, is for some purposes a much better summary measure of national well-being than, say, gross domestic product, a flow concept. Recently, the World Bank ranked countries on this basis, incorporating its own highly approximate estimates of natural wealth and human capital. Canada came in second, after Australia, in this *per capita* world ranking.[1] There are significant controversies about how best to assign monetary values to natural resource assets.

The resource use accounts (flows 3 and 5 in Figure 1) show the physical quantities of various natural resources that are used by industries to produce their outputs, and by consuming households. As such, these accounts are closely connected to the input-output tables. For other environmental commodities such as air and water, there are no corresponding stock accounts, although associated environmental quality measures can be developed and, possibly, linked to the resource use and waste output accounts.

The waste output accounts record emissions of waste products, whether solid, liquid or gaseous, generated by industries, governments and households (flow 6 in Figure 1). These accounts are being developed in physical terms only. They can be thought of as a counterpart of the resource use accounts, the two together providing an integrated description of natural resources flowing through and being transformed by the economic system. Finally, the environmental protection accounts disaggregate the existing gross output time series in the core national accounts to show 'defensive' or 'protective' outlays separately from other production costs.

Canada is but one of several countries building environmental accounts linked to conventional national accounts. In 1993, an international group – known as the London Group – was established as a Canadian initiative to coordinate these research activities and to facilitate the sharing of experiences. Other countries that have been active in the field include the Netherlands, the Nordic countries, Germany, France, Australia, Japan, the United Kingdom and, until recently, the United States.[2] Several international institutions, notably Eurostat, the OECD, the UN and the World Bank, have also been playing important roles.

The Canadian environmental accounting framework bears many similarities to the System of Integrated Environmental and Economic Accounting (SEEA), proposed by the Statistical Division of the United Nations.[3] However, a major difference is that in the SEEA a new aggregate, 'environmentally-adjusted net domestic product' (EDP), is given central focus. The Canadian satellite accounts do not redefine or supplement existing SNA aggregates such as gross or net domestic (or national) product, although the accounts do provide much of the information necessary for those who may wish to calculate such 'green aggregates'. It will take many years of data development, research

1. See ***Monitoring Environmental Progress: A Report on Work in Progress***, World Bank, September 1995.
2. When the Clinton Administration was first elected, one of its first actions was to initiate a program of environmental accounting in the Bureau of Economic Analysis. Early results from this work were published in the ***Survey of Current Business*** in the spring of 1994. More recently, the Republican Congress has put the project on hold.
3. United Nations, ***SNA Handbook on Integrated Environmental and Economic Accounting***, Statistical Office of the United Nations, Series F#61, New York, 1993.

and professional discussion before meaningful, reliable and credible aggregates of the kind proposed in the United Nations framework are possible from a statistical perspective.[1]

The five-year work program set out in the Green Plan will end in a year and a half. A comprehensive report will be published at that time, explaining the accounting framework, presenting the new time series estimates and documenting the statistical sources and methods.

4.4 Geographical information systems

As mentioned in Section 2, Statistics Canada maintains a spatially-referenced database known as the Environmental Information System, containing time-series socio-economic and biophysical microdata from the Censuses of Population and Agriculture, from the surveys of manufacturing and mining and from a number of other sources. This database has proven useful in a wide range of applications. Using the EIS as a starting point, a project is now under way to develop a comprehensive set of land accounts integrating stock, quality and value statistics pertaining to the nation's land resources.

Land is used for commercial, residential, agricultural, recreational and what might be called general ecological functions. This is a very broad classification of land use; the land accounts provide a more detailed classification where possible. They also contain information about the physical nature of the surface of the land (for example, built-up, or covered with mature forest). Land potential is identified, in terms of the biophysical properties such as climate, geology and slope. Finally, the accounts provide estimates of the land value.

When complete, the land accounts will provide an integrated set of statistics indicating the net economic wealth attributable to Canada's land resources. A consistent set of national, provincial and regional land statistics will serve to support analyses of biodiversity, sustainable development and carrying capacity.

> *To a large extent it is ultimately the soil that needs to provide food and fibre, partition and cleanse the water that runs off or permeate and recharge water tables, provide the geographical base to convert carbon dioxide to photosynthate, act as a sink for other anthropogenic gases and act as the recipient of solid wastes that are not discharged into the aqueous system.*[2]

The land accounts involve an integrated database within a geographic information system, which can be used at scales ranging from local (census enumeration areas, ecodistricts, or sub-sub-drainage basins) up to national. A standard classification system and spatial framework are needed to support this hierarchical approach. The project builds on earlier work by Environment Canada on the Canada Land Inventory (CLI) and the Canada Land Use Monitoring Program (CLUMP) and draws upon the experience of France, the Netherlands and Germany, countries that are more advanced in this field.

Statistics Canada's national balance sheet accounts already include aggregate value estimates for commercial, residential and agricultural land. However, these estimates are

---

1. The quest for a more comprehensive welfare indicator, reflecting household and environmental benefits and disbenefits as well as those that are channelled through the market economy (and appear in the traditional GDP), is longstanding. For a recent commentary on this subject, see Clifford Cobb, Ted Halstead and Jonathan Rowe, "If the GDP is up, why is America down?", ***The Atlantic Monthly***, October 1995, pp. 59-78.
2. "Land, the Critical Resource for Sustainability," by Les Lavkulich, ***Sustainable Development Research Institute Newsletter***, September 1995, p. 2.

not presently available in a consistent, hierarchical breakdown, below the national level. Moreover, they take no account of the value of wilderness and park land, which of course is used for outdoor recreation, wildlife habitat and general ecological evolution.

More detailed land statistics will provide a single framework with which to harmonize data now collected by numerous jurisdictions for many different purposes (such as forestry management, administration of agricultural programs or urban tax assessment). For example, many of the provinces and territories have their own unique ecological and land use classifications. Much of the land tenure and use information is dispersed over registry offices in thousands of municipalities across the country. A national land classification system is required to permit comparisons among jurisdictions and to utilize information from a variety of sources.

At the national level, the data will support comparative descriptions and analyses of land patterns. For example, the benefits and costs associated with converting agricultural land for urban development can be measured in conjunction with the land's potential value in other uses, thereby allowing sustainability and biodiversity impacts to be assessed. Areas undergoing development pressure, and areas suitable for alternative uses can be more readily located with such a database. Data at the provincial level are needed for resource management and policy development, and require a more detailed classification of land information. At the municipal level, land use and cover data are required based on an even more detailed classification in order to carry out physical planning and land use management. Using the land accounts system, a detailed profile of an urban area can be created, whereby changes in socio-economic variables such as population density can be evaluated with respect to infrastructure and housing locations.

Comprehensive annual estimates of land cover and land use change can be prepared at the national level from the detailed local land statistics. Initially, the project is focusing on a single province, New Brunswick, and a single year, 1992. In a second stage it will be extended to cover all provinces and territories, for decennial periods. Eventually, demand and budgetary factors permitting (the current budget is reviewed in Section 5.3), land use, value and cover estimates will be updated on an annual basis.

5. Elements shaping the future

Statistics Canada has had an environmental statistics program for about 20 years – a very small one initially and a somewhat larger one now. The extent of progress over this period is evident in the following markers:

- A great many data sources are now being turned into useful environmental statistics. Federal and provincial administrative and regulatory data have been catalogued. Existing survey data are being recast in terms of environmentally-relevant geographical classifications to make the information more useful for environmental analysis. New and modified household, business and government surveys are filling key data gaps.
- The compendium ***Human Activity and the Environment*** and the spatial database upon which it is built have grown to become indispensible reference sources for state of the environment analysis, reporting and education in Canada. In addition, the unique annual publication ***Environmental Perspectives*** now provides regular

statistical updates and reports on new developments in environmental statistics between the normally quinquennial issues of ***Human Activity and the Environment***.

- Finally, a strong conceptual framework for environmental statistics, closely linked to the national accounts system that has proven so effective for economic monitoring and analysis over the past fifty years, is taking definite form. The environmental, natural resource and land accounts now under construction, in parallel with other countries and international institutions, can play a key role in policy-making for sustainable development.

How is this program likely to change over the coming decade? The answer will depend on the nature of the mandate from government, on evolving relationships with data-supplying and data-using partners, and on the size of the budget. This section considers each of these three topics in turn.

5.1 The government mandate

5.1.1 The Green Plan

Over the past four years, the federal Green Plan has been a principal driving force behind the environmental statistics program. It set broad goals to be achieved, spurred the development of environmental and natural resource accounts and provided five years of budgetary funding. The accounts are now coming into shape. However, work on them is scheduled to end in early 1997.

It will be regrettable if the environmental accounts and the associated data development work are terminated. The framework they provide is very well suited for analysis and policy-making for sustainable development. Environment-related variables are linked directly to the conventional SNA framework, used the world over for regional, national and international economic analysis and policy-making. Other countries are moving aggressively to develop environmental accounting systems and world standards are beginning to emerge. It must be decided within the next year or so whether or not this part of the program will be renewed.

5.1.2 The environment industry

Growing policy interest in the 'environment industry' has provided another, newly emerging source of mandate for the program. As noted previously, the federal government announced a new environment industry policy, linking the government's economic and environmental strategies, in September 1994.

When the environment industry strategy was first announced, it was determined that funds would be provided to Statistics Canada to develop new sources of information pertaining to the outputs, exports and imports, employment, technologies and other characteristics of the industry. However, the initiative has been scaled down and delayed over the past year for budgetary reasons. It may yet go forward, but the status of the strategy and Statistics Canada's role in it are clouded at the present time.

5.1.3 Greening of government

In October 1994 the Minister of Environment announced that a new Commissioner of the Environment and Sustainable Development would be established, within the Office of the

Auditor General. In June 1995 a further announcement was made to the effect that all federal departments would be required to develop, and to submit to Parliament, their own individual sustainable development strategies. Progress toward the objectives set out in these departmental strategies would subsequently be evaluated by the Commissioner.[1] This 'green government initiative' is intended to encourage each agency of government to "use the lens of its own mandate to ensure that appropriate consideration is given to the economic, social and environmental components of sustainable development".

As a federal department, Statistics Canada will be preparing a strategy of this kind over the next two years. The Bureau may also be able to contribute by helping to integrate the strategies of other departments. This could involve defining standards and assembling comparable statistics on environmental expenditures by departments, for example, and promoting the environmental accounting system as a framework for sustainable development policy-making.

5.1.4 State of environment reporting

Over the past decade, Environment Canada has had primary responsibility for preparing a quinquennial 'state of the environment' report for Canada. Several of the provincial and municipal governments have prepared comparable reports for their areas of jurisdiction as well. The first national report was published in 1986 and the second in 1991. A third report is currently in preparation and will be released toward the end of 1996. Statistics Canada has been an important contributor to all three federal reports and to some of the provincial and municipal reports.

After 1996, the SOE reporting function will be terminated at Environment Canada as a cost-saving measure. This turn of events may imply an increased reliance on the environmental reporting work done by Statistics Canada. The Bureau may be called upon to take over some of the functions previously handled by the SOE group at Environment Canada. Alternatively, national SOE reporting may simply disappear entirely.

5.2 Relationships with partners

5.2.1 Business survey respondents

New environment-related surveys depend for their success on the co-operation and goodwill of business respondents. The response burden is particularly onerous in the case of environmental surveys because the information being sought is often more complex than usual, involving difficult new concepts not directly connected to standard income and balance sheet statements. The growing need for more regionally- and industrially-detailed information about the efficiency of different technologies, about pollution flows and about environmental protection expenditures puts a strain on respondents' goodwill.

Rarely but increasingly, companies are including environmental information in their regular financial statements, voluntarily. Some tabulate pollutants emitted by their plants and show the extent to which such emissions have increased or decreased. Others try to

1. See "Government Establishes a Commissioner of the Environment and Sustainable Development," Environment Canada News Release, October 19, 1994 and ***A Guide to Green Government***, Minister of Supply and Services Canada, Cat. No. En21-136, 1995.

weigh their use of energy, air, water and materials against their output of pollutants and marketable products.[1] However, such environmental reports remain more the exception than the rule and there are as yet no real standards for this kind of reporting.

Statistics Canada will have to proceed carefully, seeking ways of minimizing the respondent burden as much as possible while demonstrating clearly the national importance of the environmental information requested. At the same time, the Bureau must work closely with business people and others to develop practical and useful accounting conventions.

5.2.2 Federal departments

Federal departments both supply raw data to Statistics Canada and use the environment-related (and other) statistics produced by Statistics Canada. Environment Canada, Natural Resources Canada and Fisheries and Oceans Canada are key data suppliers; Environment Canada and Industry Canada are the most important clients.

These departments are all dealing with large budget cutbacks and this will have an important impact on their capacity to collaborate in collecting and organising environmental information. Environment Canada, in particular, has provided financial support for several environment-related surveys and studies in the past, notably the Survey of Water Use in Canadian Industry, the Survey of the Importance of Wildlife to Canadians, the Local Government Waste Management Survey and pilot studies of urban land use based on digital satellite imagery. The pace of change in Ottawa will continue to be rapid in the years immediately ahead, bringing opportunities but also serious problems for Statistics Canada.

5.2.3 Provincial departments

Provincial government departments are important clients of the environmental statistics program. Indeed, natural resource management and environmental policy are primarily provincial, rather than federal areas of jurisdiction. Provincial departments collect a wide range of environment-related data for regulatory and monitoring reasons and make it available to Statistics Canada and others. They use Statistics Canada data for state of the environment reporting and other purposes and they depend on the Bureau for leadership with regard to statistical classification systems and data collection standards.

The provincial and territorial governments and the federal government coordinate their environment-related policy-making and administrative work through the Canadian Council of Ministers of the Environment (CCME). Statistics Canada participates in the CCME's State of the Environment Reporting Task Group and, on occasion, in its Solid Waste Management Task Group.

In the year ahead, Statistics Canada is embarking on a new initiative to develop integrated environment-health databases for the regional health centres. Most provinces manage health care through a network of these centres. The new regional databases will be constructed from the Census of Population, the Survey of Manufacturing, the Canadian Mortality and the Hospital Morbidity Databases, selected data from Environment Canada and the provincial environment ministries and other sources in the EIS. They will be geographical information systems, allowing officials in the health

1. See, for example, "A green account," ***The Economist***, September 4, 1993.

centres to study complex cross-sectorial questions for their locality, using mapping techniques. The project is starting in Ontario, where the provincial Ministry of Health has shown considerable enthusiasm.

5.2.4 Municipalities

The main point of contact with the municipalities at the present time is in the area of waste management. The larger municipalities are both respondents to and principal users of the Local Government Waste Management Survey. Statistics Canada has also had dealings with certain municipalities from time to time, in connection with particular pilot projects and analytical studies. Work on the land accounts also requires interactions with the municipal land registries. The Bureau will be seeking to build closer working relationships with municipalities in the period ahead.

5.2.5 Schools and universities

Educational institutions use ***Human Activity and the Environment***, the associated ***Teacher's Kit*** and the E-Stat CD-ROM as a basis for course work and as reference material for research studies. In addition, Statistics Canada's World Wide Web site will soon contain an extensive section with environmental information that can be easily accessed by students and educators all over the world. The education community is expected to be a client group of growing importance in the future.

5.2.6 Other domestic groups

Statistics Canada has regular contact with a variety of other groups and institutions that use environmental information. Some of these are the National Round Table on the Environment and the Economy, the International Institute for Sustainable Development, the Parliamentary Committee on Environment and Sustainable Development, the Sustainable Development Research Institute, the Canadian Environmental Industry Association, the Canadian Society for Ecological Economics and a number of consultants.

5.2.7 International colleagues

Like Canada, many other countries are also working to develop well-integrated, high-quality environmental statistics. The field is still relatively new. International institutions, such as the United Nations Statistical Office, the Organisation for Economic Co-operation and Development, the Statistical Office of the European Community and the World Bank, are participating actively. As a follow-up to NAFTA, a tripartite working group has also been established involving environmental policy-makers and statisticians from Mexico, the United States and Canada. Through these international associations, statistical standards are adopted and statistical compendia are assembled, to permit comparisons of environmental indicators across national boundaries. Statistics Canada is a significant player on the world scene, both benefiting from the lessons learned in other nations and contributing on the basis of its own experience.

5.3 The budget

The current annual budget for the environmental statistics program is about $1.6 million, of which 60% is from the Green Plan and most of the remainder is base program funding.

The program also finances some of its activities via cost recovery – sales of EIS data, special studies and surveys done on contract. There are 22 full-time staff, with backgrounds in a wide range of disciplines including economics, geography, computer science, biology, geology, chemical engineering and operations research. Table 1 shows the budget in each of the past four years, including special survey funding.

Table 1. Budget for Environmental Statistics (Thousands of dollars)

	1992/93	1993/94	1994/95	1995/96
Base budget	500	500	500	500
Green Plan	450	550	750	950
Cost recovery funds	90	80	30	115
CCME database inventory	--	100	--	--
CCME packaging survey	--	900	--	--
Household survey	--	--	400	--
Total	*1,040*	*2,130*	*1,680*	*1,565*

The program faces grave uncertainties in the period immediately ahead. The Green Plan expires on April 1, 1997 and the future is clouded beyond that date. Severe cutbacks in other departments that have been important sponsors of environmental surveys in previous years – notably Environment Canada – are already having an impact.

6. Conclusions

As Canada's population and economy continue to expand, pressures on the nation's limited natural resources grow ever larger. Reliable environmental statistics are needed more now than ever before, if we are to monitor and understand what is happening and to ensure that essential resources are preserved for future generations.

In this light, the environmental statistics program faces many challenges. The most important ones on the horizon are the following:

- to complete the new system of environmental accounts and to promote successfully its use as a framework for pursuing sustainable development;
- to finish building the land accounts and to foster good partnerships with the municipal and provincial government officials who will both support and use them;
- to continue developing the survey system so that it yields better information about environmental protection activities, environmentally-efficient technologies, waste generation and its management, household behaviour vis-à-vis the environment and other emerging environmental issues; and
- to further improve ***Human Activity and the Environment*** and ***Environmental Perspectives*** as essential tools for state of the environment reporting, education and research.

Environment-related publications

Human Activity and the Environment, cat. no. 11-509E, editions published in March 1978, March 1986, September 1991 and June 1994.

Human Activity and the Environment: Teacher's Kit, cat. no. 10-3002 XKE, September 1995.

Environmental Perspectives, cat. no. 11-528E, editions published in March 1993 and June 1995.

Databases for Environmental Analysis: Government of Canada, cat. no. 11-527E, November 1992.

Databases for Environmental Analysis: Provincial and Territorial Governments, cat. no. 11-529E, September 1994.

Households and the Environment, cat. no. 11-526, editions published in July 1992 and May 1995.

Local Government Waste Management Survey, 1993, cat. no. 16F0002XNE, August 1995.