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FRAMEWORK FOR FEDERAL
S&T ACTIVITIES IN
NATURAL RESOURCE AND
ENVIRONMENTAL MANAGEMENT

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FRAMEWORK FOR FEDERAL
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SUMMARY

Recent studies by the Ministry of State for Science and Technology on various aspects of federal involvement in science and technology related to the management of natural resources and the environment led to the observation that many of the situations and problems facing the various resource areas may be common and that their examination would be of interest. In view of the large volume of information that would be relevant, a case study approach was considered to be the most effective. The aim has been to identify the general character of the role of the federal government, suggest mechanisms for planning, sponsoring and coordinating its activities, comment on how the activities might be assessed on a consistent basis and define the interaction with other departments and sectors.

Four representative case studies embracing specific programs were mutually selected by the respective departments and the Ministry as follows:

Energy, Mines and Resources - Coal

Agriculture - Oilseeds Crops Program

Environment - Federal-Provincial Water
Planning and Management.

Fisheries and Oceans - Science in Support of
Fisheries Resource Management

Information on each program was collected from head office and regional contacts from each department based on a common list of points to examine in a consistent way the scope, origin and purpose of the program, relevant legislation and government objectives, execution and results of the program, and the interaction with other groups.

S&T activities of these programs have been compared and the various factors that have influenced them examined. These studies have resulted in the identification of seven roles, having a major S&T component, that are performed by the federal government in connection with its involvement in the management of natural resources and the environment. These roles have been tested, with positive results, against four other program areas, namely: beef, forestry, uranium and wildlife management. In both the case studies and the test areas, the programs are highly varied but are representative of federal involvement in the overall area. Accordingly, the roles, as listed below, should be recognized as describing the general character of the federal involvement in S&T activities related to natural resources and environmental management:

1. Development of national inventories and statistics.
2. Resolution of national or regional problems.

3. Management of resources under federal jurisdiction.
4. International obligations and activities.
5. Enhancement of Canadian technological capability.
6. Establishment of codes and standards.
7. Provision of independent advice and certification.

The roles have evolved as the result of continuing departmental efforts in implementing policies which were identified initially by the British North America Act and augmented by subsequent Canadian statutes. They have evolved with departmental mandates and thus reflect the currently accepted distribution of responsibilities between the federal and provincial governments. For this reason, the seven roles should be used as the basic framework for current and future federal S&T activities as long as there is no significant change in the presently accepted areas of federal and provincial responsibilities.

This framework does not define the magnitude of the departmental effort nor the way it should be carried out. However, it represents areas of continuing federal responsibilities and departments should use this framework, embracing the seven roles, in determining the type of effort to be undertaken in their various program areas so as to respond as effectively as possible to departmental missions.

Additionally, this framework could be used in the assessment of related activities. The concept that S&T is an essential and continuing component of the identified roles should be recognized. Also, these roles should be used as a framework on which to base the development of criteria for the selection, management and post-evaluation of these S&T activities related to the management of natural resources and the environment.

Examination of federal legislation related to resource areas shows that only 8 acts refer exclusively, or in a major way, to S&T. These acts vary considerably, especially with regard to the rationale for undertaking such activities, or how far into the processing of resources the mandates extend. Although required federal S&T activities can be performed adequately under existing legislation, most acts might be clarified or strengthened. Accordingly, those statutes relating to the performance of S&T by the federal government in natural resources and environmental management should be reviewed with the object of clarifying the legislation in each area where necessary and at an opportune time, to reflect more effectively the scope of current departmental interests, the purpose of the S&T activities undertaken, and the definition of mechanisms for coordinating these activities within the federal government and among the federal government

and the provinces and industry.

Increasingly, issues arise which can only be handled within the mandates of several departments. For this reason, interdepartmental coordination is essential. Therefore, a lead department (federal focus) should be recognized for each resources area: and this lead department should a) be responsible for coordinating all departmental interests, with special reference to S&T activities, and b) make use of any appropriate mechanism, including formal committees, to bring about the desired coordination of federal effort.

Finally, and possibly most importantly, the federal government cannot act alone and should refrain from unilateral action in dealing with natural resources research even though these resources form the basis of the national economy. Federal interests clearly include prices, availability, distribution and utilization. However, because the provinces have jurisdiction over the resources (except for fisheries) and hence over their production, joint responsibility must be recognized and consultative mechanisms should be established in each area to embrace those management roles for which the federal government has a responsibility; special emphasis should be given to establishing specific

mechanisms to deal with the S&T component of the management roles; the S&T mechanisms should foster informal contacts but provide for formal structures when required; the consultative bodies on S&T should provide for provincial participation at both the policy setting and program implementation levels, with an input from industry and the universities where appropriate; and in areas of joint funding of S&T activities, specific federal-provincial agreements should be arranged.

TABLE OF CONTENTS

INTRODUCTION

CASE STUDIES: S&T ACTIVITIES

Coal
Oilseeds Crops Program
Federal-Provincial Water Planning and Management
Science in Support of Fisheries Management

CASE STUDIES: POLICIES AND LEGISLATION

Policies
Legislation

GENERAL CHARACTER OF FEDERAL INVOLVEMENT

Derivation of Roles
Testing of Roles
Discussion

ASSESSMENT AND CONSULTATIVE MECHANISMS

Assessment
Legislative Requirements
Interdepartmental Interactions
Federal-Provincial Agreements and Relations

INTRODUCTION

During 1976 MOSST undertook an investigation of federal S&T activities in forestry at the request of the Department of Fisheries and the Environment. The objective of that study was to examine not so much what activities were being carried out but why the work was being done and how effective and useful were the results. Thus the rationale for federal involvement and the relationship of this effort with that of other departments and other sectors, including the provinces, universities and industry, were examined.

The forestry study was undertaken in response to a number of questions that had been raised within the federal government concerning the scope of federal involvement in forestry management activities and the associated R&D expenditures. Similar federal involvements and expenditures in other resource areas have also been questioned with respect to the actual value of the R&D performed to the resource area and to society at large; the amount of scientific assistance that industry should be given; how much R&D the country requires and what portion the federal government can afford or should provide; and the priorities for overall S&T expenditures both in relation to other priorities and within themselves. Results obtained from the forestry study suggested that the approach taken should be effective in examining many of the situations and problems in other

areas of natural resource and environmental management.

In order to examine the very large amount of information which would be relevant, a case study approach was considered to be the most effective. Accordingly, plans for the present project were prepared and work was initiated early in 1978. The terms of reference state that by undertaking a number of relevant case studies of federal science and technology activities related to natural resource and environmental management the project is intended to:

1. identify the general character of the role for the federal government;
2. define the requisite interaction with other sectors;
- 3.(a) based on these findings, suggest mechanisms for effectively planning, sponsoring and coordinating these activities federally and between the federal and the provincial governments and the private sector; and
(b) comment on how these activities might be assessed by the operating departments or the central agencies on a consistent basis to decide if they should be continued, terminated or transferred to an external performer.

The objective of this study has thus been to examine several representative but quite different examples of federal involvement in the various areas of natural resources and environmental management, to identify common features, and thereby to develop the general character of this involvement. For this purpose, four studies were drawn from activities of the Departments of Agriculture, Energy, Mines and Resources, Environment, and Fisheries and Oceans. Candidate studies to cover as wide a range of issues as possible were identified in each activity area and were discussed with departmental contacts designated for the project. The following case studies were selected by mutual agreement:

Energy, Mines and Resources - Coal

Agriculture - Oilseeds Crops Program

Environment - Federal-Provincial Water Planning
and Management

Fisheries and Oceans - Science in Support of Fisheries
Resource Management

In order to develop the case studies in as consistent a manner as possible, a common list of points was prepared for use as the base for discussions with the various departmental representatives.

Although a major portion of the required information could be obtained from departmental headquarters, one or more visits were made in connection with each study to regional laboratories and offices and to other pertinent contacts for additional information.

Each case study* has been developed to examine the scope of the program, its origin, purpose and relevance, the legislation and government objectives involved, execution and results of the program, and the interactions with other departments, the provinces and industry.

Federal S&T activities in areas covered by the case studies are summarized in this report and policies and legislation that define the mandates for these activities are examined. The general character of the federal involvement in natural resources and environmental management having a major S&T component is identified and described in terms of roles to be performed. A framework within which this involvement can be carried out and assessed, and a basis for establishing consultative mechanisms both within the federal government and among the federal government, the provinces and industry, are proposed.

* Individual case study reports have been prepared as working papers and are on file within the Ministry.

CASE STUDIES: S&T ACTIVITIES

The four case studies involving S&T activities in coal (EMR), oilseeds (CDA), water management (DOE), and fisheries management (DFO) are representative of such activities undertaken by the federal government. In each of the areas studied, federal laboratories constitute the principal R&D capability in Canada. The extent of this federal effort is indicated in the following chart which shows R&D expenditures. Values of the respective products, and associated development or implementation activities, where applicable, are also provided.

Coal

Federal S&T activities in coal are in response to various policy directives and at present EMR is preparing new policy papers in five areas:

1. demand - part of a study of overall energy demand to the end of the century;
2. resource and reserve assessment - arbitrarily defined as the amount of coal potentially available at the mine entrance;
3. supply - the amount of coal that could be made available for specific purposes, e.g. coking, gasification;

CASE STUDIES

	Product Value \$ million	Federal R&D Expenditures \$ million FY 1977-78	Development Projects \$ million
Coal	700 a)	5	1 f)
Oilseeds	500 b)	4.5	-
Water Management	- c)	3-5	7-10 g)
Fisheries Management	3,100 d)	76(e)	-

- Notes:
- a) Value of production at mine entrance for 1977.
 - b) Value of crop for 1977.
 - c) Value of product is not applicable but value of benefits from reduced flooding, water for irrigation, improved fisheries would be substantial.
 - d) Value of commercial Canadian catch, all species, for 1977 was \$1.1 billion; remainder was foreign catch from waters managed by Canada.
 - e) Expenditures for FY 1978-79.
 - f) Cost-shared and contracted projects for development of new coal technology.
 - g) Implementation cost of program is over several years with about equal federal-provincial input.

4. distribution - transportation, storage, delivery, etc.;
5. utilization - covering priorities for the use of coal and technology development in Canada.

Science and technology have a direct influence on the last four of these. Moreover, the demand for coal will also be affected by its availability and the ease with which it can be used. Thus the practicality of policies in all of the above areas will be partly dependent on Canadian technological expertise in exploration, mining, processing and utilization.

Coal is mined in Canada's eastern and western provinces. The resources are owned provincially but supply, distribution and utilization are national in scope and therefore the responsibility of the federal government. However, because all aspects of policy are highly interdependent there is also a federal interest in resource and reserve assessment, particularly in supporting and coordinating provincial assessments to ensure their compatibility, so as to permit the development of a national inventory. This is required for both federal and provincial use in planning and operations as well as policy development. Many of Canada's geological formations and the resources they contain are unique and the S&T input required for resource assessment is considerable, involving geology, exploration, mining and processing and

classification of data. In recent years, the coal-producing provinces, except Alberta, have conducted jointly funded assessment projects because of mutual interests and the needs of the provinces for technical and financial assistance.

From a national viewpoint, strategies for increasing the use of coal need even greater S&T support in the areas of utilization, processing and distribution than in resource assessment. A major reason for this is that the R&D capability of the industry is low because of its desperate financial conditions from 1950 to 1970, which resulted from the virtual elimination of the use of coal from the railways, domestic heating and industrial processes. Only electric power generation and coke production for steelmaking remained as major consumers of coal, though even here oil and gas made significant inroads.

The western coal industry recovered somewhat because of sales of coking coal to Japan from 1971 onwards, but coal production in Nova Scotia is still uneconomic. Though the "energy crisis" of 1973 and subsequent events have brought back an interest in coal as a future energy source, the actual economic situation for coal has, if anything, declined since then. It seems inevitable that coal will be

needed in considerable quantities in the future, but just when is difficult to predict. At present it is not economic to switch to coal from oil or gas because of the large capital investment for new equipment and the relatively high price of coal, the cost of energy from coal (at \$40/ton) being about 95% of that from residual oil. Consequently, the markets resulting from increased use of coal, which would provide the cash flow to support R&D by the industry, neither exist nor are they even visible. For the above reasons, the federal capability has been developed as a result of federal policies to prevent the collapse of the coal industry and to encourage the use of domestic coal.

Present federal energy strategies include the increased use of coal to replace imported oil, beginning in the Maritimes with electric power generation being converted back to coal, the adoption of coal for new federal heating plants, and the encouragement of other industries to convert to coal. Support of the use of coal in other parts of Canada and the decision to compile a national coal inventory are other strategies. As a result, present federal coal R&D is more in support of federal strategies than in support of the industry although the latter will

inevitably benefit if more coal is used.

Any attempt to revive the use of coal in response to government initiatives must begin with either the resurrection of old technology or the development of new. The first of these options is all but eliminated by current and future requirements for better environmental protection and greater efficiency. Coal was abandoned, in part, because it was dirty and hard to handle and control. Its reintroduction under the same conditions is not acceptable. Furthermore, the potential environmental effects of using large quantities of coal would require improvements even in the technologies of electric power generation and coke making. In view of the present industrial R&D situation, much of the burden of supporting the R&D necessary to implement coal strategies will rest on the federal government until the use of coal increases or the prospects of sufficient profits for industry to engage in R&D become apparent. Federal laboratories will also have to conduct much of the R&D because of limited outside facilities. It is essential however that demonstration projects be conducted by industry, where the technology will be used, but federal funding will also be necessary for this.

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The present federal coal S&T program covers geological surveys, mining, safety, processing, transportation, utilization and environmental control. Numerous joint programs are being conducted with industrial and provincial organizations, mostly designed to encourage exploration, development of new resources and development and introduction of new technologies for improved mining, energy efficiency and environmental control. Eventually, it must be the private sector and provincial utilities that will actually mine, process and use the coal with the new technology, but this situation is far from being achieved.

In the fields of other commodities for which more extensive external R&D facilities exist, in otherwise similar circumstances, more of the federal program could be contracted out, but this would merely change the mechanism of conducting R&D, not the necessity nor responsibility for its provision.

Present energy problems are world-wide and Canada is involved, through IEA, OECD, UN and via agreements with individual countries, in safeguarding its own energy supplies and attempting to solve the problem on a world scale. Canada's S&T interests at present are mainly the exchange

of technological and resource information but joint R&D ventures are likely in the future. S&T input is also needed to establish Canadian positions in international negotiations.

Another international area in which federal R&D has been involved is the export trade. Because of many unusual characteristics, Canadian coals have been viewed by potential customers with some skepticism when compared with coals from other countries. In the negotiations for exports of coking coal to Japan in the 1960's federal staff provided the necessary technical data to show that Canadian coals could be blended with others to produce satisfactory coke for the Japanese steel industry. As a result, contracts for some 180 million tons over 15 years were signed. More recently, results of federal R&D on steam coal were used to support Canadian negotiations to sell coal to South Korea. Federal support to Canadian industry in overcoming the reluctance of foreign governments to deal solely with industry seems likely to increase because the governments of many countries take an active role in trade negotiations and appear to expect the same from Canada.

An important subject of federal S&T is the establishment of safety standards for equipment for coal mines. R&D is

conducted for the development of better standards, monitoring of dangerous gases in mines, and the prediction of earth movements. The department is responsible for national certification of electrical and diesel machinery and belt conveyors for use in coal mines. Other equipment is also tested for safety though not legally certified. A major area of federal effort is the coordination of provincial standards for replacing various adaptations of US or UK standards by new ones specifically oriented to Canadian conditions. The lack of uniform equipment standards causes problems for companies, workers and manufacturers. An S&T input involving the performance of R&D is needed for drafting the standards. Considerable success has been achieved with the provinces in the adoption of uniform standards, though much remains to be done. Because of different specific interests and financial resources, it would be virtually impossible for each province to have its own standards development laboratory.

Another area for which EMR has a responsibility is related to coal in regions under federal jurisdiction. These include the Territories and the Dominion Coal Blocks in BC. At present, interest in coal in the Territories is mainly in resource evaluation.

The federal government has substantial requirements for the heating of its own buildings. It is also responsible for energy policy and therefore must be a leader in implementing its own strategies, one of which is the increased use of coal. The R&D component for this is provided mainly by EMR.

Oilseeds Crops Program

Work on oilseeds began as a result of shortages of lubricating and cooking oils during World War II. It has achieved remarkable success in its contribution to federal policies for enhancing Canadian agriculture. For instance, in the early 1950's, the concerted thrust to find a marketable oilseed that could be grown on the Prairies resulted in the widespread cultivation of rapeseed. In 1970, Agriculture Canada made a definite policy decision to try to establish soybeans outside the traditional growing area of southwestern Ontario. In both these cases, S&T played a vital role in the evaluation of policy options. R&D in oilseeds has been aimed at extending the regions in which each crop can be grown profitably as well as improving the efficiency of production, adaptability and quality of oilseed crops and their products. As a result, oilseeds have grown into an important commodity.

In large areas of the Prairies, such as the Peace River region of Alberta, northcentral Saskatchewan and the inter-lake and southern regions of Manitoba, rapeseed is now frequently the main crop. Total Canadian farm cash receipts from oilseeds stood at 11.8% of all crop receipts in the 1971-75 period, or some \$360 million annually, comparable to the value of coal production. Exports were worth an average of about \$280 million per year.

Other successful crops introduced have been mustard seed, sunflowers and soybeans. Canada exports both rapeseed and mustard seed, and domestic requirements for soya oil are expected to be met from domestic crops within six to ten years. Improvements in the disease resistance of sunflower is still needed but, on the whole, considerable success has been achieved.

Though agriculture in Canada is influenced largely by climate and soil conditions, these are rarely specific to any one province. Hence, it is necessary to develop technology that could be applicable in a number of provinces. At the same time, the knowledge gained from conducting R&D work for specific conditions can generally be used as a base for work in other parts of the country. For example, valuable

experience was gained in developing a soybean variety that could be grown in Eastern Ontario. This knowledge was then applied in developing a strain of soybean that can be grown in southern Manitoba.

In oilseeds, as in much of the rest of agriculture, the industry is highly fragmented. Even large farms are relatively small operations in comparison to what is needed to finance R&D. Much of the coordination and virtually all the R&D for the improvement of existing crops and the introduction of new ones have resulted from federal encouragement. Consequently, there has been a major federal involvement in oilseeds R&D to develop a Canadian technological base in this area.

The type of work conducted by federal laboratories is complicated by the fact that, after a certain time, a new strain may lose specific characteristics such as resistance to disease or pests. The development of new strains must therefore be a continuing process although priorities for the type of crop will vary. Also, the use of incorrect methods by seed breeders can potentially breed out specific characteristics so federal surveillance of standards is necessary to maintain seed quality.

The development of new strains requires a substantial R&D effort because successes are not predictable and promising results require extensive testing. Moreover, once a new seed becomes available, it can only be kept proprietary for a year or so; after that, it can be reproduced by other growers. For these reasons a commercially viable seed development industry does not appear possible; certainly, few countries have yet found a way of making it so, and all major food exporting countries have substantial federal agricultural R&D efforts.

The further breeding of seeds and the growing of hybrid varieties for sale to farmers is done on a commercial scale but the R&D required for hybrids is very much less than for the development of new strains. The commercial seed breeders are the farmers's principal source of new seeds.

Accurate scientific data is a prerequisite to the formulation of policies in the area of oilseeds. The necessity to maintain national inventories has played an important part in the program. The Canadian Grain Commission conducts most of the surveys. Currently, Canada lacks a good satellite system for monitoring acreages of different crops and possible yield. To overcome this, the federal government cooperates with the provinces in taking an early sampling of crops to

predict yield. However, to maintain an adequate and consistent statistical base, such monitoring and statistics gathering functions need to be coordinated by the federal government. As in coal, the major S&T input is to develop methods for sampling and data handling, and ensure the consistency of inventories so that uniform interpretation is possible.

Federal S&T makes an important contribution to the establishment of national codes and standards for oilseeds. As rapeseed oil alone accounts for some 40 percent of the total vegetable oil consumed in Canada, federal involvement in drawing up detailed national health codes and regulations on the composition of rapeseed oil is essential. Furthermore, as the bulk of Canada's rapeseed crop is exported, consistently high standards are required if markets abroad are to be maintained and possibly expanded. In large measure, Canadian success in exporting rapeseed stems from the improvement in seed quality; that is, the virtual elimination of erucic acid and the reduction in the level of glucosinolates. This is helping to overcome the prejudice against rapeseed, which is still strong in Europe. The high international regard for Canada's flaxseed crop is also due to its quality, as it has a higher oil content and iodine value than seed produced

elsewhere. Federal efforts in maintaining high standards has contributed to this advantageous situation for flaxseed.

Canada's international involvement in agricultural research is considerable. The main thrust is to improve the opportunities for export of agricultural products. Most of the international relations in oilseeds are with individual countries. A problem with close cooperation in R&D could be the danger of strengthening the position of possible competitors in the international market.

An additional function for S&T staff is to provide technical support to the Canadian Grain Commission, which is involved in monitoring foreign sales and assuring importers of the high quality of Canadian oilseeds. The department, either alone or through ITC, is also heavily involved in backing the quality of the product in foreign markets.

Federal-Provincial Water Planning and Management

The Canada Water Act (1970), which governs federal-provincial water planning and management (WP&M), recognizes federal concerns over the increasing demand for water in Canada and identifies

pollution as an urgent national problem. It also recognizes the need for a better assessment of water resources, data on future supply and demand, and the necessity for better management to ensure better water quality.

As part of the strategy to alleviate these concerns, federal-provincial committees have been set up under the Act, whose duties include the initiation of river basin management plans that are of mutual interest. Thus, until a committee decides that a study is necessary and sets up a planning board, the federal government will not commission S&T projects. A province could act unilaterally but would receive no federal support. Except in a national emergency; if agreement is not obtained, a project would not be started.

When a river basin study has been decided upon, a planning board with representatives of the interested organizations is set up to manage it and the necessary work is commissioned. It may be done by federal, provincial, industrial or any other organization with competence and facilities.

The S&T in water management is that thought necessary by the specific planning boards, first to enable decisions to be made on how control and management of water can be achieved in the river basins or lakes under consideration,

and second, to enable plans to be implemented. This S&T, therefore, is in direct response to planning and operations initiated because of federal and provincial recognition that a problem exists.

A threshold capability in federal S&T is essential to identify problem areas and to develop preliminary plans with the provinces before specific water management studies can be initiated. Furthermore, a background description of some of the characteristics of the water system to be studied is very useful in designing the specific study and even as a source of information to be used along with that generated during the study. Thus the technological inputs required in the overall planning and management of lakes and river basins depend on S&T of wider scope than that needed solely to support individual planning studies. They include R&D previously performed in other related studies by DOE, such as research in waters under federal jurisdiction, as well as the water quality and quantity data gathered across the country by the Water Survey of Canada. Finally, the federal S&T experience accumulated from previous WP&M studies provides techniques and information that can be used in identifying and assessing new problem areas, planning new studies and implementing their results. Thus, S&T

results from water planning and management studies contribute generally to federal expertise in aquatic science. They also provide input to the formulation of federal water policies as well as fulfilling their primary role in policy implementation.

Although individual water management problems are usually site-specific, the S&T capability developed for one region is often applicable to others. Consequently, this S&T capability has an important role in assisting in the solutions of water problems across Canada.

While most of the projects of WP&M are conducted jointly with provincial governments, water problems also occur in areas under federal jurisdiction. Under such circumstances R&D on water may be conducted by DOE. Actual water management projects are usually conducted jointly by DOE and DINA or DND, depending on which department has jurisdiction in the particular region.

A national inventory of the nature, extent and distribution of water resources is an important part of the information required for the development of national policies on water management. This is an essential input to WP&M projects which in turn provide data on many aspects of the seasonal variation of water quantity and quality with industrial, agricultural, residential and other activities. Much

of the actual work is data collection in the field. This is a process similar to field data collection for geological surveys or fisheries stock. It includes measurements or estimates of water flows, geographical characteristics, rainfall, climate and social and economic statistics. These provide the basis of analysis to determine the types of management or control of the river system that are possible and their potential effects on the physical, social and economic characters of the areas.

WP&M projects can influence international activities concerning boundary waters with the U.S. and in turn are affected by international considerations and agreements. These influences can be direct if the projects deal with rivers flowing across the Canada-U.S. border or indirect if the data developed can be used in international agreements.

WP&M studies also identify sources, mechanisms and means of control of water pollution as well as developing techniques to measure them. Much of this information is also useful in developing codes and standards for water and general environmental quality and, in this regard, implementation of many WP&M studies involves the upgrading of water quality.

The WP&M projects do not attempt to develop Canadian industrial R&D capability directly as is being done at present

for coal. However, some of the R&D and virtually all the implementation work are contracted to the private sector and in this way help to improve Canadian technological capability in the area of water control.

Science in Support of Fisheries Resource Management

As in coal, oilseeds and water, the federal government provides the major Canadian R&D capability for fisheries. The major reason for this is that the federal government was given jurisdiction over coastal and inland fisheries, under terms of the BNA Act, whereas ownership of other natural resources, minerals, forests, water, etc. was given to the provinces. This had to be modified for inland fisheries as a result of a number of court decisions which decreed that access to the lakes and rivers, as well as the lake and river bottoms, is within the control of the provinces. Accordingly, their management is provided by the provinces, except in the Atlantic region. Thus, the management of coastal and of inland fisheries are handled differently. However, R&D for freshwater fisheries is still conducted primarily in federal laboratories.

The fact that the federal government has jurisdiction over coastal fisheries does not imply that there is no role for the provinces. Similarly, provincial jurisdiction over

inland fisheries, as with other resources, gives this level of government the operational management role for these resources but does not give such a degree of exclusivity in their management as to rule out involvement by the federal government. Management is obviously too broad a function to be examined without further definition and, as demonstrated with the other cases, it is necessary to break it down into various functions in order to discuss the involvement of the two levels of government.

Coastal fisheries S&T is related primarily to management functions and is dedicated largely to the accurate assessment of the quality and quantity of the various fish stocks, with an increasing interest in the associated functions of restoration, augmentation and culture. To develop accurate statistical data on each species, special techniques are necessary which involve the use of research vessels and the monitoring of commercial fishing fleet activities. This requires research in data handling and processing. Also required is a good understanding of marine conditions and their effects on the breeding, feeding and migratory habits of fish, of the interaction of the various species and of the development and maintenance of adequate food supplies for each species.

The primary federal function in fisheries is the operational management of a resource under federal jurisdiction. S&T is a major tool in providing the technological base required in establishing stock quotas and other management directives.

The Extension of Jurisdiction Program (EJP) has dominated fisheries management for a number of years. A major technological effort as well as extensive international negotiations were needed prior to the extension of the management zone to 200 miles offshore. Since then the S&T effort has been required in implementing the policy as the total area added to Canadian coastal waters is in excess of one million square miles.

There are several other functions related to management that would involve the federal government irrespective of the jurisdiction over coastal fisheries. In this case, stock assessment is a major function. This requires the development of an effective inventory of the various stocks of all commercially significant fish species in each designated region.

Fisheries management, especially coastal, has also been much concerned with international agreements or conventions

on each major species plus a number of general agreements for specific geographic regions. There are many such agreements for both the Atlantic and Pacific coasts plus several involving freshwater fisheries.

A major increase in international involvement was brought about by the disastrous reduction of fish stocks during the early 1970s, which resulted in major financial problems for all those involved in fishing, especially on the Atlantic coast. To combat this problem, major reductions in the Total Allowable Catches had to be negotiated for the major fish species, which resulted in the drastic curtailment of operations, and in certain areas, the removal of foreign vessels. Such stringent controls of fish stocks have been required to ensure their natural rehabilitation plus additional measures to enhance the stocks. Controls had to be applied to the whole Atlantic region, because of the migratory nature of fish and the interaction of the different species. This could not be achieved on a province by province basis; five provinces were involved.

In addition, many problems that affect inland fisheries in Ontario, for example, can also be of concern in other provinces. Although the solutions of such problems could be handled separately by individual provinces, it would not

be as effective or efficient to do so and federal involvement is required.

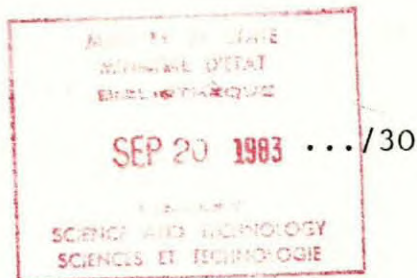
Fisheries, like agriculture, is an industry comprised of numerous individuals or small groups which cannot support an R&D effort. Fish processors, although larger in size and thus able to support some development work to improve the utilization and marketing of fish products, are still very small compared with most of their foreign counterparts which are also major competitors, since approximately 80 percent of all fish caught by Canadians is exported.

The government has recently enunciated general policies relating to assisting the industrial sector to enhance the level of its technological capabilities and thereby improve its competitive position in both domestic and international markets. Industries concerned with upgrading natural products, especially in areas of the country that normally suffer serious economic problems, would be covered by such policies.

Fish is a major foodstuff and all products must meet the appropriate standards for quality. S&T is required in their development and also to ensure that industry has the capability to process and handle the products so that standards can be met. In addition to standards relating to product quality, fisheries harvesting techniques and the gear used

must meet standards that have been established to ensure the protection of the fish stocks and habitat, including the sea bottom, against undue damage.

Periodically it is necessary for the department to act as an independent technical advisor. This can apply inter-provincially in resolving problems affecting several provinces, or more frequently, to provide a declaration of quality with respect to a product destined for export markets.



GOVERNMENT POLICIES AND LEGISLATION

Policies

Examination of the four case studies in the preceding chapter has shown that government policies on natural resources have had a major impact on federal S&T activities. Up to the late 1960s, the federal and provincial governments adopted policies that encouraged the development of natural resources for both national and regional benefits. From that period, governments, especially the provinces, have become involved in more activities and the provision of additional services and, needing more revenue, have increasingly been looking to their natural resources, particularly minerals, to provide it.

Canada has also begun to be aware of the magnitude of the environmental problem. In addition, federal policies have been introduced to contract out R&D required by the federal government whenever appropriate so that its performance might aid specific industrial organizations to upgrade generally the technological capability of Canadian industry, and to enhance the transfer of technology from government to industry. Nevertheless, questions have still been asked about the extent of federal involvement in S&T, particularly where it also benefits the provinces and nongovernment sectors,

.../31.

and whether such R&D would best be funded and done by, or closer to, the provinces and industry. A further look at the policies affecting activities of the four case studies exemplify the situation.

Specific policies regarding coal had been subject to close scrutiny between 1920 and 1960. Though its relative importance began to decrease after 1942, coal was the major source of energy in Canada from the mid-1800s till 1953 and for many years coal and national energy policies were almost synonymous. A major cause for government concern was that domestic coal was mined in areas far from the main markets in Ontario and Quebec.

The desire to make Canada less dependent on foreign energy supplies has been a major feature of Canadian energy policy since before Confederation. Largely because of transportation costs, this desire has not been fulfilled. A further complication has been the high cost of mining Nova Scotian coal, which has meant that the industry has always had difficulty in being competitive in central Canada. Because of the importance of coal to Nova Scotia's economy, the federal government has been unwilling to let the industry fail and this has formed a second aspect of federal coal policy.

By 1970 government interest in coal reached a low point because of the importance of oil and gas. This situation persisted until the 1973-4 "energy crisis". Federal energy policies have since included coal though its future is still uncertain. Neither objective, independence from foreign coal supplies nor the viability of the Nova Scotian coal industry, has yet been achieved.

Although some rapeseed had been grown in Canada on a limited basis during World War II, interest in this crop has evolved largely since the early 1950s, when the government decided that new sources of vegetable oil were needed to augment limited domestic supplies. Accordingly, oilseed production was developed and expanded and S&T was undertaken to produce varieties better suited to both animal and human consumption, which had been a serious problem with the product available at that time.

While federal policy has been to maintain the principal R&D capability in Canada, provincial agricultural departments have looked after extension services. In this regard the provinces have been responsible for introducing the results of federal R&D to farmers.

Many aspects of inland waters, such as navigation and fisheries, are the constitutional responsibility of the

federal government, whereas the river basins themselves are predominantly provincial and therefore subject to provincial jurisdiction. Prior to the later 1960s, the main federal role in river basin management was providing financial support, with only limited input into planning, for a number of projects involving the construction of dams and barrages which were believed to be the answer to both river control and power generation. In addition, the federal government provided financial relief for large-scale flooding, and funding where navigation was involved or DINA had interests. In the late 1960s these diverse ways of funding were brought together under the Canada Water Act (1970) to provide for federal input at the planning, as well as the funding and implementation stages, and to set out specific mechanisms to accomplish this.

Extension of jurisdiction to the 200 mile limit for economic management of resources in January 1977 has dominated scientific activities relating to fisheries management over the past several years. Development of relevant policies has been necessary to manage the one million square miles or more of the continental shelf, which may also contain energy and mineral resources, that had been added to the areas of coastal waters for management purposes. An additional

critical factor that led to new policies was the acute economic crisis which had afflicted the fishing industry during the early 1970s. Besides the economic potential of the oceans, recognition and examination of the extent and implication of ocean pollution has reinforced the necessity to increase control of coastal waters. Canada's fisheries policy also supports fisheries as a necessary industry in coastal provinces and in inland areas.

The foregoing indicates that federal S&T in resource management has been responding to federal policies since Confederation. Most of the early acts setting out mandates for R&D in, for example, geology, mining and metallurgy state quite clearly the government policy of the day which was, in summary, to support the development of Canadian natural resources by assisting industry.

The large-scale interactions of various federal and provincial resources policies, plus the environmental effects of today, were probably unforeseen when the acts were drafted. Today, a large number of interacting factors, federal-provincial, social, economic, environmental etc. must be considered in developing management strategies. Hence, the role of S&T becomes less easily visible to policy-makers and is sometimes thought of as belonging exclusively to industry and therefore

not required by, nor of interest to, government. This problem of defining the input of S&T to government policy has been further complicated by the fact that certain of the older acts do not define this relationship although they give clear mandates for S&T activities. This has led to many S&T units making their own interpretation of what is required of them. It is difficult to see how S&T input to policy is less relevant today than it was 100 years ago, especially when society is increasingly dependent on technology. In addition, some segments of industry do not have the necessary R&D capability required to implement federal strategies, hence federal input is essential.

Legislation

Legislation covering federal involvement in natural resource and environmental management dates back to Confederation and the British North America Act. The relevant statutes, in addition to legislation passed by the British Parliament, (the BNA Act 1867-1962, the Alberta, Manitoba and Saskatchewan Natural Resource Acts 1930, and the Union of Newfoundland with Canada Act 1949, each of which contains a number of sections dealing with natural resources) include over 100 separate pieces of Canadian legislation.

This latter legislation deals with specific topics relating to natural resources and the environment. In addition, there would be legislation affecting major activities of departments and agencies, such as Finance, Transportation, Industry, Trade and Commerce, National Research Council and others, which, although not relating directly to resources, may well have an important and far-reaching impact on the area.

The BNA Act is concerned primarily with the question of ownership and makes it clear that the provinces own the resources and hence have responsibility for their management. Section 109 provides that all lands, mines, minerals and royalties belong to the provinces. The interpretation* is that through ownership of the resources the provinces will have a continuing, exclusive source of revenue.

The relevant Canadian legislation covers a wide range of federal activity areas. With respect to agriculture, there are a total of 49 acts. These are concerned with the provision of economic support and assistance for production and marketing of foodstuffs, the correction of regional disparities, the establishment and maintenance of standards

*National Resources and Public Property under the Canadian Constitution by G.V. LaForest, 218 pages. University of Toronto Press 1969.

required for the supply of foodstuffs to both domestic and export markets. Those acts covering the performance of S&T relate to the establishment of the department and the experimental farm stations and to the undertaking of R&D in connection with the development of standards for the control of food quality.

Most of the 18 acts relating to fisheries refer to international conventions which cover operational guidelines and to product standards. Only two acts are concerned with research and development; one with fisheries development and the other with the Fisheries Research Board.

In the cases of minerals (17 acts), and the environment (22 acts), the majority is concerned with federal operational roles relating to standards, international relations and impact on industry and the economy. Only a half dozen acts relate to research and development required in these sectors.

In summary, of the more than 100 acts relating to federal involvement in natural resource and environmental management, less than twenty have any concern with the performance of research and development. In this group five acts, listed below, deal exclusively, or in a major way, with R&D related to the four case studies:

1. Resources and Technical Surveys Act
2. Experimental Farm Stations Act
3. Canada Water Act
4. Fisheries Development Act
5. Fisheries Research Board Act

An examination of these acts shows that legislation under which federal R&D is performed reflects the policies and objectives of the federal government in its areas of jurisdiction. The interest of the federal government in conducting R&D has differed with the resource and has evolved over a period of time. Though the BNA Act established the provinces as owners of the resources located within their boundaries, it also provided the federal government with a number of powers that impinge on their management and use.

Interest in coal predates even Confederation. The Geological Survey of Canada Founding Act (1842) was a provincial act of the United Provinces of Upper and Lower Canada. One of its aims was to determine whether there were any coal deposits in the province. The GSC was incorporated into the federal government at Confederation. Evolution of this legislation led to the Resources and Technical Surveys Act (1970), which specifically conferred responsibility for energy policy on EMR and permitted the department to carry out R&D in support of policy.

Section 95 of the BNA Act gave concurrent powers of legislation in agriculture to the federal and provincial

governments. Other sections of the BNA Act specify that matters of education are an exclusive provincial right so that extension services belong to the provinces. Overall preeminence in agriculture remains with the federal government.

Though the Experimental Farm Stations Act gave the Department considerable latitude, both levels of government have shared efforts, with research being mainly federal and extension primarily provincial.

The federal government's responsibility in water management derives from its jurisdiction over navigation and fisheries. The Boundary Waters Treaty (1909) applies to waters along the Canada-U.S. border and provides legislative jurisdiction over developments in these waters. As noted, recent interest in water planning and management has resulted in the federal government becoming jointly involved with the provinces in areas such as dam building, flood relief, data collection etc. The Canada Water Act (1970) has formalized this relationship and instituted joint planning and financing for the control of freshwater resources in Canada.

In contrast to coal, oilseeds and water management, federal responsibility for fisheries management is clearly

enunciated in the BNA Act. Section 91 declares that "the exclusive Legislative Authority of the Parliament of Canada extends to all matters coming within the Classes of Subjects next hereunder enumerated, that is to say,...

12. Sea Coast and Inland Fisheries."

Shortly after Confederation, a number of court decisions relating to managing and licensing inland fisheries required that the approach with respect to the provinces had to be modified. Although jurisdiction over fisheries clearly belonged to the federal government, access to the lakes and rivers, as well as lake and river bottoms, was within the control of the provinces. Consequently, inland fisheries have become a joint responsibility in that constitutionally the federal government has responsibility, but has withdrawn from operational management functions through agreements with most provinces.

The various acts generally refer to the performance of R&D in processing and utilizing, as well as developing, resources where appropriate. However, there is a good deal of variation in interpreting how far into the processing of metals, foodstuffs etc. the departments should go.

The importance of R&D to the development of Canada's natural resources is stressed in a number of acts. For

.../41

example, the Resources and Technical Surveys Act (1970) places the department under strict obligation to undertake R&D by stating that

"3. The Minister shall

d) make such chemical, mechanical, metallurgical and other researches and investigations as are necessary or desirable to carry out the purposes and provisions of this Act and particularly to aid the mining and metallurgical industry of Canada;"

However, the extent of this obligation, that is, the levels of effort "as are necessary or desirable" with which the Department needs to address the issue, are not defined.

Another noteworthy point is that these acts state that federal-provincial agreements may be arranged but, except for the Canada Water Act, they put little emphasis on developing mechanisms for consultation and cooperation.

GENERAL CHARACTER OF FEDERAL INVOLVEMENT

Derivation of Federal Roles

As indicated in preceding chapters, federal involvement in S&T activities related to natural resources and environmental management can be described in terms of policy directives and associated legislation. Such directives have been issued from time to time, starting with the pronouncements of the BNA Act and augmented by subsequent Cabinet Decisions and Canadian statutes. This legislation provides the basis for establishing and defining departmental mandates.

Periodically, problem areas or opportunities are identified which require consideration by the government or Parliament. Accordingly, the issue becomes a priority for examination by the department concerned, an inter-departmental committee, a parliamentary committee or commission, depending on its perceived importance. The result of this effort would be either a new policy directive, a modification of existing policies or possibly new legislation. As an example, there have been five such reviews since 1900 that have had significant effects on coal policies and hence, federal activities related to coal. Between such reviews, ongoing activities including S&T are maintained to administer

existing policies, to generate required strategies and mechanisms and to implement the new or modified policies. In addition, departments undertake activities oriented to identifying problem or opportunity issues on a continuing basis, and make recommendations accordingly.

This iterative process is essential so that departments can respond effectively to new issues. In this regard S&T can be described as one of the principal tools available to a department in establishing policies, assessing their effectiveness, developing the necessary strategies and mechanisms, and implementing them on an ongoing basis.

Examination of the range of activities carried out in each of the areas covered by the case studies has permitted the identification of several distinct functions that are common to those four areas and constitute the basic means whereby strategies and hence policies are implemented.

These functions are designated as roles in this report and are detailed below. Only those with a major S&T component at present are included. Seven of these are identified and are defined as follows:

1. *Development of national inventories and statistics upon which policies, regulations and economic activities can be based.*

National inventories of natural resources and ecosystems are essential for development of feasible policies by both federal and provincial governments. They are becoming more important as the reserves of some commodities become limited. The federal role is providing a national overview and coordinating and unifying the various provincial programs.

S&T input to inventories is most significant in the development of technologies for dealing with data collection and information processing. In all four studies the programs involved the compilation of resource inventories. For fisheries and coal there are specific inventory programs, and WP&M and oilseeds programs contribute resource data to other departmental inventory programs.

2. Resolution of national and regional problems.

This role is related to policies dealing with problems affecting the whole or major regions of the country and to the equalization of services from one region to another. The function of S&T here is to provide the technology required to resolve specific problems and to ensure that the S&T developed for one area or problem is applied in others. For example, while water problems are generally unique to their lake or river systems, the S&T developed for their study and management is generally applicable to other systems. Similarly S&T developed for coal, oilseeds and fisheries is applicable

to problems in various regions of the country. Such S&T activities could be carried out in conjunction with the provinces but this would not be necessary or appropriate in all situations.

3. Management of resources under federal jurisdiction.

This is a major task for fisheries R&D, especially in view of the recent rapid growth in both national and international interest in the resources of the oceans and the declared program to control activities on the Canadian continental shelf. The water resources of the Territories are of considerable importance, especially with regard to their protection from pollution. At present the importance of coal in federal areas is significant only in the Dominion Coal Blocks, whose legal status is still unresolved.

4. International obligations and the establishment of Canadian positions in international negotiations.

Canada is a member of several international organizations such as the UN, OECD, IEA and NATO. As well, treaties are negotiated with individual or groups of countries.

S&T contributions are necessary in negotiations with the US on boundary waters and in defining international agreements on fisheries. Canada contributes to OECD energy

inventories, IEA technology information programs, and other multilateral committees. There are also bilateral agreements for S&T cooperation in agricultural, water and energy developments.

5. Enhancement of Canadian technological capability, especially in sectors currently unable to undertake the task themselves.

This role is related to those parts of the national economy that do not at present have the level of technological capability required to respond to government policies. The coal industry has not been able to support the development of technology necessary to permit the use of coal as a major source of energy in the future. The farming industry is composed of many small operations, widely scattered, and consequently has been unable to undertake the development of new varieties of oilseeds needed for Canadian conditions. A similar situation exists with the fishing industry including both the fishermen and the processors.

6. Establishment of codes and standards of quality, safety, performance etc. for domestic and international needs.

The quality standards for fish, oilseeds and water affecting food are federal responsibilities to which federal

S&T has direct input. In other areas, such as safety of mining and fishing equipment, regulation is a provincial responsibility. Federal S&T expertise has provided an overview necessary for coordinating and setting up uniform national standards, and this role has usually been endorsed by provincial inspectors.

7. Provision of independent advice and certification in the negotiation of export and other contracts and agreements.

Support has been given for coal in developing markets in Japan and potential markets in South Korea. Federal S&T backing has also been extensive in the overseas marketing of oilseeds and fish products. This role is seen as increasing because many foreign governments take an active role in trade negotiations and the Canadian government is reciprocating.

Chart 1 follows and summarizes the S&T components of the roles for each case study. Almost all the roles are applicable for each area although the relative importance of the role and of the S&T contribution may differ. Also, because of the wide differences in the areas themselves, the nature of the S&T work conducted by the four departments differs radically. Nevertheless, these roles are common to the four resource areas examined and they use S&T to implement policy directives.

Testing of Roles

The roles discussed in the preceding section have been derived from an examination of four widely different but representative case studies of federal S&T activities. To determine whether or not these roles will apply generally to program areas in natural resources and environmental management, they have been tested against four other, quite different areas. The required data for this test were available in part within the Ministry; otherwise they were obtained from the department concerned. The programs chosen were beef, forestry, uranium and wildlife.

The beef program is a major one in Agriculture Canada, 2-3 times as large as the oilseeds program. The ratios of R&D to farm receipts for the two commodities are about the same. Whereas most of the oilseeds crop is exported unprocessed, most of the beef is processed and used in the domestic market. Because of this, beef has a greater multiplier effect in the economy.

Over 44% of Canada is covered by forests and woodlands. Forestry has been a major industry since before Confederation and today its products generate the largest net export earnings of all commodities (some \$5.5 billion in 1976). The federal S&T effort is larger than for coal or oilseeds, and totals about \$40 million.

CHART 1

DERIVATION OF ROLESSummaryNatural Resources or Environmental Program

<u>Role</u>	<u>Coal</u>	<u>Oilseeds</u>	<u>Water Management</u>	<u>Fisheries Management</u>
1. National Inventories	Uniform national data base is essential to assess reserves for federal and provincial policy & planning activities and for operational purposes.	Monitoring of acreages and ensuring the consistency of inventories are required for a uniform interpretation of data.	National inventory of the nature, extent and distribution of water resources is required for policy development.	Development of inventory of stocks by region is essential to management of fisheries.
2. National and Regional Problems	Problems affecting different areas of country, as environmental impact of large scale use of coal, require an equitable national approach.	Technology for county or for various regions can be developed efficiently with results from one area being applied to others.	Water problems can be national or regional in scope and S&T capability developed for one region is often directly applicable in others.	Because of Extension of Jurisdiction Program, the migratory habits of fish and interaction of species regional approach is essential.
3. Resources under Federal Jurisdiction	Minor involvement relating to evaluation of deposits in the Territories and the Dominion Coal Blocks.	Not applicable.	Minor role related to problems in Territories and other areas under federal jurisdiction.	Federal government is responsible for control and operational management of coastal fisheries.
4. International Activities	International commitments and export trade require technological support.	Minor though important role oriented to improving export opportunities for Canadian oilseeds.	Because of extent of boundary waters, this is a major role.	Numerous international conventions and agreements plus control of foreign fleet in extended zone require a major effort in international activities.
5. Canadian Technological Capability	Implementation of current federal strategies in energy requires a level of technological capability that the eastern coal industry is not able to provide.	Farming industry is highly fragmented so technical assistance is essential to provide the strains and varieties required for climate and health.	Industry is involved in contracts to provide required R&D and implementation activities in this program.	Industry (fishermen and processors) is highly fragmented and cannot support required technology development to assure its competitive position.
6. Codes and Standards	Establishment of uniform safety codes and certification of mine equipment are essential.	Rigid national codes and standards are essential to satisfy health requirements and international markets.	Codes and standards are required with respect to water quality and in areas of pollution control and environmental quality.	Codes and standards are essential for product quality, processing, handling, type of equipment used, to protect fish stocks and habitat.
7. Independent Advisor or Guarantor	Federal R&D was required to support sales of coal to Japan.	Federal government has had to assure importers of quality of Canadian oilseeds.	Insignificant at present.	Federal technical advice required periodically to resolve interprovincial problems and to provide a declaration of product quality.

The major federal involvement in uranium is through Atomic Energy of Canada Limited, with the Atomic Energy Control Board and EMR involved in regulation and mining, and extraction respectively. Originally, military secrecy was a major reason for federal involvement in uranium but the main concern at present is public safety in the nuclear power program.

Federal involvement in wildlife management is associated primarily with a number of international conventions oriented to the preservation and general management of various, largely migratory, species. Its overall worth is difficult to measure but is considerable as it is of major value to the recreation and tourism industry. The total federal effort for FY 1978-79 was \$11.1 million.

The relationships between S&T activities in the four programs and the seven roles described previously are shown in Chart II.

The federal roles in forestry are similar to coal, whereas, in the uranium and beef programs, the respective major concerns are the safety and reliability of nuclear power and the nationwide problem of improving yields under Canadian conditions.

Discussion

The foregoing examination of four case studies, as summarized in Chart I, has permitted the identification of seven roles having a major S&T component that are common to activities related to the federal involvement in these areas of natural resource and environmental management. These roles have been tested against four other program areas as shown in Chart II. In both of these situations the programs represented by the case studies and the test areas are very different in scope and coverage but can be described as representative of federal involvement in the overall natural resources and the environment area. Hence it is concluded that the roles effectively define this involvement and form a rationale or framework for related federal activities and it is recommended that: *the roles as listed below should be recognized as describing the general character of the federal involvement in S&T activities related to natural resources and environmental management:*

1. *Development of national inventories and statistics*
2. *Resolution of national and regional problems*
3. *Management of resources under federal jurisdiction*
4. *International obligations and negotiations*
5. *Enhancement of Canadian technological capability* *scientific*
6. *Establishment of codes and standards* *and*
7. *Provision of independent advice and certification*

CHART 2

EVALUATION OF ROLESNatural Resources or Environmental Program

<u>Role</u>	<u>Beef</u>	<u>Forestry</u>	<u>Uranium</u>	<u>Wildlife Management</u>
1. National Inventories	Land inventory significant as high percentage usable only for grazing. In general, data compiled for planning, production & regulation.	Data compiled jointly with provinces for use in policy planning and operations by federal and provincial governments and industry.	Federal government has maintained inventory of exploration data from companies and of processed uranium.	Size of migratory bird flocks and other wildlife is monitored for proper management by means of hunting licences and limits.
2. National and Regional Problems	Northern climate major factor in utilizing land resources. Introduction of new breeds and higher yields per land area and breeding cow oriented to climate problems.	Major effort is directed to problems that are national in scope or affect large regions of country, e.g. the spruce budworm infestation which affects all of Eastern Canada.	Major areas of national concern are safety and the use of nuclear energy for power generation.	Wildlife migrating across provincial boundaries is studied and provincial governments are advised regarding management strategies.
3. Resources under Federal Jurisdiction	Not presently applicable but some potential exists for developing horses, beef and buffalo for forage areas in the Territories.	Management assistance is provided for National Parks and the Territories (DINA) and for defence establishments (to DND).	Detection of ore bodies in federal areas (Territories) is main effort in this role.	Because of the Migratory Bird Convention, such birds are under federal jurisdiction. This is a major function and includes habitat protection.
4. International Activities	There is interest in introducing breeds that could be adapted to Canadian conditions. Program exists with France on meat & milk breeding. Beef production from dairy herds is of interest.	Ongoing but relatively minor component of program. Joint programs are underway with other countries.	There is considerable activity relating to sale of power stations to other countries and in nuclear safety agreements.	This is a very important function because of above Convention and agreements on other wildlife species, e.g. polar bears.
5. Canadian Technological Capability	This is a significant role because of fragmentation of industry and transportation problem. Areas of interest include: meat handling (pre-packaged boxes), operation of feedlots.	Major direct industrial interest is in forest products in which work has recently been transferred to private sector with continuing partial support by contract and contribution.	Essential aspect of program because industry has had no experience in meeting standards or producing nuclear material for power generation.	Studies of wildlife contribute to management of agricultural and forest resources. Wise use of wildlife, an important resource, is promoted.
6. Codes and Standards	Codes and standards are essential for grading, plus feed-stuffs (supplements), contagious diseases, internal and external pests.	Codes and standards are essential for marketing of forest products in domestic and foreign outlets, for building design, and for handling and operating procedures.	Safety has been the cornerstone of the federal effort. All aspects of program have required specific codes and standards because effect of radiation is unknown.	Standards respecting the health or contamination of wildlife populations are significant as they can have an impact on domestic animals and humans.
7. Independent Advisor or Guarantor	Important role in assuring that handling, storage and processing procedures are adequate.	Minor but important role, especially in foreign sales of wood products.	Federal groups have been the principal advisors for all matters concerning nuclear products handling and power generation.	Certification of the health of wildlife specimens is required on occasion.

These roles have evolved as the result of continuing departmental efforts in implementing policies defined initially by the British North America Act and subsequently by Canadian statutes. They have thus evolved in parallel with the mandates of the departments and today reflect the currently accepted distribution of responsibilities between the federal and provincial governments. Therefore, unless there is a major shift in the areas of responsibility between the two levels of government, there would be no justification in changing these roles. Accordingly, it is recommended that *the seven roles should be used as the basic framework for current and future federal S&T activities as long as there is no significant change in the presently accepted areas of federal and provincial responsibilities.*

This framework does not indicate the magnitude of the effort to be made in support of any particular role, or the way in which it should be carried out to the optimum benefit to the country (e.g. how much effort should be put into resource assessment, and whether it should be done in-house, by contract, by crown corporation etc.). Decisions will depend on various such factors as social and economic priorities, the characteristics of the resource, regional disparities etc. and will need further criteria for their determination. Moreover,

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all roles will not be equally relevant to every resource or environmental program. The basic roles, however, represent areas of continuing federal responsibilities in resource and environmental management. It is therefore recommended that ^{MOSST} departments should use this framework, embracing the seven roles, in determining the type of effort to be undertaken in their various program areas so as to respond as effectively as possible to departmental missions.

Performance of these roles by the federal government should not impinge in any way on provincial responsibilities in the area of natural resources and environmental management. The provinces must undertake their management functions on their own. However, efforts of the two levels of government should be complementary and should harmonize federal and provincial concerns. Good coordination of effort is essential and requires effective consultative mechanisms. These are discussed in the following chapter.

ASSESSMENT AND CONSULTATIVE MECHANISMS

Assessment of S&T Activities

The recognition of federal roles which require a major S&T input for their performance in the management and development of natural resources and the environment, as identified in the preceding chapter, provides the preliminary basis for justifying and evaluating federal involvement in the area. These roles can be used as a framework within which more detailed systems can be established in that they provide the guidelines for a consistent and reasoned approach in identifying S&T activities required by departments, and the parameters by which proposed new programs, and existing programs, might be assessed for their continuation, expansion, transfer to other sectors, or phasing out, as appropriate.

A basic criterion in assessing the validity of federal involvement in S&T related to the natural resources should be that the effort contributes to one or more of the identified roles. As noted earlier, the level of this involvement will not necessarily be the same with each role for the various resources areas and can vary for a given resource and with time. Also, while the role of federal jurisdiction over a resource may be a major criterion, it is not an essential one, because of the national importance of the natural resources.

Furthermore, the fact that most of the cases studied show only limited S&T contributions to some roles (e.g. technical advisory) does not mean that these roles themselves are unimportant. It may be necessary in other circumstances to conduct S&T activities whose sole purpose is to support such roles.

Finally, it should be emphasized that as S&T would be undertaken in support of an identified federal role, the federal government should ensure that it has the capability to carry out that S&T. Any portion contracted out would be a part of the federal S&T component and consequently should be conceived and managed by adequate intramural capability.

It is therefore recommended ^{to whom?} that:

- the concept that S&T is an essential and continuing component of the identified roles should be recognized; and
- these roles should be used as a framework on which to base the development of criteria for the selection, management and post-evaluation of these S&T activities related to the management of natural resources and the environment.

Legislative Requirements

In addition to those statutes, discussed in an earlier section, which relate specifically to case study activities,

the following legislation covers S&T in other resources areas:

- Forestry Development and Research Act
- Clear Air Act
- Wildlife Canada Act

Thus, only eight acts relating to natural resources and environmental management refer exclusively or in a major way to R&D.

The rationale for undertaking R&D, as declared by these acts, varies considerably. Generally, the purpose is identified but not always, as in one instance, the act states simply that "The Minister shall provide for the conduct of research relating to..."* The Canada Water Act (1970) is the only statute that clearly outlines the role of science and the mechanism by which the federal and provincial governments can cooperate to meet their objectives and priorities. In other acts, guidance is given for R&D but the mechanism for the activity in terms of long-range policies or priorities is not discussed. The older acts appear to view the purpose of R&D efforts as obvious and indicate it in only general terms. Moreover, little is said about the way in which the results of R&D are to be used. This has resulted, in certain situations, in the interpretation that the purpose of government science is primarily to extend knowledge and hence

* Forestry Development and Research Act.

scientific excellence is the major criterion on which results should be based. With increasing concern over the relevance of the work undertaken in this period of fiscal constraint, it is essential to recognize S&T as a major tool to be used by the federal government in its various roles associated with natural resources and environmental management and hence in meeting the social and economic goals of Canada.

As discussed earlier, there is a good deal of variation in the interpretation of how far into the processing of metals, foodstuffs etc. the respective statutes permit departments to go. Clarification in this regard would be desirable. A similar difficulty relates to the scope of departmental responsibilities in that new issues can arise which fall between the recognized mandates of a number of departments. Without clear mandates the departmental response is invariably limited even though several departments may have the expertise and interest.

Although required federal S&T activities can be performed adequately under existing legislation, most acts could be clarified or strengthened. Accordingly, it is recommended that *those statutes relating to the performance of S&T by the federal government in natural resources and*

environmental management should be reviewed with the object of clarifying the legislation in each area where necessary and at an opportune time, to reflect more effectively the scope of current departmental interests, the purpose of the S&T activities undertaken, and the definition of mechanisms for coordinating these activities within the federal government and among the federal government and the provinces and industry.

Interdepartmental Interactions

Federal interests in the management of natural resource and the environment, as described by the identified roles, are widespread and many departments and agencies have an involvement with each resource area. For example, about 20 departments can be expected to be involved with various aspects of any resource. Interdepartmental interactions may range from no contact to informal peer discussions, to structured permanent committees. A large proportion of these interactions are either influenced by S&T activities or have an impact on them.

Representative examples of such interactions can be readily drawn from the case studies. In the case of coal, there are major contacts with DREE on regional development, and with ITC on industrial support and development of foreign markets. For oilseeds, there are contacts with ITC on

marketing and manufacturing, and with NHW on product contaminants. For water management, with DFO and NHW on water quality, with DREE on the funding of flood control measures, and with EA on negotiations regarding the IJC. For fisheries, with DOE on ecological and environmental problems, with DREE on regional development, and with EA on Law of the Sea negotiations.

In the majority of such contacts, interdepartmental interaction is effective because a lead department is recognized as the focus in a particular resource area. Problems can occur when a department, not the lead, has an interest and provides budgetary support for certain undertakings. As an example, DREE identifies fisheries, forestry, mining, flood control, agriculture (ARDA) activities in the sub-agreements to the General Agreements that have been negotiated with most of the provinces. Since these General Agreements are with individual provinces, regional approaches which are required in, say, coastal fisheries in the Atlantic Region, can be hampered and their effectiveness reduced. Furthermore, technical feasibility may not be sufficiently well established before major funding is committed.

The necessity to have an identified focus within the federal government has been stressed by a number of outside

groups, for example, by the Canadian Forestry Advisory Council, an external advisor group to the Minister of the Environment.

The interaction of both CDA and DFO with ITC has been increasing over the past several years. It can be expected to continue as both of these resource-based departments assume broader roles in marketing. The federal government has recognized the need to play a more important role in food, from basic production to the marketing of the final product. No longer can the government be concerned with only the production of the raw materials, fish at dock-side or beef and cereal at the farm gate.

As noted in the preceding section, legislation does not always define clearly the separation of departmental mandates in some activities associated with natural resources. Accordingly, these mandates can only be effectively implemented by interdepartmental cooperation.

In order to enhance the effectiveness of the involvement of the many departments with interests and responsibilities in each natural resource and environmental area it is recommended that:

- a lead department (federal focus) should be recognized for each resource area; and

- this lead department should a) *be responsible for coordinating all departmental interests, with special reference to S&T activities, and*
- b) *make use of any appropriate mechanism including formal committees to bring about the desired coordination of federal effort.*

Such committees could be patterned on the Interdepartmental Panel on Energy R&D. This panel represents the first attempt to coordinate interdepartment R&D by influencing actual budgets. Since its founding in 1976, it has been concerned mainly with the allocation of additional funding, though it has been able to influence the overall direction of energy R&D to a limited degree.

Federal-Provincial Agreements and Relations

Current Situation

Consultative mechanisms between the federal and provincial governments regarding R&D vary considerably, with the level of consultation depending on the subject and degree of federal involvement. Examples drawn from the case studies show that the most formal arrangement is that dealing with water management. An effective hierarchial mechanism with a long history has been developed in agriculture. Consultations dealing with coal tend to be on an ad hoc basis. Fisheries consultations are oriented to the various species, are managerial in

approach and involve some 72 committees and advisory groups.

With respect to coal, formal liaison with the provinces exists through the federal-provincial mines and energy ministers conferences, but at present no federal-provincial group deals with coal R&D. In addition to contacts with provincial power utilities or crown corporations, there are numerous federal-provincial projects and contacts in specific areas of work. Liaison with Alberta has been extensive. However, that province has kept confidential its coal resources data and this has created some difficulties for EMR's coal resource assessment.

As EMR's coal R&D is directed to facilitating the use of domestic coal and to providing geological data on coal deposits, joint funding of projects with industry is arranged to permit better support and cooperation. Contacts also include meetings for advice and consultation, and membership in professional organizations and industrial groups such as CSA.* EMR staff serves on boards of directors or technical committees of various industrial R&D associations. Such contacts provide an important input in determining research priorities.

*CSA - Canadian Standards Association

In addition to ad hoc and informal consultations, there exists an advisory group, the National Advisory Committee on Mining and Metallurgical Research (NACMMR). This committee, established in 1968, is chaired by a senior EMR official and the members are drawn from industry, provincial agencies, universities and other federal agencies. Its purpose is to advise the Minister of EMR on R&D relating to energy and mineral resources in Canada, on coordination of federal and other research programs, and on sponsorship of university and other research. NACMMR has three energy sub-committees which meet once or twice a year to examine CANMET projects and to present outside views on the value of results.

A current government-industry problem is that government tends to introduce new standards by regulation. This procedure permits a speedy introduction of regulations but causes problems for industry, which would prefer changes to be effected through organizations such as CSA committees. A more structured liaison with industry would be desirable.

The principal consultative mechanism in agriculture is the Canadian Agricultural Services Coordinating Committee (CASCC). Membership includes the Deputy Minister, Agriculture Canada, as chairman, the provincial deputy ministers of agriculture, and university representatives. Agriculture

Canada is further represented on the Canada Committees and Expert Committees (sub-committees of CASCC) and provides much of the essential technical information and support. There is thus a linkage between these Expert Committees and Research Branch Establishments. Accordingly, CASCC, in coordinating the research efforts of both federal and non-federal government bodies, can act as an impartial outside body with good knowledge of federal resources and a capability to see that its recommendations are implemented.

Consultations with industry are extensive but are usually informal. In addition, Agriculture Canada meets annually with the Rapeseed Association of Canada which represents growers, crushers, shippers, feed manufacturers, plus the prairie governments. These meetings permit the federal government to monitor the performance of rapeseed crops, to prevent possible problems from developing, to follow up on industry complaints and to determine their cause.

These direct and indirect techniques give Agriculture Canada the means to promote the transfer of new technologies to the farmer. The system works effectively as indicated by the fact that it took only two years to have farmers change over to growing low-erucic acid strains of rapeseed.

Since water management deals specifically with activities which are jointly sponsored by federal and provincial govern-

ments, there are many well-developed and formal federal-provincial consultative committees. The Canada Water Act recognizes that each level of government has areas of responsibility and has provided for a mechanism to minimize the problem of the two levels of government developing differing, even contradictory, policies and programs. The Act provides for federal-provincial committees to maintain continuing consultation on water resource matters and to provide advice on priorities for research planning, conservation, development and utilization. These consultative committees also advise on the formulation of water policies and programs and facilitate their coordination and implementation.

Specifically, the Act allows the Minister of the Environment to enter into an arrangement with each province to establish formal federal-provincial consultative committees. One such committee has been established for each province. Federal representation on these committees varies from province to province, but includes at least one senior official of the Inland Waters Directorate with others drawn from other sections of the Department of the Environment and other federal departments (e.g. DFO, DREE and MOT). The formal committees meet from time to time to discuss such

matters as water monitoring, flood damage reduction, flood risk mapping, international water studies and federal-provincial agreements.

Less formal consultations occur more frequently, as each federal-provincial study is directed by a board consisting of representatives from both levels of government. These officials, usually managers of water programs, develop a rapport which facilitates future contacts. At the same time, researchers, engineers and technicians from each level of government and the private sector are often involved in specific parts of the planning study. This allows for an easy transfer of technology across the country.

It is noteworthy that federal-provincial consultations in water management projects are more functional than advisory. The direction of R&D is restricted by the terms of the Canada Water Act, which gives to R&D a specific purpose, the implementation of federal-provincial decisions.

Federal-provincial interactions with respect to fisheries are very extensive. There are some 72 consultative committees and advisory bodies with national (4), Atlantic (36), freshwater (14) and Pacific (18) groups. Subject areas embraced range from general fisheries management on a national basis to specific species and cover both commercial and sports

fishing. In a majority of situations, a technical base is required. Though nongovernment groups such as fishermen associations and processor organizations are the principal participants, provincial governments have a major role in all but four or five of these committees.

With respect to the Atlantic region, there are recurring contacts with local and provincial groups. The department is recognized as having the expertise as the provinces have few biologists. The Regional DGs and directors plus specialists meet with each province on a regular basis to discuss problems and provincial interests. Official contact with the provinces, however, is with the Atlantic Fisheries Management Committee. This group, comprising the ADM, Atlantic and the Regional DGs, establishes quotas and controls for each fish stock in the various fishing areas along the coast and provides advice to fishermen, processors and provinces.

Technical advice for this management committee comes from the Canadian Atlantic Fisheries Scientific Advisory Council (CAFSAC). This is an internal federal government group which is organized on a subject basis with a sub-committee for each. These sub-committees may have provincial input. This Council thus provides the scientific base for advice given outside the government and for establishing the

quotas for allowable catches.

Such a structured mechanism has not yet been required on the Pacific coast because only one province is involved, and there are fewer species of commercial significance in fewer designated fishing areas. However, as a result of the extension of management responsibility to the 200-mile limit, some form of a formal committee is considered to be desirable.

Interactions with the provinces' fisheries are directly related to management problems. The federal government is involved in strategic planning with Ontario. The province has a good biological competence and much of its work is applicable to more than one province. An Interpretive Group has been established to ensure good liaison, to communicate the results of programs and to identify and discuss problems. In the case of Manitoba, there is also effective consultation. The province has a working group with the Freshwater Institute. Consultations are carried out by means of the Federal-Provincial Committee on Management which covers the fisheries management responsibilities delegated to the province.

Consultative mechanisms in coastal fisheries management are aimed primarily at informing fishermen, processors and provinces of the federal regulations respecting fisheries stocks management. These mechanisms do not directly affect

the performance of R&D. A technical base for the regulations is essential and this is provided by the department with the results transferred to the respective management committee via such groups as CAFSAC. Federal-provincial consultation takes place on a regular basis to develop the best approach to implement the management regulations. In this aspect of the management role the provinces can and do have a major input. In freshwater fisheries, however, involvement of the provinces is more extensive and includes R&D, as with Ontario.

Proposed Mechanism

Examination of the various systems of federal-provincial consultation has shown that the most effective intergovernmental relationships occur when both the federal government and the provinces have a strong S&T capability such as the Canada-Ontario interactions on fisheries, forestry and agriculture. In fact, what is important is that each knows how to operate in its own area of responsibility, and is able to communicate with the other.

Generally, the federal government can improve relationships by refraining from unilateral action where joint action is preferable or required until both levels of government agree on the problem and how it should be solved. In such situations,

the federal government should forego even a preliminary study of the problem until an agreement is obtained. Even where unilateral action may be considered to be necessary, as much prior communication as possible is needed.

Because of joint federal-provincial concerns for resources, the need for consultative mechanisms is obvious and vital. Two primary types can be identified: formal, officially constituted by governments, and informal, ongoing and often spontaneous contacts between individuals. Informal contacts occur usually at the initial stage of cooperation. It may be advantageous for them to remain at this level, depending on the situation. Because of common interests of the two levels of governments in the area of natural resources and the environment, it is essential to have the different groups in regular contact to provide cross-fertilization of ideas. Some duplication of effort may even be valuable to establish credibility. However, effective informal cooperation would eliminate wasteful duplication, though at this stage there appears to be surprisingly little.

Formal consultative mechanisms vary considerably. Examples are found in CASCC and in water management. CASCC is a hierarchial mechanism chiefly interested in setting policies and leaves implementation in the hands of experts.

In water management, consultation affects both the policies and programs of the federal and provincial governments. Formal committees have been established with each province to maintain regular consultations on priorities for research, planning, conservation, development and utilization of water. Furthermore, they provide an important part in developing federal-provincial agreements and provide advice in both formulating and implementing water policies and programs.

For effective consultation between the federal and provincial governments, there must be a real input by the provinces and, where appropriate, by industry and the universities. As discussed above, the CASCC and water consultative systems are examples of mechanisms which allow the provinces to express their point of view at a number of stages and make recommendations to budget. Such inputs by the provinces are necessary both for policy setting and program implementation. Formal committee structures for all resources should permit this.

As management of Canada's natural resources and the environment must be recognized as a joint responsibility of the federal and provincial governments, it is recommended

.../71

that:

- *consultative mechanisms should be established in each area to embrace those management roles for which the federal government has a responsibility;*
- *special emphasis should be given to establishing specific mechanisms to deal with the S&T component of the management roles;*
- *the S&T mechanisms should foster informal contacts but provide for formal structures when required;*
- *the consultative bodies on S&T should provide for provincial participation at both the policy setting and program implementation levels, with an input from industry and the universities where appropriate; and*
- *in areas of joint funding of S&T activities, specific federal-provincial agreements should be arranged.*

In this way, provinces would have a real input into the planning and management, including financial responsibility to an increasing extent, of the S&T activities undertaken by the federal government in natural resources and environmental management. Also, the provinces should be involved in the periodic review of these consultative mechanisms to provide comment on their continuing value. This would provide the provinces with an opportunity to offer recommendations regarding such consultative mechanisms in a forum other than the political one.

