

A comparative study on Canadian and Chinese river basin planning

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Abstract — The paper tries to summarize basic approaches to river basin planning in Canada and in China, and makes a comparative analysis taking the Saint John River in Canada and the Taizi River in China as examples. The analytical results indicated that policy and management are the major features of the river basin planning study in Canada; control and treatment of water pollution have been generally treated in China; lack of implementation is a common problem in both countries.

Keywords: river basin planning; public participation; water pollution.

1 Introduction

Water is a most precious natural resources, and is also one of the indispensable conditions for a sustainable environment. Human life and productive activities can not develop without water. With the rapid growth of population and the development of economy, more and more attention is being paid to water problems. In order to develop and rationally use water resources, river basin planning has been promoted and developed since the early 1960s.

River basin planning is a process or means to achieve optimum management for water resources at a given basin or watershed, related to development, utilization and management of water resources. Water resources planning, therefore, has turned into one of the main contents of river basin planning studies. Water resource planning can be described as a device for guiding management of water resources to achieve special goals.

This study, first of all, tries to summarize basic approaches to river basin planning

in Canada and China, and then makes a comparative analysis taking the Saint John River in Canada and the Taizi River in China as examples. However, it is hard to make a detailed analysis because of insufficient time and information. Therefore, the paper is only a preliminary analysis and it still needs further revision.

2 Summary of basic approaches to river basin planning

2.1 River basin planning in Canada

2.1.1 Development of the planning process

In Canada, most of the river basin planning were carried out between the mid 1960s and the early 1980s especially in 1970s. After the passage of the Canada Water Act in 1970, the provincial governments joined the federal government to develop river basin planning and water management studies including the Fraser, Mackenzie, Qu'Appelle, Okanagan, Shubenacadie-Stewiacke, Cold-Beaver, Saint John rivers and so on.

Initially, comprehensive river basin planning in the Qu'Appelle, Okanagan and Saint John basins produced significant advances in research and application of multi-objective planning techniques as well as methods to generate information on the public preference to evaluation process of the plan. These studies were also intended to develop planning and evaluation skills and tools which could be transferred to other basins. During the 1970s, the focus of studies gradually changed to water resource planning that was action-oriented and aimed at the resolution of the specific and emerging problems of water management.

2.1.2 Evaluation procedures in planning

In river basin planning studies the evaluation process includes the definition of public planning goals and objectives, the assessment of water resource capability to meet present and future requirement, the development and evaluation of management alternatives to enhance resource capability, and the combination of these alternatives and a unified management plan. The different types of river basin studies that have been carried out in Canada do not follow this pattern uniformly. The comprehensive basin planning studies, completed for the Okanagan, Qu'Appelle, Souris and Saint John basins, have explicitly included such a process.

At the outset of the study, a program of data collection and research on the current and anticipated future physical status of water and related land resources, economic situation, as well as inputs from the public involvement program, provided the basis for determining planning objectives. The planning process was then initiated to develop and evaluate alternative programs of water and related land management to achieve the objectives.

2.2 River basin planning in China

In China, river basin planning was studied and developed in the early 1980s and at present it is being carried out in some river basins.

In the early stage of development, the major objective of studies was water pollution problems, especially organic pollution. Important research results were derived from works on the Songhua, Yiluo, Yalu and Tuojiang rivers, in which many research methods and technologies were adopted, such as water quality modelling, linear programming and multi-objective programming.

In the late 1980s, with further development river basin planning was further strengthened in terms of content and scope of study. Some research results reflect this characteristic in the reports of the Seventh-Five Year Plan in China. However, monitoring, prediction, control and treatment of water pollution continue to be important research focuses including many aspects on the development, utilization, protection and scientific management of water resources.

2.3 Similarities and differences between Canadian and Chinese river basin planning

In comparison of Canadian river basin planning with that in China, there is not only a lot of similarities but also great differences. These can be summarized as follows:

2.3.1 Similarities

- The planning focus has been evolved from sole objective to multiple objectives;
- Mathematical methods have been adopted in many river basin planning;
- Benefit-cost analysis has been adopted;
- Environmental impact assessment is universally applied.

2.3.2 Differences

In Canada:

- Public participation is stressed;
- Management is emphasized, especially in responsibilities of the organization;
- Importance is attached to implementation;

The scope of river basin planning in Canada, which is usually more extensive than in China, includes every aspect related to water resource planning, such as agriculture, fisheries, wildlife, mining, tourism, flooding, land use and use of biocides and so on.

In China:

- Methods for assessment and prediction are stressed;
- The techniques for the control and treatment of water pollution are stressed;

The focal point is on the control and treatment of water pollution in most of river basin planning.

3 Information and data collection

3.1 Saint John River basin

3.1.1 General information

The Saint John River basin, with a drainage area of 55167 square km and through a main stem 700 km in length, is one of the largest ones in the Atlantic Provinces (Fig. 1). The climate of the basin can best be described as "humid continental", characterized by long, cold winters, cool summers, and no dry season. The overall mean annual precipitation over the basin upstream of Fredericton is in the order of 38 inches. The ten-year recurrence interval mean monthly low flow for the summer period at Grand Falls is calculated to be about 2300 cfs. The basin population was 0.3 million in 1971. The main pollutants are BOD and suspended solids. About 85 per cent of the BOD loading and 63 percent of the suspended solids originate from two pulp companies.

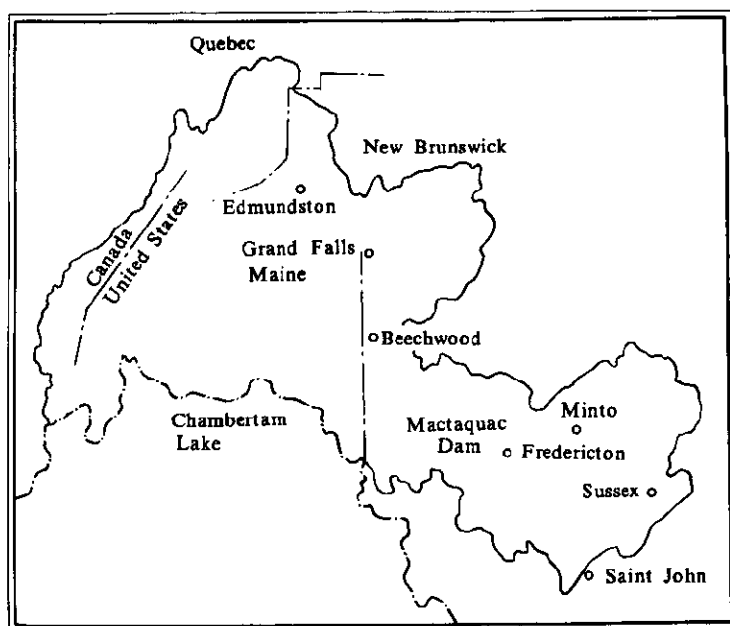


Fig. 1 Diagram of the Saint John River basin

3.1.2 Data collection

Every aspect of river basin planning has a data requirement if proper judgements

are to be made and appropriate actions taken. The type of data needed depends on the purpose for which it is put and the nature of the subject. There are three general types of data: continuous observations, periodic surveys, and initial inventory surveys.

Continuous observations are required for dynamic elements such as precipitation, volume rate, and most parameters of water quality. Periodic surveys are adequate for other elements, e. g. snow cover at the beginning of the spring snowmelt period, forest cover, fish and wildlife populations, land use, economic and demographic data. Some elements, however, require only an initial inventory, e. g. soils and geology, physiography, and certain background water chemistry parameters. The collection of data on water use in the basin and their correlation with relevant economic data is an essential feature of any management system.

3.2 Taizi River basin

3.2.1 General information

The Taizi River watershed, with an area of 13883 square km and a main stem 313 km in length, is situated in the middle part of Liaoning Province and runs through three cities— Benxi, Liaoyang and Anshan (Fig. 2). It is located in the East Asia monsoon area in the continental climate with extreme hot and cold changes. Mean annual air temperature and precipitation are 7.8°C and 800 mm respectively. The minimal average flow and the maximum average flow of the Taizi River each year are $21.7\text{m}^3/\text{s}$ and $92\text{m}^3/\text{s}$, respectively.

The basin population was 5.97 million in 1989.

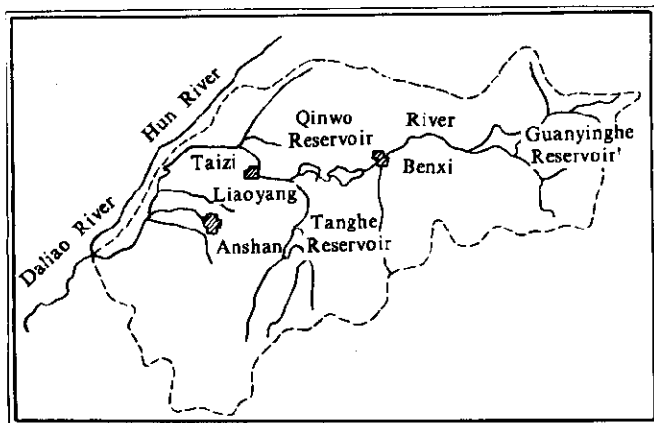


Fig. 2 Diagram of the Taizi River basin

3.2.2 Data collection

Taizi River planning uses data from two sources:

Collection of the baseline data including hydrology, meteorology, climate, population, industry, agriculture and natural resources and so on; Monitoring data: in the Taizi River watershed the selected monitoring items include water temperature, pH, DO, BOD₅, COD, phenol, total CN⁻, NH₃-N, NO₃-N, and NO₂⁻-N and so on.

4 Planning objectives and procedures

4.1 Saint John River basin

4.1.1 Planning objective

The planning objective of the study is to provide for optimum management of the water resources of the Saint John River basin for the social betterment and economic improvement in the region, with due consideration being given to the maintenance of a proper ecological balance.

In order to achieve of this goal, six specific management objectives are pursued actively and continuously: security of supply; protection of the water resources; use of improved technology; protection of the community; promotion of the resource; development of basin-wide objectives.

4.1.2 Planning procedures

The Saint John River basin planning focuses first on developing a framework for management and it is divided into six decision levels.

First level decision: terms of reference — provide for optimum management of the water resource.

Second level decision: major management objectives — ensure security of supply; protect the water resources; protection of the community; encourage use of improve technology, promote optimum development of the resource; achieve basin-wide standards.

Third level decision: essential management tasks — establish water quality and quantity criteria and standards for all uses; manage water availability; control and manage water use; exercise a strong influence upon land use; establish a technical strategy and schedule for abatement of pollution from existing sources; develop program to ensure compliance; undertake specific projects.

Fourth level decision: action policies — establishment of criteria; management of availability; management of water use; influence on land use; strategy for pollution abatement; programs to ensure compliant specific projects.

Fifth level decision: responsibilities—Water management; land use management; resource development; provision of services; research and development.

Sixth level decision: Instruments.

4.2 Taizi River basin

4.2.1 Planning objectives

Objectives for the Taizi River basin planning study are as follows: In the short-term (1995), to control water pollution and to improve water quality of the main river sections; in the long-term (2000), to improve water quality of the entire basin and to coordinate environmental, economic and social development.

4.2.2 Planning procedures

By means of systems engineering, the relationships among all factors of water pollution control systems are to be analyzed and coordinated. The effects of the coordinated factors on the overall objective are simultaneously considered, so that the optimum control of the overall environmental problems may be explored.

The planning is divided into three levels to be studied:

Level 1 A survey of the Taizi River basin: this level includes natural environment, society and economy, investigation and assessment of pollution sources, water quality monitoring and assessment.

Level 2 Control planning for the pollution sources and determination of environmental assimilative capacity of the river: prediction of the output value of the factories and enterprises; prediction for discharge sewage and pollution loading; allotment of reduction of the pollutants; control countermeasures; functional division of water bodies and determination of water quality criterion; building water quality model and parameter estimation; prediction for the discharge sewage and pollution loading at the discharge ditches; determining the maximum permissible discharge.

Level 3 Planning for the collective wastewater treatment in the basin: determining objects of pollution control and environmental construction; treatment analysis of sewage in main discharge ditches; combination and optimization of the pollution control projects; analysis for benefit and cost of the projects.

5 Comparative analysis of Canadian and Chinese river basin planning

From these two case studies of Canadian and Chinese river basin planning, it has been clearly indicated that there are great difference between them. In the Saint John River basin planning, policy and management, such as public participation and allocation of responsibilities are emphasized. In the Taizi River basin planning, the methods for prediction and assessment, and the techniques for control and treatment of

water pollution are used as focal points for study.

5.1 Policy and management stressed by Canadian planning

5.1.1 Public participation

Public participation in Canada is a prominent characteristic and plays an important role in planning. The process of public participation has been applied more extensively in the development of river basin planning than in the studies for special purposes. Public participation is perceived as being a systematic two-way communication process which aims at: further public understanding of water resources problems and the means by which these are investigated by planners; keeping the public fully informed about the status of the planning process, the findings and their implications; actively solicit from all concerned basin residents their opinions and preferences regarding water resource management alternatives.

The Saint John River Basin Board is responsible for an extensive public participation program with as many as eight staff members. This is a four-year program to encourage the involvement of the public in the planning process through formal and informal meetings and activity of field staff scattered throughout the New Brunswick part of the basin.

5.1.2 Implementation

The implementation of the planning is another characteristic in and after the river basin planning studies in Canada. An important criterion of success, which evaluates a river basin planning, should be whether or not the planning can be or is being implemented. In Canada the implementation phase of basin planning, therefore, is paid ample attention to. It is the reason that most river basin planning in Canada can be fairly implemented.

In the Saint John River basin planning, the recommendations have been presented to an organizational framework for management of the basins' water resources and for a large number of projects and programs respectively. As the aims of water management are to improve its contribution to the prosperity of the population, the sooner a highly effective system of management is introduced, the better it would be. However, careful judgement is required to determine the sequence in which action should be taken in order to obtain the best results, with the least disruption and expenditure, and as early as possible.

After completion of the Saint John River basin planning study, the Federal and Provincial Governments set up a small task force to review the planning results and make recommendations for implementation. This group concluded in 1978 that no special formalized agreement for implementation was required.

5.2 Method and technique stressed by Chinese planning

The Taizi River basin planning example, as a typical case study, reflects the main

contents of river basin planning in China. In the planning, first, a lot mathematical method for assessment and prediction of water quality are extensively adopted, e. g. fuzzy mathematics, Street-Phelps model for multiple sources and reaches, prediction model of grey water system, optimal, allotment model for the reduction of the pollutants and Hierarchical Analytical Process. Second, a large number of techniques for water pollution control and treatment are considered, such as nitrogen removal, oxidation ponds, primary treatment, secondary treatment and land treatment and so on, to be applied in the optimum treatment projects of water pollution. Therefore, it has been clearly indicated that the methods for assessment and prediction, and the techniques for water pollution control and treatment are considered in Chinese river basin planning.

It can be seen that water pollution in some river basins such as the Taizi River basin in China has become an extremely serious problem. Therefore, the key water problem to be solved is water pollution. Despite other related water problems such as soil erosion, land use, use of fertilizers and biocides in China water pollution is the most serious problem. Control and treatment of water pollution, therefore, must be regarded as a key point in river basin planning since all water problems may not be treated under the present condition of the economy in China.

6 Lessons to be learned

In river basin planning in Canada public participation is a very successful experience but is not yet applied in China. China can not provide the essential requirements of public participation at present, but it may be adopted with reform of the economic and political systems.

The lack of implementation has been a serious problem since the development of planning studies in China. The reasons come from many aspects. One of the main reasons is that the units undertaking basin planning are often scientific research institutions or universities rather than implementing agencies. Therefore, the river basin planning studies pay attention to theory but ignore implementation.

The implementation of basin planning in Canada is much better than in China. However, there is still some common problems.

The implementation of planning studies must be stressed, no matter when river basin planning is being carried out or after it has been finished.

7 Conclusions

Control and treatment of water pollution, as a prime objective of study, have

been generally treated in river basin planning in China. This is appropriate since all problems related to water resources can not be simultaneously treated under the present condition of the economy in China.

Lack of implementation is a common problem in both countries. The implementation of basin planning in Canada, however, is much better than in China. Therefore, the implementation of the planning study must be stressed.

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