Rakaia River and Catchment New Zealand: Twenty-year Planning Case Study

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ABSTRACT

Planning for development and conservation of the Rakaia River and catchment in Canterbury, New Zealand, is examined as a 20-year case study. The natural environment of the river has unusual features but the human environment illustrates aspects which are unfortunately very common.

Although a balanced and comprehensive planning approach was called for, particularly for irrigation development in harmony with wildlife and recreation interests, this has not happened. Reasons for this are examined and prospects for the future are suggested.

Conclusions include the need for decision-aiding to be timed right, as well as of high quality and for decision-making to be properly vested in a regional authority.

INTRODUCTION

The Rakaia River has the highest mean flow in Canterbury Province and region and ranks tenth in New Zealand. The river and catchment are important for recreation and wildlife and have considerable potential for development, especially for irrigation. There are unusual features of the interaction between the river and the surrounding Plains, including weather patterns which can provide high river flows with drought conditions on farms across the Plains. About 200,000 hectares are currently irrigated in Canterbury - about half the area which it would be practicable to irrigate with present technology. The river itself is a fine example of a braided gravel river and its upper reaches provide a home and breeding ground for a unique, bent-billed bird, the wrybill plover.

Balanced development and conservation of the Rakaia River and its catchment, in the overall interests of Canterbury and New Zealand, called for a value-based, systematic, public-participation, multi-objective, comprehensive, regional planning approach. This has not occurred; this paper reviews, as a 1969-88 case study, what has happened instead.

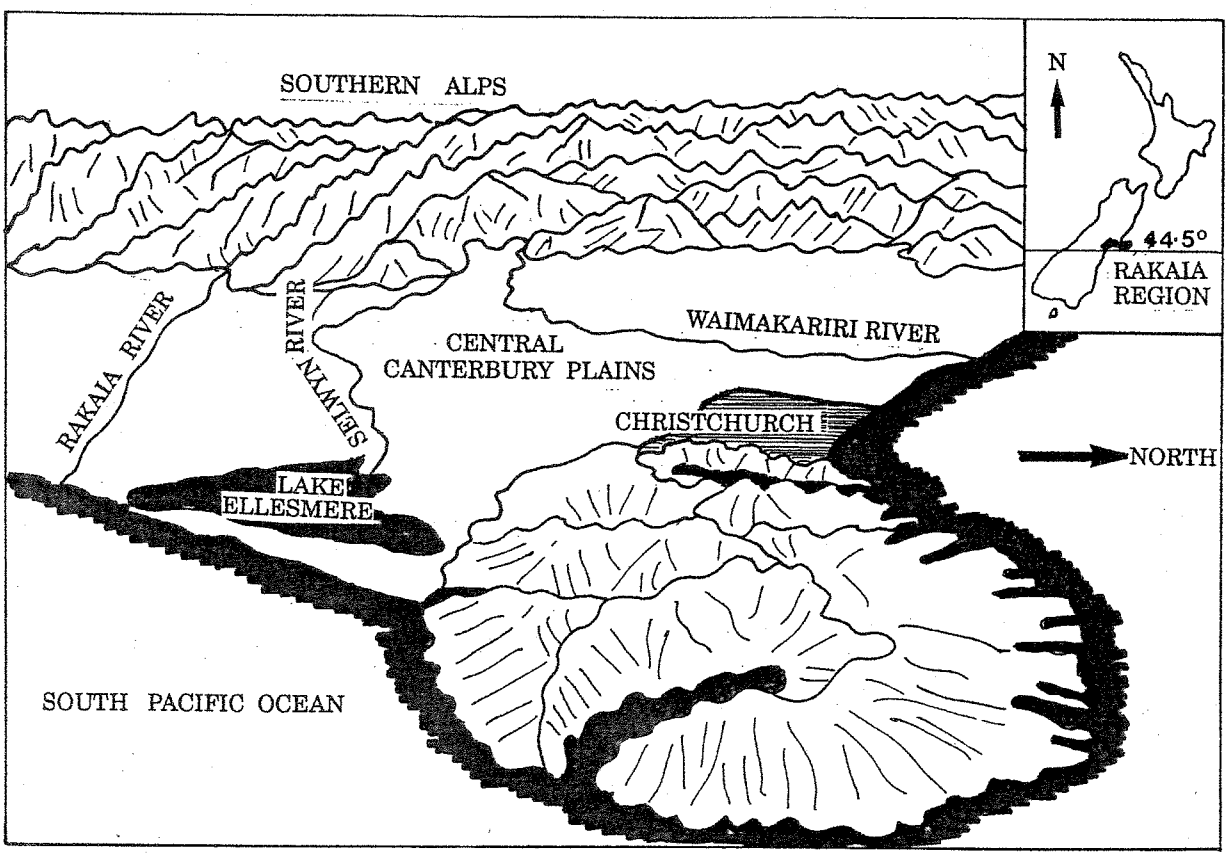

Figure 1. Location diagram for the Rakaia River on the Canterbury Plains and (inset) in South Island, New Zealand. (Adapted from [11].)

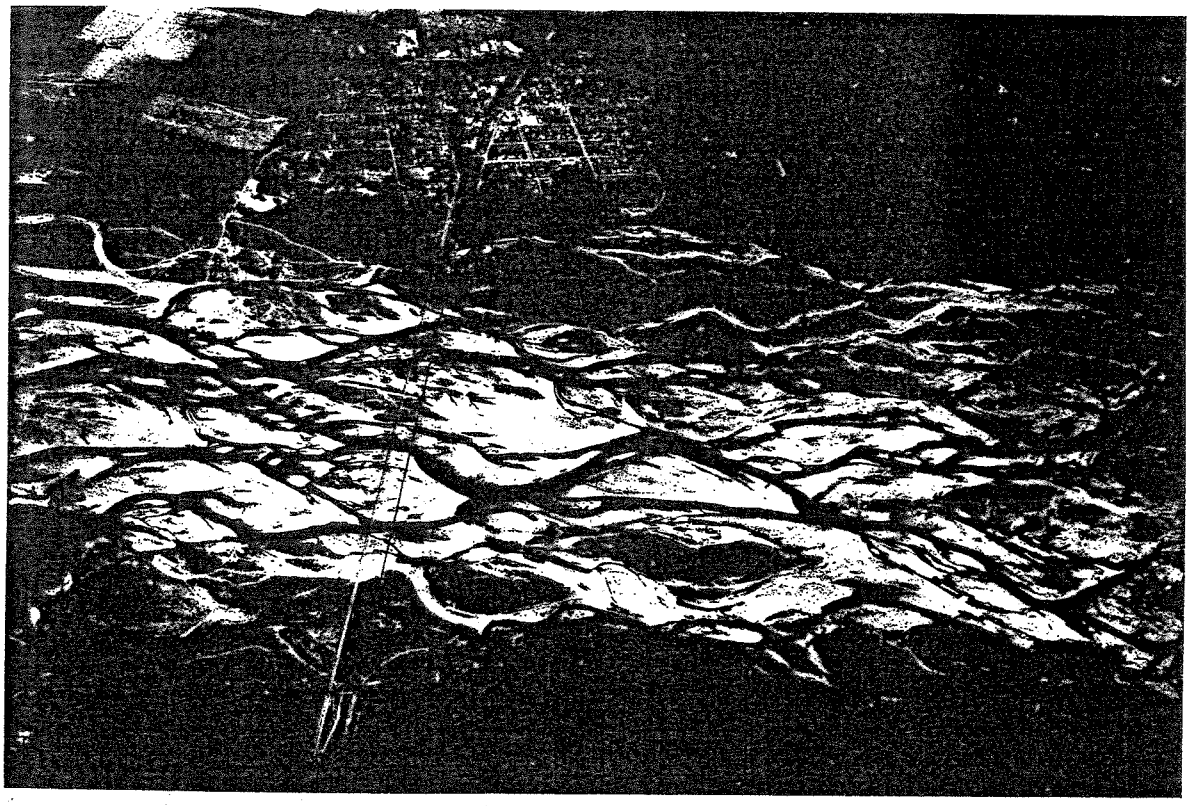

Figure 2. The braided channel of the Rakaia River. (Photo by K.W.C. Nicolle, Lincoln University.)

NATURAL ENVIRONMENT

The Rakaia river drains a 2900 km^2 catchment; about 2500 km^2 is above a gorge where the river leaves a mountainous area which goes to the backbone of South Island, the Southern Alps. The rest is over the Canterbury Plains, as the river flows in a braided pattern 60 km to the South Pacific Ocean. (Figures 1 and 2).

The geological history of the area is complex, but the present results are quite simple: the upper river wends its way through spectacular valleys filled in with gravels formed by freezing and glaciers and the lower river flows on about a 1:220 slope across Plains also formed by the actions of glaciers and the rivers that flowed in the warmer times between glacial periods. The gravel Plains are covered with silt blown from the ground-up gravel in the river beds. The resulting loam soils are good for farming if there is enough water from rain or irrigation.

Mean annual rainfall varies from about 650 mm near the coast, to 1200 mm near the gorge and to about 7000 mm near the main divide. There are about 45 km^2 of permanent snow and ice in the upper catchment. The Plains enjoy about 2000 hours of sunshine each year. Strong, dry north-westerly winds are an important feature of the climate; they can dry out the Plains while at the same time providing high river flows from the rain they dropped in the upper catchment.

Mean annual flow is about 200 m^3/s; mean monthly flows are highest in Summer and lowest in Winter - a different pattern from many other rivers crossing the Plains. Several flood flows peaking at over 3000 m^3/s have been recorded in the last twenty years and there have been flows as low as 77 m^3/s. There are several lakes in the upper catchment and one is used as a reservoir for hydro-electric generation, thus having an effect on downstream flows. A smaller hydro-electric station discharges water from another river into the Rakaia about half-way down the Plains.

The upper catchment is mainly covered in native tussock grassland, much grazed by sheep and cattle. About a third is bare gravel and rock; about a tenth is beech (Nothofagus) forest. The Plains are mostly pastoral grasslands, with significant arable farming and some horticulture.

A bent-billed bird, the wrybill plover (Anarhynchus frontalis), is an important part of the local fauna. There are thought to be fewer than 7000 in the world, all living on braided river beds in South Island, New Zealand - mainly the Rakaia. Sea-running Quinnat salmon (Oncorhynchus tshawytscha; Chinook, King or Tyree salmon) have successfully become established in the Rakaia, returning to breed in selected headwater areas.

Detailed information on the Rakaia River and catchment is given in a four-volume Resource Survey published in 1983 [1].

HUMAN ENVIRONMENT

Expectations of the river

The braided patterns shown in Figure 2 and the shallow depths of water ensure that the Rakaia is not a waterway for cargo transport. There are many other potential or actual purposes and human expectations. The list below is mine and in my priority order; therefore a statement of my point of view is relevant. I have been a professional engineer for 25 years; with a 20-year interest in water resources, including the Rakaia; a university teacher (natural resources engineering) for the last 8 years; rarely in a position of water resources decision-making and never so for the Rakaia.

Very important:
1. Drain the catchment to the sea
2. Not injure or kill people by flood or erosion
3. Not damage costly human structures by flood or erosion
4. Provide a home for wrybill plovers

Important:
5. Supply domestic and stock water
6. Provide recreation by viewing, boating and fishing
7. Provide spawning grounds for Quinnat salmon
8. Provide some hydro-electric energy from the headwaters
9. Recharge groundwater in the lower Plains

Desired by some:
10. Provide some irrigation for adjacent land
11. Provide commercial fisheries for Quinnat salmon
12. Dilute wastes and deliver them to the sea
13. Provide industrial water supply
14. Be a race-track for jet-boating competition

Other possibilities:
15. Provide further hydro-electric energy (using canals)
16. Provide irrigation for more distant land

Only 1 and 6 interfere very little with other expectations on the list. Among the "out-of-stream" uses (5, 10, 13, 15, 16), it is the two irrigation expectations (10, 16) which became controversial. They were realistic, being planned for and involved flows of water abstracted which were seen as of threatening size by people with other expectations of the river.

The legal and political environment

Three pieces of national legislation are essential to understanding the legal environment. The Soil Conservation and Rivers Control Act 1941 was far-sighted law dealing with control of flooding and soil erosion. It set up a national council and regional authorities; the national council was serviced in part by a national government agency. The Water and Soil Conservation Act 1967 responded to public concerns about the quality of water and soil resources and their allocation for various purposes. An important amendment to the latter Act is known as the Wild and Scenic Rivers legislation 1981; it provided for Local and National Conservation Orders. A new national authority set up under the 1967 Act took over and included the functions of the previous national council and the same regional authorities and central government agency serviced this National Water and Soil Conservation Authority.

A Planning Tribunal, part of the national judicial system, has been available to adjudicate on matters not able to be resolved by the regional water and soil authority or the national authority. Appeals against its rulings enter the higher courts of the New Zealand legal system.

New Zealand is governed by a British-style parliamentary democracy. Members of parliament representing regional electorates stand for election each three years in a two-strong-parties system. It is not uncommon for local and regional contentious issues to result in national legislation.

The technical environment

New Zealand has a well-educated population. The participation rate in university education is lower than some other OECD countries [2], but scientists, engineers and others in the technical environment are well aware of international developments and standards in many specialist fields.

One way of looking at how water resource development and conservation has been assisted by the technical environment in the twenty-year period being considered is to use the six-yearly

National Water Conferences, beginning in 1970, as indicators of the kinds of methods and ideas being used. (The first such conference was in 1964, and played an important part leading to the Water and Soil Conservation Act 1967. The twenty-year period being considered is 1969 to 1988.)

The 1970 conference contained background and presented papers which mostly presented single-purpose, single-process or single industry view-points: soil erosion; groundwater; water supply chemistry; hydro development; irrigation; ... . Two or three papers showed an awareness of water resource systems thinking; references were made to "the Harvard model" for design of water resource systems [3]. Central government economists spoke about multi-purpose water resource studies and how competing regional projects should be evaluated. One paper [4] specifically discussed water resources problems, planning and policy in a manner showing good knowledge of the late 1960s developments in North American thinking.

By the time of the 1976 conference the first World Congress on Water Resources had been held in Illinois; it contained a New Zealand contribution [5] with a rather single-purpose planning flavour. By contrast, the 1976 conference was dominated by papers and discussion on national and regional multi-objective planning and evaluation of water resources development. Multiple objectives, environmental impacts, public participation, intangible benefits - all these occupied the conference. Texts now well-known were referred to [6, 7, 8]. There was a paper suggesting comprehensive multi-objective planning for the Rakaia [9].

The 1982 conference was largely concerned with policy and management related to water. The 1981 Wild and Scenic Rivers legislation was important, as were other aspects of environmental impacts. Getting **land** and **water** legislation working together was a recurring theme. By now, Loucks et al. [10] had been added to the list of influential textbooks.

Opening the 1988 conference, the Chief Executive Officer of the central government Ministry for the Environment stated: "We are undoubtedly in the midst of a revolution in policy reform of the legal and institutional framework for resource management in this country." This was no over-statement and the environmental law reform in progress has wide-reaching effects on water resource planning and management. This "policy and practice" conference had a major emphasis on management of water. One paper, a very useful fore-runner of this one, was on The Rakaia Catchment - a Case Study for Conservation Orders, Catchment Management Plans and Regional Planning [11]. Another was on Decision-making for Multiple Utilization of Water Resources (of the Clutha River) [12]; it was about institutional arrangements for decision-making, not methods and techniques for decision support systems.

By 1988 the text-book authors (usually academic, with case-study experience) had a fully-integrated package available, including: planning methods; project appraisal; data management; engineering, environmental, economic, financial, social, legal and institutional aspects; risk and uncertainty; systems theory; mathematical modelling and optimization; and case studies (e.g. [13, 14, 15]).

Over the twenty-year period, university graduates from a few New Zealand university departments which have teaching and research related to water resources planning and management have joined the workforce in positions related to Rakaia River planning and management.

A SEQUENCE OF PROCESSES

The first nine important expectations listed earlier were being adequately satisfied prior to the (arbitrary) beginning of this case study period in 1969. It was the tenth expectation, irrigation, whose development proposals set the present sequence in motion.

Irrigation had been practised near the Rakaia since the 1930s, including large schemes constructed and operated by central government. There was debate about costs and policy in the 1960s and farmer pressure on members of parliament leading to a new national policy for

irrigation in 1971. By subsidy to farmers and irrigation committees, the new policy encouraged farmer interest in irrigation. The policy envisaged that local councils and the regional water and soil authorities would promote, construct and operate schemes. There was mention by central government of encouraging projects that would provide for storage and multi-purpose use of water. Also in 1971, a joint investigation by a university and a central government department (Agriculture) was announced, to consider the economics of irrigation using Rakaia and Waimakariri River water (Figure 1). The regional water and soil authority responded to a direct request from a central government Minister (Public Works) by preparing a 40-page report on the water resources of the Rakaia [16]. The nearby agricultural university (Lincoln) produced two reports: on water resources development for irrigation on the Plains and on the groundwater resources beneath them [17, 18]. The economic study begun in 1971 was published in 1974, showing returns on capital to the farmers of 20% to 30% and returns to the nation of about 10%.

A marked increase in public awareness then followed the irrigation development proposals and consequent resource studies. When the regional water and soil authority followed up its water resources report with a management and allocation plan in 1974 the irrigation proponents were happy but there was a group who were not, including salmon anglers and other recreational fishing groups. The authority expected the plan, which had no statutory backing but a good measure of support, "to endure for an initial period of some 10 years". Professional groups held public meetings in 1975 specifically on the Rakaia and irrigation and there were many articles in daily newspapers.

The world "oil shock" in 1973 gave rise to the New Zealand Energy Research and Development Committee. It funded projects examining energy use, sources and alternatives. A group of consultants examined the Rakaia for further hydro-electric development and reported on combined hydro/irrigation proposals in 1976 [19]. Although the report had some support in the region, it received very little from central government.

From about 1972 to 1977, conservation interests had been put in the position of reacting to proposals and policies, often with insufficient data on wildlife and recreation. During 1978 and 1979 the central government agency servicing the national authority carried out a collaborative research project on Rakaia water use and irrigation development [20]. The project report was accompanied by reports from the collaborators in 1979 and 1980 on: fish and fishery values; river flows; recreation, landscape and planning; matching water supply and demand; and the economics of alternative irrigation schemes.

Public debate of the issues was by now frequent and sometimes heated. "Save the Rakaia" posters and vehicle bumper stickers were commonly seen. Applications for water rights for major irrigation schemes were made to the regional authority in 1982. Also in 1982, the authority published a timetable for preparation of an up-dated resource report (1983), draft (1983) and final (1984) allocation and management plans. They invited public submissions and held public meetings. Professional groups organised a further series of public education and discussion meetings. Further research reports appeared, one of them based on a study undertaken by a multi-disciplinary team of "economists, geographers, physicists, biologists, sociologists and public policy and legal experts from a range of institutions in Canterbury" [21], primarily to identify urgent and longer-term research needs.

The resource survey published in March 1983 [1], just over ten years after the 40-page pioneering effort of Stephen [16], is a magnificent set of four volumes, over 600 pages, plus appendices, compiled by 10 contributors with consultant assistance. It contains information in detail on: physical and biological resources of many kinds; recreational resources, wild and scenic values; resource use and future demands. The regional authority followed it in August 1983 with an "issues and options" report intended to lead up to the draft management and allocation plan, which was published in November. A separate regional authority, a "united" planning council set up by local government councils, combined forces with its counterpart South of the Rakaia during 1984 to 1986 to produce a report on priorities for irrigation development in the two major regions [22]. This study was a deliberate attempt to use the lull in irrigation development to take a comprehensive regional planning approach.

However, another process had been set in train in June 1983, when a combined group of acclimatisation societies (introduced fish and game-birds) applied to central government under the 1981 Wild and Scenic Rivers legislation for a Water Conservation Order covering all the waters of the Rakaia catchment. The national authority set up a committee which held a seven-day hearing in December 1983. 59 local authorities and organisations and 186 individuals responded to a call for submissions and objections. Importantly, the committee considered that planning for irrigation was not sufficiently advanced for the **needs** of primary industry to be clearly specified - something the 1981 legislation required them to "take into account". They recommended a draft National Water Conservation Order on **parts** of the Rakaia catchment which contained rules on sharing flows between conservation and irrigation interests. The national authority published this draft in April 1984.

The draft Water Conservation Order was appealed to the Planning Tribunal. The Tribunal decided (May 1985) that the intent of the 1981 legislation was to ensure, for wild and scenic rivers, that this would over-ride other features, including multiple use possibilities. They extended the Conservation order to the whole catchment and increased the minimum flows (below which no water could be taken from the river for irrigation) to levels which the farmer groups believed would make irrigation uneconomic. The national farmers' group then appealed against the Tribunal decision to the High Court of New Zealand. It decided the Tribunal had made errors in law and referred the matter back to the Tribunal in November 1986. But this High Court decision was also appealed, to the Court of Appeal, the highest court in the land (apart from Parliament). The Court of Appeal over-turned the High Court decision and restored the Tribunal recommendations in September 1987. They agreed that the 1981 legislation gave primacy to conservation - not at all costs, but with a presumption in its favour.

Mason [11] considers this protracted litigation and related planning issues in more detail. He compares water and soil resource management planning, the conservation order process and comprehensive regional planning. He concludes that the single-objective conservation order process detracted from the multi-objective water and soil management planning process and that comprehensive regional planning based on detailed resource investigations would have been better.

Although conservation interests are pleased with the Rakaia result, and farmers are not, no-one can be pleased about the way it was arrived at. The water and soil resource legislation has been acknowledged for at least 10 years to be overdue for reform. As noted at the end of the last section, this is now occurring. The Minister for the Environment announced in January 1988 that there would be a major review of the laws governing New Zealand's "natural and physical resources". It is in progress and includes the 1941, 1967 and 1981 water and soil legislation.

A SEQUENCE OF HUMAN INTEREST

This sequence on its own adds little that is new to the description of processes. But it aids the discussion if put in the context of **decision-makers** and **decision-aiders.** In particular, the role of system analysis as part of decision support systems can be examined [23].

From the beginning of the study period, travellers, farmers and recreators were interested in the Rakaia. Decisions were made by central government agencies and the regional water authority relating to bridges, flood and erosion protection, stock water and recreation (including fishing) without serious or long-term contention. Decision-aiders were the staff of these agencies and their methods were straightforward and unsophisticated.

When the farmers' interest in irrigation increased, politicians became involved. Both groups raised the profile of irrigation development proposals and people from the media became interested. Public awareness was therefore raised. It soon became apparent that the responsibility for important decisions was not entirely clear and that central government policy was changeable. (Cynics would say that policy changed regularly each 3-year parliamentary period). The regional water authority was given enlarged and more complicated functions by

the 1967 legislation, but without a similar enlargement of its staffing and funding. There was not a history of specialist decision-aid consultant support to the regional water authority, particularly in water resources system analysis and planning.

University educators should be at the forefront of understanding in their fields, even if they are not practitioners or decision-makers. A handful became involved with the Rakaia, usually offering specialist advice on sub-systems. It was obvious that their role as decision-aiders was slight - free advice is often little-valued. The small amount of formal system analysis which was carried out involved several graduates of the nearby rurally-oriented university. Maidment et al. [20] includes a simulation model for irrigation water demands based on a previous model of Smart [24] and a second simulation model for balancing water supply from the river with demand.

When it was realised how little information was available on some aspects of the Rakaia resources, particularly biological and recreational information, there was a sudden upsurge in data gathering, so many scientists became involved. At a time when this was looking promising for comprehensive planning, and when there were signs of systematic analysis of alternatives beginning, the legal process described earlier was set going. Lawyers, judges and tribunal members became the decision-makers, filling an authority vacuum created by unclear legislation. Many aspects of the New Zealand legal system are by nature adversarial; decision-making was constrained to being on oversimplified dualisms: fish or irrigation; farmers or fishers; conservation or development.

The judicial system is independent of political influence in making their decisions. But the political system creates the legislation. By 1988, the issues were back with the politicians.

AIDING AND MAKING DECISIONS

It is much easier to **not** do something than to **do** something. A development proposal for water resources needs both high quality and appropriate timing of decision-aiding advice and information. If it is to happen, it needs decisions made by people who have the necessary authority. This case study highlights problems of timing of decision-aiding and confusion over decision-making authority. (There is high-quality information available and I make no criticism of the quality of people involved in any of the categories discussed.) It also suggests the question:

What would have happened if the regional water authority, in about 1974, had been adequately funded and motivated to employ a competent team of consultants to carry out a comprehensive regional plan for water resources development?

The authority provided an excellent resource survey report in 1983, but it was overtaken and sidelined by litigation based on hastily-conceived legislation.

The decision-aiding advice was excellent in detail and on sub-systems, but too little and too late on comprehensive planning methodology, conflict resolution and public participation.

The administrative structure for water resource planning has not allowed comprehensive regional planning to be integrated with particular resource development proposals and the subsequent decision-making necessary to see well-balanced development and conservation. From 1989, there is a much-changed regional and local government structure in New Zealand. The new Canterbury Regional Council has taken over the functions of the regional water authority. This promises the **possibility** of better-integrated planning in future. In the last few years, the government reforms and a prolonged downturn in the rural economy of New Zealand have stopped extensive irrigation development in Canterbury and delayed planning for further projects. But the worst drought in human memory struck Canterbury in 1988/89, causing particular hardship to farmers and emphasizing the lost opportunities suggested by this case study.

The river cares nothing for all this. Between 1969 and 1988 it transported 125 billion (US) cubic metres of water and much gravel to the sea.

CONCLUSIONS

1. This twenty-year case study illustrates many problems and lost opportunities for wise development and conservation of the Rakaia River and catchment.

2. With water resource systems, as for others, it is much easier to do nothing than to do something. For the Rakaia, this has frustrated wise development and conservation.

3. Both high quality and appropriate timing of decision-aiding advice are necessary to support decision-making. For the Rakaia, inappropriate timing has lowered the value of high-quality advice.

4. An adversarial legal system is not an appropriate forum for moving multi-objective water resources planning proposals towards better solutions past human-interest conflicts. For the Rakaia, this has been the major difficulty.

5. Comprehensive regional development planning is the most appropriate umbrella for large-scale irrigation development in the Canterbury region and the Rakaia River and its catchment will figure prominently.

6. Regional conservation and recreation interests can be appropriately considered within comprehensive regional development planning. National interests, including conservation and recreation, can be appropriately considered by national input to regional planning, with provision for **very rare** judicial or political intervention.

7. Decision-aiding in this case study would have been greatly assisted if the best-available contemporary water resources system analysis and planning had been applied by practically-oriented consultants advising the regional water authority.

8. The best hope for the future lies with an authoritative Canterbury Regional Council, better natural resources legislation and wise use of system analysis and planning consultants.

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