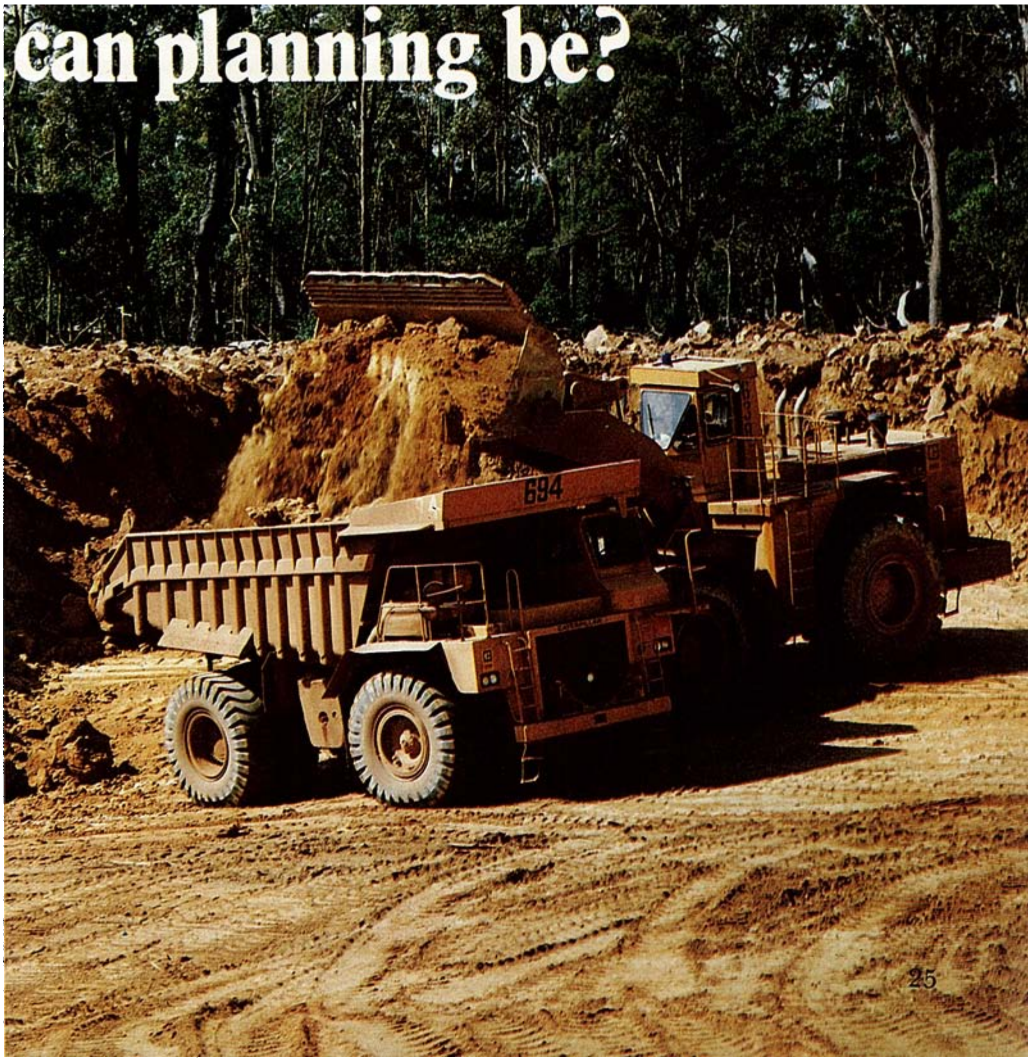
How rational can planning be?



A recently published book edited by two CSIRO scientists asks the question: what does it mean to be 'rational' about environmental planning?

The book reports a study of the problem of salty run-off and conflicting land uses in Western Australia's Darling Range (see *Ecos* No. 4), and delves deeply into the question of how scientific information can be used in environmental planning. It looks specifically at Western Australia's Murray River and its catchment.

This river is big enough to make a large contribution to Perth's water supply. Unfortunately, though, it has a salt content more than double the World Health Organization's recommended level for drinking-water. Damming schemes, or changes in land use in the catchment, could produce water with an acceptable salt content. But are any of these schemes justifiable, and if so, on what grounds? The study grappled with this question.

A salty surprise

To the pioneers who began to occupy the Murray catchment in the 1830s, the 660 000 sq. km of untouched country provided the opportunity to establish a better life. At first the settlers looked for grass on which sheep could feed and for reliable water-holes. Around the turn of the century, they cleared more of the country and the emphasis shifted to wheat-growing.

As a result of the clearing, more salt found its way into the Murray. (About half the catchment is now cleared.) Pollution of land and waterways by salt as a result of agriculture has been the big surprise that land managers, both public and private, have had to face in Western Australia. Although the link began to be suspected before World War I, it was not until 1976 that regulations on clearing were introduced for some privately owned land.

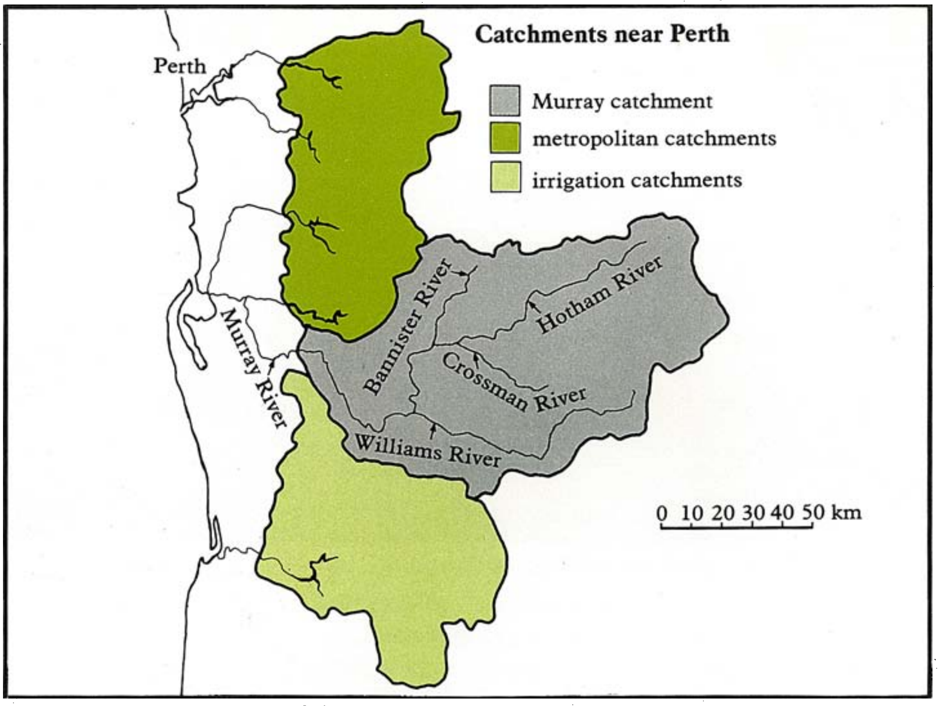
The problem has given rise to a number of conflicts between interested groups. Perth householders and industry will want more fresh water in future. Reforestation could improve water quality, but farmers will not want to see profitable land turned back to forests. In the areas that are still forested, future bauxite-mining may affect water quality — and offend conservationist groups as well.

In the early seventies, a study team, brought together by Dr David Bennett from among staff in CSIRO and Western Australian State government agencies, began thinking about how to use scientific knowledge more efficiently in such cases. They eventually decided to look at benefit–cost analysis, and study different schemes for land and water use in the Murray catchment, using a computer to find the best scheme. The aim was to see whether this approach (a form of systems analysis) could provide a satisfactory framework for handling scientific information in environmental planning.

The team put a lot of effort into comparing benefit–cost analysis with other methods, and working out when and why it should be used. The book, titled 'On Rational Grounds', contains a detailed discussion of these matters.

Data base

Working from rainfall records and from land-form maps prepared by scientists in the CSIRO Division of Land Resources Management (now the Division of Groundwater Research), the team began its Murray catchment benefit–cost analysis by dividing the catchment into zones on the basis of their suitability for different types of agriculture, forestry, and mining.



The Murray collects 318 million cu. m of water per year, on average, but it's too salty to use (more than 1200 mg per L). Perth currently consumes about 150 million cu. m per year.

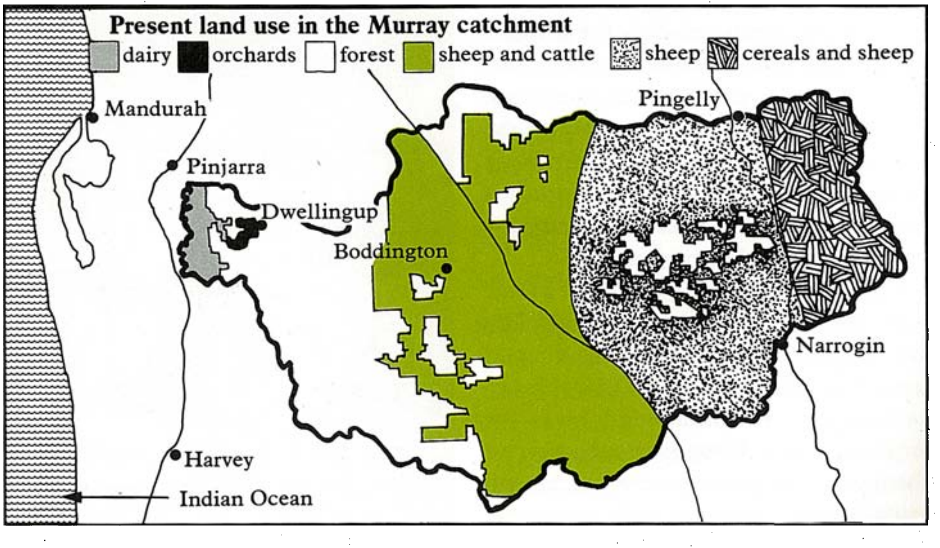
The next component of the data base came from scientists who had been studying the salinity problem. Agricultural land releases more salt and less water to streams in the east of the catchment than it does in the west, and the scientists were able to supply estimates of how much water and salt would flow from each zone, for each type of land use.

Then team members worked out sets of figures for all the expenses and returns to be expected from each land use in each zone. Among these were the value of the water itself and the costs due to damage from salinity. Engineers from the Perth Metropolitan Water Supply Sewerage and Drainage Board calculated costs for two different schemes for damming the Murray. In one scheme a single dam collects all the catchment's water, while in the other the salty water from the eastern catchment is collected in an upper dam and piped past a lower dam that collects the better-quality water.

The team then used benefit–cost analysis on these estimates. This kind of analysis attempts to assess the net (benefits minus costs) effect of a scheme on society's welfare. It also compares the cost of the scheme with the willingness of people to pay for its products (for example, water).

Sometimes willingness to pay is easy to measure. In the Murray study, the value

Most of the salinity comes from the eastern part of the catchment, where little forest remains.



of land uses such as timber production was relatively easy to calculate, although some degree of uncertainty inevitably remained. However, land uses with a 'product' that is not sold in a market posed much greater problems. In these cases, what people would be willing to pay for the 'product' was not known. Recreation is one such product. Water is another because, although consumers pay for it, its price is not determined by a market but set by an authority.

Much of the study concerned ways of getting around these problems, although some aspects — for example, valuing the benefits of having conservation areas — were abandoned as too difficult. Instead, existing and proposed conservation areas were included as constant features.

The book points out that people are often rightly suspicious of the application of benefit–cost analysis to such intangibles. The reason for attempting to value them is that the market, left to itself, will seldom handle them properly. If something is 'as free as the air', people will over-use it without worrying where more is to come from. This applies, for example, to the farmer who clears his land without having to pay for the effect that the salt released has on the water downstream.

If something is 'as free as the air', people will over-use it.

Once the valuations of land use were complete, the task was to find the best allocation of land uses to the various catchment zones, for each water development. As well as producing a land use plan for the catchment, this process provided the most optimistic assessment of the net benefit of the water development. The method used was a computerized technique called 'linear programming', which simplifies this kind of allocation problem by assuming that two hectares of any land use give twice the net benefit of one, up to whatever limit is set by what the user thinks is possible or acceptable.

Some results

The scientists say that the problems in valuing land uses, plus uncertainties in scientific predictions, mean that details of the plans produced by the computer as 'best' should be taken 'with a grain of salt'. But definite and stable conclusions do emerge.

The study team

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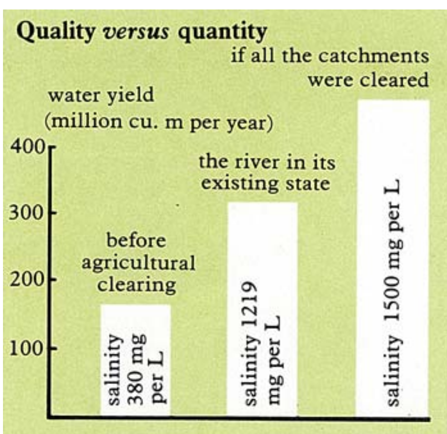
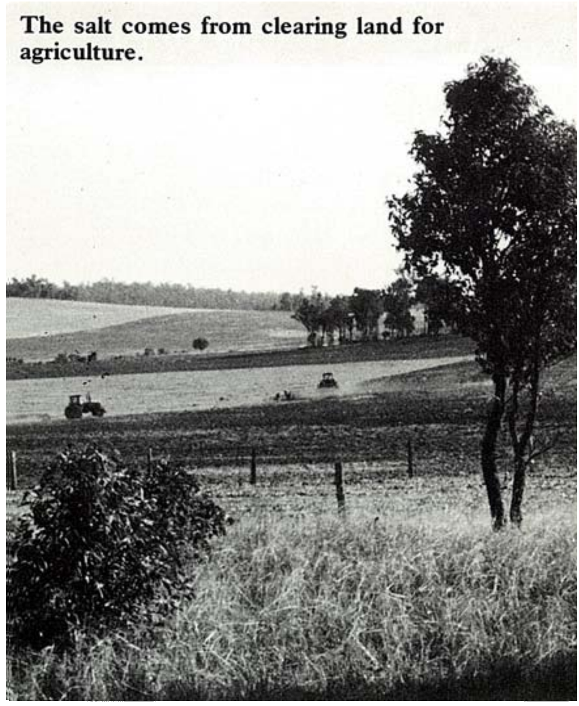
The pie charts in the box show how the study suggests land uses can best be divided up in the catchment, depending on whether we build no dam, one dam, or two dams. The calculated annual values in each case suggest that a one-dam scheme would result in a net loss to society, however well existing land uses were arranged, while a two-dam scheme could show a small profit.

The differences are not very great, however, and the figures suggest that neither dam option is very inviting. Considering the likely cost of the dams, this conclusion could be important.

What could change this conclusion? The demand for water in Perth may rise more quickly than was assumed. Perhaps it will be shown that salt in water causes less damage to domestic appliances than has been thought, so allowable salt levels can be raised slightly. Or research into



The model of the Murray catchment shows that the less forest there is, the greater the water yield, but salinity increases also.



The salt comes from clearing land for agriculture.

new land uses may show that it is not necessary to reforest so much of the catchment in order to make the water quality acceptable.

The big differences in agricultural area between the diagrams point to one general conclusion — that the possible land use conflicts over salinity tend to boil down to the single question: how much agriculture should there be? The different ways of meeting water standards have little effect on the other land uses, if achieving the greatest net benefit to society is the goal.

Are any of the schemes justifiable?

The book points out that conclusions like this can sometimes be reached by an alert thinker without the help of systems analysis. However, this requires deep involvement in the subject-matter and the luck to make the right mental connections at the right time. The process of systems analysis helps reduce the need for luck, and acts as a check that other factors do not have unexpected effects on the conclusions.

What does it all mean?

Land use planning involves three-cornered relations between the community with its requirements, the scientists who can say what is technically possible, and the planners who try to match what is wanted with what can be done.

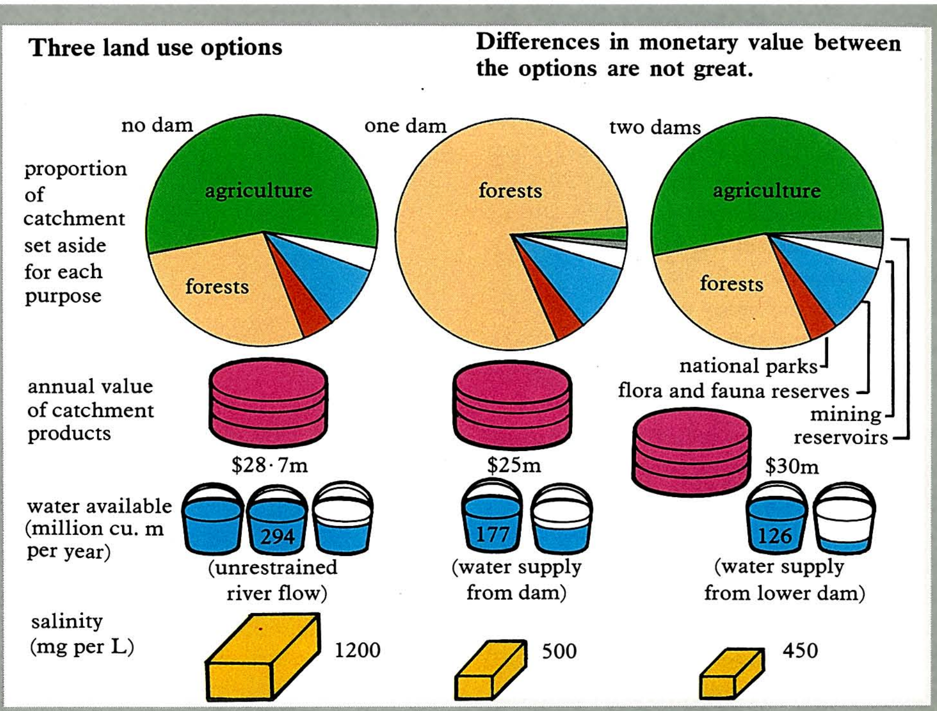
Three scenarios considered by the study

The study looked at the best way of apportioning land use in cases involving different numbers of dams (none, one, or two).

For the no-dam case, the results suggest very little change from existing land use.

When one dam is built and land use is constrained such that salinity is kept below 500 mg per litre, much land has to be planted to forests.

When two dams are constructed, the lower (below Nanga Bridge) stores good-quality water; the upper dam diverts saline headwaters just below the junction of the Hotham and Williams Rivers. Land use is very similar to that with no dams. The differences in monetary value between the three options are not very great, considering the uncertainties in the data. This suggests that neither dam option is very inviting.



Members of the study team believe systems analysis offers some hope of bringing the corners closer together. This is because it provides ways of bringing together large quantities of scientific information, and gives some tests of whether society's demands conflict and whether projects are worth while.

But the techniques involved are imperfect as well as complex and hard to explain. Their complexity means that few members of the community have the patience to understand them, and their imperfections mean that they don't provide definitive solutions to environmental problems.

Balancing these good and bad points, the team arrived at the following position: to be rational about environmental planning means being prepared to justify a plan in as much depth as possible, both to those who gain by it and those who lose. Systems analysis can certainly help provide justification in depth. Planners (and others) who reject it without providing better justifications for their projects are doing less than society may rightfully demand.

Systems analysis provides ways of bringing together large quantities of scientific information.

More about the topic

'On Rational Grounds: Systems Analysis in Catchment Land Use.' D. Bennett and J.F. Thomas (eds). (Elsevier: Amsterdam 1982.)

'On Rational Grounds' . . . a precis of a study on the Western Australian Murray River. H. Bradbury. *Forest Focus*, No. 26, 1982.

What future for a salt-affected catchment? P. Eckersley. *Journal of Agriculture, Western Australia*, 1982, **21**, 35–40.

Strengths and weaknesses of the system approach. D. Macpherson and D. Bennett. In 'Land Use Planning — Recent Advances', 39–47. (The University of Western Australia and the Australian Institute of Agricultural Science (WA) and ANZAAS (WA): Perth 1979.)

The result of clearing: saline water rises and kills vegetation.