Investing in river health

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Abstract Rivers provide society with numerous returns. These relate to both the passive and extractive uses of the resources embodied in river environments. Some returns are manifest in the form of financial gains whilst others are non-monetary. For instance, rivers are a source of monetary income for those who harvest their fish. The water flowing in rivers is extracted for drinking and to water crops and livestock that in turn yield monetary profits. However, rivers are also the source of non-monetary values arising from biological diversity. People who use them for recreation (picnicking, swimming, boating) also receive non-monetary returns. The use of rivers to yield these returns has had negative consequences. With extraction for financial return has come diminished water quantity and quality. The result has been a diminished capacity of rivers to yield (non-extractive) environmental returns and to continue to provide extractive values.

A river is like any other asset. With use, the value of an asset depreciates because its productivity declines. In order to maintain the productive capacity of their assets, managers put aside from their profits depreciation reserves that can be invested in the repair or replacement of those assets. Society now faces a situation in which its river assets have depreciated in terms of their capacity to provide monetary and non-monetary returns. An investment in river “repair” is required. But, investment means that society gives up something now in order to achieve some benefit in the future. Society thus has to grapple with the choice between investing in river health and other investments – such as in hospitals, schools, defence etc. – as well as between investing in river health and current consumption – such as on clothes, food, cars etc. A commonly used aid for investment decision making in the public sector is benefit cost analysis. However, its usefulness in tackling the river investment problem is restricted because it requires all benefits and costs to be measured in dollar terms, and many of the benefits arising from investments in river health are non-monetary.

In this paper, techniques that enable non-monetary values to be estimated in dollar terms are described. Applications of the techniques to the estimation of the environmental values of rivers are demonstrated. The values estimated are used to demonstrate the extent of returns that are possible from investing in river health.

Keywords Benefit cost analysis; depreciation; investment decisions; non-market benefits; river health

Rivers are assets

Accountants define assets as “resources which promise future economic benefits to the business” (Hoggett and Edwards, 1987 p.15). Even though accountants see assets as being diverse – ranging from tangible assets like buildings and equipment through to intangible assets such as patent rights and good will – the accounting definition is limiting. First, the notion of an asset should not be restricted to the business world. Individuals hold assets. Society as a whole holds assets. Second, some resources promise benefits that are outside the realm of “economic” in the financial sense of the word.

It is by extending the accountant’s notion of an asset that the issue of investing in river health can be analysed. Begin by considering the asset holdings of individuals. People hold financial assets in the form of bank accounts, shares and bonds. These assets hold out the promise of financial returns in the form of interest payments and dividends. People also hold physical assets like cars and houses. These assets are valuable because they promise the benefits of the services they can provide – mobility, shelter. Some of the assets individuals hold are intangible. Amongst these are the knowledge and skills people acquire. They promise returns in terms of financial income. But they also offer non-monetary returns defined in more nebulous terms such as satisfaction and utility.

Now consider rivers as assets. They promise a wide array of future benefits both
financial and non-monetary. Some businesses use them as their source of water for irrigating crops and livestock that are sold for profit. Other businesses use them as the basis for white-water rafting ventures, again in search of financial rewards. Individuals can also consider rivers as assets. People who enjoy picnics by a river or who go boating, fishing or swimming in a river will see that river as an asset that provides benefits to them through time. These benefits are enjoyed as a result of people coming into direct contact with the river. Other benefits are generated without direct contact. For instance, a river can be a source of biological diversity benefits ranging from gene-pool maintenance to the protection of endangered species.

Hence, rivers are assets that provide future benefits to society that are tangible and intangible, monetary and non-monetary. Some of the benefits can be captured by individuals as private profits whilst others are available to the broader community as public goods.

Depreciation of assets
A further basic concept of accountancy of relevance to assets is depreciation. But you don’t need to be an accountant or in business to understand the concept and its importance. We all live with depreciation. If you own a car, you’ll know that as you use it you progressively wear it out. And as you wear it out, the value of the car falls. That fall in the price of the asset is depreciation. The falling price is simply a reflection of the reducing future benefits that the asset will be able to provide.

What you need to do to cope with depreciation is to keep putting aside some of your hard earned money in order to either buy a replacement car or to pay for repairs to the old one. If you don’t do this – if you instead consume all your income – the time will come when your old car gives up and you’ll not be able to afford a new one or you’ll have to go into debt to buy a replacement.

Businesses do the same. They set aside some of their profits as “depreciation allowances” to allow them to maintain or replace their assets. They do this in the knowledge that if they don’t, their continued ability to produce income will be jeopardised. They recognise the need to keep investing this depreciation allowance into the maintenance of their asset base. After all it is that asset base that generates the future benefits for the business. And the concept is not just true for tangible assets like machines and buildings. A business’s intangible assets can also depreciate. For instance, the skill base of a business’s workforce can become outdated. The human capital asset of the company is in that way depreciating. Maintaining the skill base of its employees through the provision of training is thus a form of investment in the asset base of the business.

The concept of depreciation is also relevant to rivers. The more rivers are used to provide benefits to individuals and to the broader community – particularly when their use involves the extraction of resource elements such as water, vegetation or fish – the less able they are to maintain their promise of future benefits. For instance, if the water of a river is used to irrigate crops and the water that is returned to the river is contaminated with salts or pesticide residues, the river’s capacity to provide future benefits in the form of biological diversity protection and recreational opportunities may be reduced. Even future profits from irrigated agriculture may be compromised by the decline in water quality. The reduction in value of the river asset that results from its use is the extent to which it is depreciated.

The question must then be asked: does society set aside a “river depreciation allowance” from its stock of wealth or from its current income to enable an investment in maintaining the health of its rivers? Have irrigators considered the depreciation of the rivers that supply a critical input to their production process in the same way as their accountants have recognised the depreciation of their pumps and tractors? The evidence (for example, see Mussared, 1997) suggests that the answer is, by and large, no. The result is a system of
rivers that is in decay: one that is severely depreciated as a result of its heavy use and one for which no depreciation fund has been financed in order to allow for investment in maintaining its value through time.

**Repairing rivers**

To avoid the prospect of rivers having such reduced capacity to produce on-going benefits, society will need to consider the allocation of some of its wealth and income to the restoration, repair and protection of rivers. In part this is a recognition that a component of that accumulated wealth and current income has been and is derived from the contribution made by rivers. For instance, businesses have generated profits using the river assets and people have been made better off through their access to relatively low cost and high quality irrigated agricultural produce.

The decision to allocate resources – to invest – in river health, is not as straightforward as the logic of accounting makes it seem. Investing in river health is just one of the myriad of possible ways society has to allocate its resources. First there is a raft of choices between putting resources aside to allow for depreciation and simply consuming them. Immediate consumption is appealing. Most of us like to travel to interesting places for our holidays, eat good food, drink fine wines, wear nice clothes etc etc. On an individual level, the choice between saving and consumption is a tough one and society as a whole finds it equally difficult.

Second, if society decides to put some resources aside for investing in the future, there is again a wide array of possibilities. Investments can be made in machinery, computer technology and vehicles – the so-called “manufactured assets”. Investments can also be made in “human assets” through allocating resources to improving the knowledge/skill base of the population and its health. There are also competing demands for investment in “natural” assets, including rivers. Vegetation, soils, wetlands and rangelands are examples of natural assets that have also been depreciated through use.

**Investment decisions**

The resource allocation choices society faces are complex and all pervasive. As individuals, we usually make such decisions on a day to day basis using some notions – both formal and informal – of weighing up the good things that we expect from making a choice against the bad things. Businesses usually make their investment decisions in a more structured way. They usually employ financial appraisal techniques that consider the consequences for profitability – expected revenue gains net of expected costs.

Society faces even more complex decision making processes because many people, with all sorts of different preferences, make up society. Hence, the goals of society are harder to define. They are not simply to maximise net financial returns, as there are many non-monetary factors that are involved. Often, decisions are made in the political arena. However the decisions taken by politicians need to be informed with respect to the expected outcomes of alternative options. If investment alternatives can be assessed in terms of a common measure of “return to society” then a systematic process of selection can be implemented.

A technique called benefit cost analysis (see Sinden and Thampapillai (1994) for a basic introduction) has been developed to provide the systematic appraisal of society’s alternative investment opportunities. Its application, say to the consideration of river health investment alternatives such as engineering works, weed control, fencing, effluent treatment technology and allocation of water for environmental flows involves the weighing up of the costs of the alternatives against the benefits arising. The costs may include elements such as concrete, fuel, machinery, posts and wire, holding tanks, herbicides and foregone irrigated agricultural production. The benefits may include improved recreation potential,
native species protected, improved future productivity in irrigated agriculture and lower drinking water treatment costs.

A major challenge facing the application of benefit cost analysis in cases involving investments in natural assets is the estimation of the values of all the benefits and costs involved in monetary terms. Only if all values can be expressed in the numeraire of the dollar can benefit cost analysis succeed in providing information that will enable the comparison of benefits and costs for a single investment. Furthermore, the use of a common numeraire is necessary for comparison (and ranking) of investment alternatives across the diverse array of opportunities that are available to society.

**Estimating non-market values**

Many of the benefits generated from investing in river health are non-market. For example, river-side picnics, native fauna protection and fish stocks are not generally bought and sold in markets. The value that they provide to society cannot therefore be estimated with reference to the information on preferences provided by buyers and sellers in market transactions. To establish these values, we need to go beyond direct market information.

The first avenue available is to look for information regarding values in markets that are somehow related to the benefit in question. Techniques that pursue this avenue are known as revealed preference methods. A popular example is the travel cost method, which is used to estimate the value of recreation benefits of natural assets. The method involves the estimation of a relationship between the costs visitors incur in their travel to a site and the number of visits made to that site. On the basis of that relationship, the response of people to the introduction of a site entrance fee is simulated and a value for site visits estimated (Bockstael, 1995).

The second pathway to valuing non-market impacts involves asking people via questionnaires, what their preferences are for the benefits under examination. Such techniques are known as stated preference methods. Perhaps the best known of these methods is the contingent valuation method. An application of this method involves a sample of people being asked to choose between continuing the current resource use regime at no additional cost and making a change that would improve the provision of the benefit in question but at a personal cost to the respondent. The willingness to pay of respondents to secure the benefit can be estimated from responses to this question (Mitchell and Carson, 1989).

A development of the contingent valuation method is choice modelling. Its application involves respondents to a questionnaire facing a sequence of choices between alternatives that offer different levels of non-market benefits at different personal costs. The method provides a richer data set on peoples’ preferences and allows for a breakdown of values into their component parts. It is therefore capable of producing value estimations for multiple scenarios of non-market benefit provision from a single application whilst a contingent valuation application is able to consider only one scenario (Bennett and Blamey, 2001).

**Some value estimates**

**Revealed preference studies**

There are comparatively few Australian examples of revealed preference studies of the value of healthy rivers. Thomas (1982) used the travel cost method to estimate the value of recreational visits to the Murray River in Western Australia. He found that each trip provided a benefit to visitors net of their costs amounting to $20. With visitation rates in the order of 42,000 visits per annum, the annual value of recreation at the Murray River approaches $1m.

Sinden (1990) analysed visitation to 24 sites along the King and Ovens Rivers in north eastern Victoria, again using the travel cost method. The results of that work showed that a
day visitor to the study sites yielded an average benefit of $27 whilst a camping visit was worth $46. To put these per visit estimates into a context of use patterns, there were 18,833 day visits and 18,167 camping visits recorded for the year in 1989. This implies an annual net benefit from recreation at the sites in the order of $1.5m.

**Stated preference studies**

Again, there are few Australian examples of stated preference studies aimed at estimating the non-market values provided by rivers. Walpole (1991) carried out a contingent valuation method application to estimate recreational benefits arising from visits to some of the sites Sinden (1990) investigated using the travel cost method. Walpole’s results vary between $9 and $38 per visit, according to the site involved.

Two choice modelling applications are the most recent contributions to the bank of studies. These studies are the first to go beyond the estimation of recreational values derived from rivers. They aim to provide estimates of other less tangible values.

The first (van Bueren and Bennett, 2000) was conducted as a part of the National Land and Water Resources Audit and was aimed at providing an assessment of the non-market values associated with land and water degradation across Australia. One of the attributes used to describe available resource management options in the choices put before those selected as respondents was “waterway health”. The choices people made in the survey enabled the estimation of the average amount people were willing to pay in order to have an additional 10km of waterways restored. The amount estimated was an average of eight cents per Australian household per annum for 20 years.

The second choice modelling application (Bennett and Morrison, 2001) was aimed most specifically at providing information to decision makers regarding the benefits of river health investments. Non-market values were estimated for five representative rivers around the State – Bega, Clarence, Murrumbidgee, Gwydir and Georges Rivers. People living within the river catchments and from around NSW were selected at random to participate in the choice modelling exercise. The four environmental attributes that were used to describe the outcomes of the alternative river investment strategies from which respondents were asked to choose their most preferred were:

- the recreational uses that were possible;
- the number of native fish species present;
- the number of water bird and other faunal species present; and,
- the percentage of the river containing healthy riverside vegetation and wetlands.

Values for each of these river attributes were estimated. The estimates are displayed in Table 1. The values listed in Table 1 are the amounts households are willing to pay on average to see improvements in the provision of each attribute by one unit. Hence, households living in the Bega River catchment are willing to pay, on average, $7.37 to see an additional native fish species living in the river. Similarly, they are willing to pay $53.16 to have the entire river return to being suitable for fishing from its current state where it is only suitable for boating at particular times.

Values were also estimated for specific circumstances of change and processes designed to allow for the “transfer” of values estimated for the representative rivers to other rivers were developed. As an example of how these value estimation processes can be used, consider an investment in river health that is proposed for a catchment on the south coast of NSW. Biophysical scientists have predicted that the proposed investment would result in an increase in the vegetation attribute by 5%, ensure the reintroduction of two fish species and improve the water quality across 15% of the length of the river from boatable to fishable. If the catchment has a household population of 4,000 then the within catchment aggregate value estimate is $80,981. Given a NSW population of approximately 1.8m
households, the appropriate aggregation calculation for the (maximum) outside catchment values is $31.97m. The total value (maximum) to all the people of NSW of the improved river environment provided by that specific proposed river health investment is therefore in the order of $32m.

Conclusions

The few examples of valuation studies documented in the previous section point to one strong and general conclusion. The non-market values of benefits provided by investments in river health are significant and, even by themselves, likely to provide a justification for society to devote resources to river restoration projects. On top of the non-market benefits of river health investment are the market benefits associated with ensuring sustainable irrigated agricultural production. These benefits would provide further impetus to the case for river health investment.

To establish the exact nature of the river health investments to be carried out would require an assessment on a case by case basis of both the market and non-market benefits as well as the costs of the investment alternatives. Once assessed in this way, the alternatives would need to be implemented starting with those yielding the greatest benefits at least cost and stopping when river investments are unable to match the returns to society that can be provided by investments in other types of assets.

References


Table 1  Attribute value estimates ($ per household)

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<tr>
<th>Sample/River</th>
<th>Vegetation</th>
<th>Fish species</th>
<th>Waterbird species</th>
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<th>Swimmable</th>
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<td></td>
<td></td>
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<td>BEG</td>
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<td>Outside catchment/</td>
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* insignificant coefficients in model at the 5 percent level

1 The figure of 2.5 people per household is used as a base-line for this calculation. ABS data indicate an average household size of 2.7 for the 1996 Census (www.abs.gov.au) however, the trend in this figure is downward.