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ECONOMIC EVALUATION OF THE YASS SALINITY ABATEMENT DEMONSTRATION PROJECT: A METHODOLOGICAL FRAMEWORK

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1. Introduction

Dryland salinity is emerging as a major form of land degradation in New South Wales. Two main types are identified; saline seepage and saline scalds.

Saline scalds develop when topsoil is removed to expose a subsoil which is naturally high in salts. Although saline scalds are partly natural features, their incidence has increased due to extensive livestock grazing and plague populations of rabbits. It is estimated that saline scalds affect around 920,000 ha mainly in the drier parts of western NSW along the floodplains of the Macquarie, Boga, Culgoa and Murrumbidgee rivers (Emery 1987).

Saline seepage is caused by changes in land use resulting in reduced water usage, increased rainfall intake and subsequent rise in water tables. It is a relatively recent development in NSW becoming evident since the 1950's.

The total area currently affected by saline seepage in NSW is around 10,000 to 12,000 ha, and is estimated to be increasing by 2-3% annually. A recent land degradation survey of NSW (Graham 1987) indicates that most severe outbreaks of saline seepage occur on the Southern Tablelands (80% of the affected area), the Central Western Slopes and lower Hunter Valley.

2. The problem of dryland salinity

Dryland salinity is a considerable economic cost to society. In this context saline seepage is a more serious problem than saline scalds. The effects of saline seepage are both on-site and off-site. They include losses in agricultural productivity and land values, damage to landholder infrastructure as well as to public property and utilities through sediment deposition, and lowering in water quality due to high salt levels. It is estimated that current losses in land values due to saline seepage are around $500 per ha (cf. to $15 per ha for scalds), while annual productivity losses average $100 per hectare (cf. to $7.60 per ha for scalds) (Emery 1987). Furthermore, in the Yass river catchment where around 15% of the problem occurs, salinity levels in the river's water are recorded to be rising by 7% annually compared to a State average of 3.5% increase.

The severity of the above problems clearly demonstrate the necessity for taking remedial measures to rehabilitate affected lands and prevent further occurrences of dryland salinity. The Yass Salinity Abatement Demonstration Project (YSADP) has been drawn up for this purpose.

3. The Yass Salinity Abatement Demonstration Project (YSADP)

The YSADP is a four year program aimed to demonstrate viable land management practices to control dryland salinity throughout the Murray-Darling Basin. The project area is the sub-catchment of Dicks, Williams and Back (Sawpit) creeks located in the Yass River catchment in the Southern Tablelands of New South Wales. The 9636 ha sub-catchment accounts for 6.7% of the State's total saline seepage problem and represents 15% of the saline affected areas in the Yass Valley. The main project components include:

3.1 Monitoring ground water tables, salt content in ground and surface water and changes in vegetation species over time in affected areas, and to determine areas that may become affected in future.

3.2 Investigate the influence of manipulating ground water levels through different land use/management options to control accessions to water tables.

3.3 Investigate techniques to rehabilitate saline scalds and salinity induced eroded lands.

3.4 Use remote sensing techniques to monitor progress of the project.

3.5 Increase landholder and community awareness of the processes of dryland salinity, its consequences on land use and productivity and possibilities for its prevention and control through a planned public awareness program.

The project is funded by two Commonwealth bodies - the National Afforestation Program and the National Soil Conservation Program - and the Soil Conservation Service of New South Wales. This paper outlines a methodology for economic evaluation of the project.

4. The objective of project evaluation

The overall evaluation of the project will be directed at making some comprehensive assessment of the impact of the whole project, taking into account both direct as well as indirect effects. Criteria that could be used for such an assessment would be technical, economic and financial in nature. The specific objectives of this evaluation are:

4.1 To establish a data-base through a base line survey of landholders in the Yass river catchment. This will help to set objective criteria for assessing the outcome of the project.

4.2 To do an economic analysis of the following proposed options to achieve project components 3.2 and 3.3.

4.21 Pasture improvement on recharge and midslope areas.

4.22 Withdraw severely affected lands from production for a period of time for revegetation with salt tolerant species, followed by strategically controlled management.

4.23 Reforestation with hardwood species as a sustainable land use option.

4.3 To do a cost-benefit analysis of the wider impact of the project taking into consideration both direct and indirect effects as enumerated in table 1.

5. Methodological framework

5.1 Conceptual framework

Cost-benefit analysis (CBA) is a highly structured method to quantify social benefits (B) and social costs (C) of a project in terms of a common monetary unit for decision making purposes. The basic idea underlying CBA is that net benefits of a project should be positive for it to be undertaken.

However, as project costs and benefits generally occur over a period of time it becomes necessary to compare them at one point in time (present). This is achieved through a process called discounting over the project period (t) using a discounting factor. As CBA is primarily a technique to make social rather than private decisions, the discounting factor used is called a social discount rate (r).

By discounting future costs and benefits at a rate r per annum, we can express them as present values (PV). Thus, if we consider the present time as zero, then the present value of any benefit (or cost) occurring in year t (Bt) is

$$PV = \frac{Bt}{(1+r)^t}$$

The net present value (NPV) of all benefits and costs of a project can be expressed as,

$$NPV = \sum_{t=0}^{T} \frac{Bt-Ct}{(1+r)^t}$$

5.2 Identification of costs and benefits

Successful application of CBA is dependent on a complete and accurate enumeration of potential costs and benefits of a project. While project costs are identified relatively easily, the same is not true for project benefits. The latter could be of five types (Asset Appraisal Guidelines, 1988).

1. Avoided costs - incremental costs which are unavoidable if nothing is done to solve a problem.

2. Savings - verifiable reductions in existing levels of expenditure if a program proceeds.

3. Revenues - incremental revenues which result directly or indirectly from a particular program.

4. Benefits to consumers not reflected in revenue flows; for example, recreational use of improved parks.

5. Benefits to the broader community where an activity may have secondary or subsidiary effects on groups other than the direct recipient.

For further convenience these costs and benefits can be broadly classified into three categories. This categorisation is demonstrated for the YSADP in table I.

5.3 Measurement of project costs and benefits

A critically important aspect of economic evaluation is the measurement of costs and benefits and their translation into monetary values where possible. Where goods and services are freely traded it would be reasonable to assume that prices reflect the value of the good or service to the consumer. In the absence of a free market or if no price is charged or where benefits are more to society rather than to individuals, more indirect measures are required. Under these circumstances a variety of techniques are available including the opportunity cost principle, contingent valuation method (Anderson and Bishop 1986) and hedonic price method (King and Sinden 1986). Where benefits cannot be valued through any of the above techniques, a complete qualitative description of the benefit will be required.

Data for measurement of project benefits can be generated through surveys. For the YSADP three surveys are proposed: i) an agricultural survey to determine production characteristics and gross margins ii) an attitudinal survey to determine landholders awareness and attitudes toward the seriousness of the dryland salinity problem iii) a community survey to determine ratepayers' willingness to pay for improved water supplies. In addition data maintained by public and local government bodies such as the Valuer General's Department and the Yass Shire Council will also be used to measure some of the project benefits. Table 2 summarises tho project benefits and their measurement techniques used in the study.

Table 1 - Categorisation of project costs and benefits under the SADP

Category I	Category II	Category III
Costs and benefits which can be readily identified and valued in monetary terms.	Outputs which can be identified and measured in physical terms, but which cannot be easily valued in monetary terms due to the absence of market signals.	Impacts which are known to exist, but cannot be precisely identified and accurately quantified, let alone valued.
Costs All costs incurred in implementing the YSADP Benefits		
1.1 Reduction in losses in agricultural productivity /reduction in losses in land values.	2.1 Lowering of ground water table in discharge areas.	3.1 Enhance aesthetic value of rural landscape, rivers and lakes.

ble 1 Continued

I	II	III
1.2 Savings in damage costs to landholder infrastructure such as fences, farm dams, etc.	2.2 Reduction in salinity levels in waterways such as creeks and rivers.	3.2 "Catalytic effect on conservation ethic" - increased involvement and commitment to practice soil conservation and adopt structural management practices.
1.3 Reduction in damage costs to public property and utilities such as roads, fences, bridges and culverts.	2.3 Reduced sedimentation in waterways such as creeks and rivers.	
1.4 Reduction in costs of maintenance of domestic water supply.	2.4 Increase individual landholder's and the general community awareness of the process of dryland salinity and techniques for its prevention and control.	
1.5 Improvement in domestic water quality through lower salinity and turbidity levels.		

Table 2 - Measurement of project benefits

	Project benefit	Measurement criteria
1.	Reduction in losses in agricultural productivity	Landholder agricultural survey in three stages - Stage I - benchmark Stage II - production diaries Stage III - re-survey at end of project
2.	Savings in damage costs to farm infrastructure	As above
3.	Reduction in losses to land values	Land valuations as done by Valuer General's department and discussions with local Real Estate Agents
4.	Reduction in damage costs to public property and utilities	Damage costs records maintained by Yass Shire Council
5.	Savings in costs to rate payers for improved water supplies	Contingent valuation method
6.	Reduction in maintenance costs of domestic water supply	Maintenance cost records kept by Yass Shire Council
7.	Increase in landholder awarene/ ۹ of presence of dryland salinity and techniques for its prevention and control	Landholder attitudinal survey in two stages - Stage I - benchmark Stage II - re-survey at end of project
8.	Improvements in water quality in rural waterways	Gauging stations in the catchment measuring salinity and turbidity levels
9.	Appreciation in "conservation ethic" by landholders and enhancement of rural landscape	Identified as having a positive impact, but not measured or valued

5.3.1 The landholder agricultural survey

The agricultural survey will be done in three stages. The first stage will establish a benchmark with respect to the following criteria.

i) Current levels of productivity on arable and grazing lands

ii) Current costs of production and gross margins of agricultural enterprises

iii) Stocking rates and management practices

iv) Extent of non-productive land due to salinity associated problems

v) On-farm damage costs incurred by farmers to farm infrastructure.

The survey will be done on a sample of 125 landholders within and outside the project area. Personal interviews will be conducted on sample members using structured questionnaires. The survey will cover the agricultural season 1988-89.

In the second stage selected landholders will be requested to maintain production diaries to monitor changes in land management and production characteristics. It is proposed to select 25 landholders for this exercise. Amongst the selected landholders will be those on whose properties demonstration works will be undertaken.

The diaries will be reviewed at quarterly intervals and the data contained therein analysed annually over the project period to monitor changes.

The third stage will be a re-survey of landholders at the end of the project period. Comparisons between key variables between the benchmark and this survey will enable a measure of project impact for evaluation.

5.3.2 The landholder attitudinal survey

The attitudinal survey is aimed at establishing landholders current level of awareness of the problem of soil salinity, its cause, its control and prevention and how serious they perceive the problem to be. Similar surveys conducted in Victoria show that while a majority of farmers are aware of salinity many do not know the causative mechanism (Barr and Cary 1984, White 1988). These findings indicate that the YSADP could have a significant impact on landholders attitudes towards dryland salinity in the Yass Valley.

The attitudinal survey will be run together with the agricultural survey and will cover the same sample households as the latter. As in the case of the agricultural survey, the attitudinal survey will be repeated at the end of the project period to measure changes in survey variables. This will contribute to evaluate project benefit 2.4 in table 1.

5.3.3 The community survey

The Yass weir is the principal domestic water supply to a population of around 4,700 persons in the Parishes of Yass and Hume.[1]

There are two problems of water quality with this supply.

Water salinity in terms of permanent hardness is relatively high (200-300 ppm), while turbidity is a serious problem increasing treatment costs (Kaub, pers.com. '38). Under the current state of the catchment, further improvements in these qualities would entail additional costs to the ratepayers in the Parishes of Yass and Hume.

Therefore, improvements in water quality as envisaged under the YSADP will save these additional costs to the community. To determine the level of this additional cost a sample community survey using the contingent valuation method is proposed.

The contingent valuation method uses survey techniques to ask people values they would place on unpriced commodities if markets did exist. The technique has been widely applied in environmental and natural resource issues including air and water quality changes. The major limitations of the technique are (Bishop and Heberlein 1985):

- the ability of the researcher to frame questions that are understandable to respondents, and
- the willingness and ability of respondents to value the good or service accurately.

Nevertheless, as Bishop and Heberlein concur,

" .... as long as certain caveats are met, the contingent valuation method is able to provide monetary values for many environmental goods and services which are sufficiently accurate to be useful in public decision making".

The contingent valuation method is based on the willingness-to-pay principle to establish values for the commodity under consideration. In relation to this project the issue posed to Yass water consumers would be "what would you be willing to pay in higher rates to have improved water quality?" Appropriate definition of the object being valued (water quality in this case) is critically important if valid and useful contingent values are to be determined (Bishop and Heberlein 1985). One possibility is the water quality ladder which has been used in earlier studies (Mitchell and Carson 1981, 1984; Desvouges et al 1983; in Bishop and Heberlein 1985).

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1 This number will increase with the proposed extension of the water supply scheme to the Parish of Binlaong in the future.

The water quality ladder is a visual aid which describes different levels of water quality to the respondent during personal interviews. The objective is to convey very simply, complex technical information on water quality parameters such as dissolved solids, toxic levels, water turbidity, etc. An example of a water quality ladder is illustrated in figure 1.

An alternative would be to actually confront respondents with two samples of water. One sample would depict the water quality as currently consumed as against a second sample improved to a degree as envisaged under the project to elicit a contingent value for it. Such an approach has obvious practical implications - firstly, in determining what degree of water quality improvement would be feasible under the project and secondly, in obtaining sufficiently large quantities of water for experiment in the survey. Nevertheless this approach merits some consideration.

5.3.4 Measurement of land values

The value of land is determined by a number of variables. They include the productivity of the land, its size, location, existence of a house and the condition of the land reflected by the degree of land degradation. Ceteris paribus, high land values would be associated with low levels of degradation. King and Sinden found a strong correlation between land price and its overall degradation potential and cost of soil conservation works in their study in the Manilla Shire in northern New South Wales (King and Sinden 1986).

Land valuations are done periodically by the Valuer General's Department. These valuations are made based on land sales in an area, but do not take into consideration any buildings, land improvements and soil conservation works. The valuations are done every six years.

The last valuation of lands in the Yass valley was done in 1984. A re-valuation of these lands are due in 1990. It is proposed to take the 1984 valuations as the base value which will then be compared with valuations to be done in 1990 to estimate this project benefit. If for some reason the Valuer General's department fails to conduct their scheduled land valuations in 1990, those lands which have undergone transaction over the project period in the project area will be identified and valuations done with the assistance of the Valuer General's department. Similar valuations can also be made by contacting local Real Estate Agents.

5.3.5 Savings in costs of domestic water supply

The Yass weir was constructed in 1927 with a storage capacity of 1125 mega litres. Sixty years later the capacity stands at 867 mega litres or 77% of the original capacity. Thus siltation of the weir following soil erosion from the Yass river catchment has resulted in almost 25% loss in storage capacity.

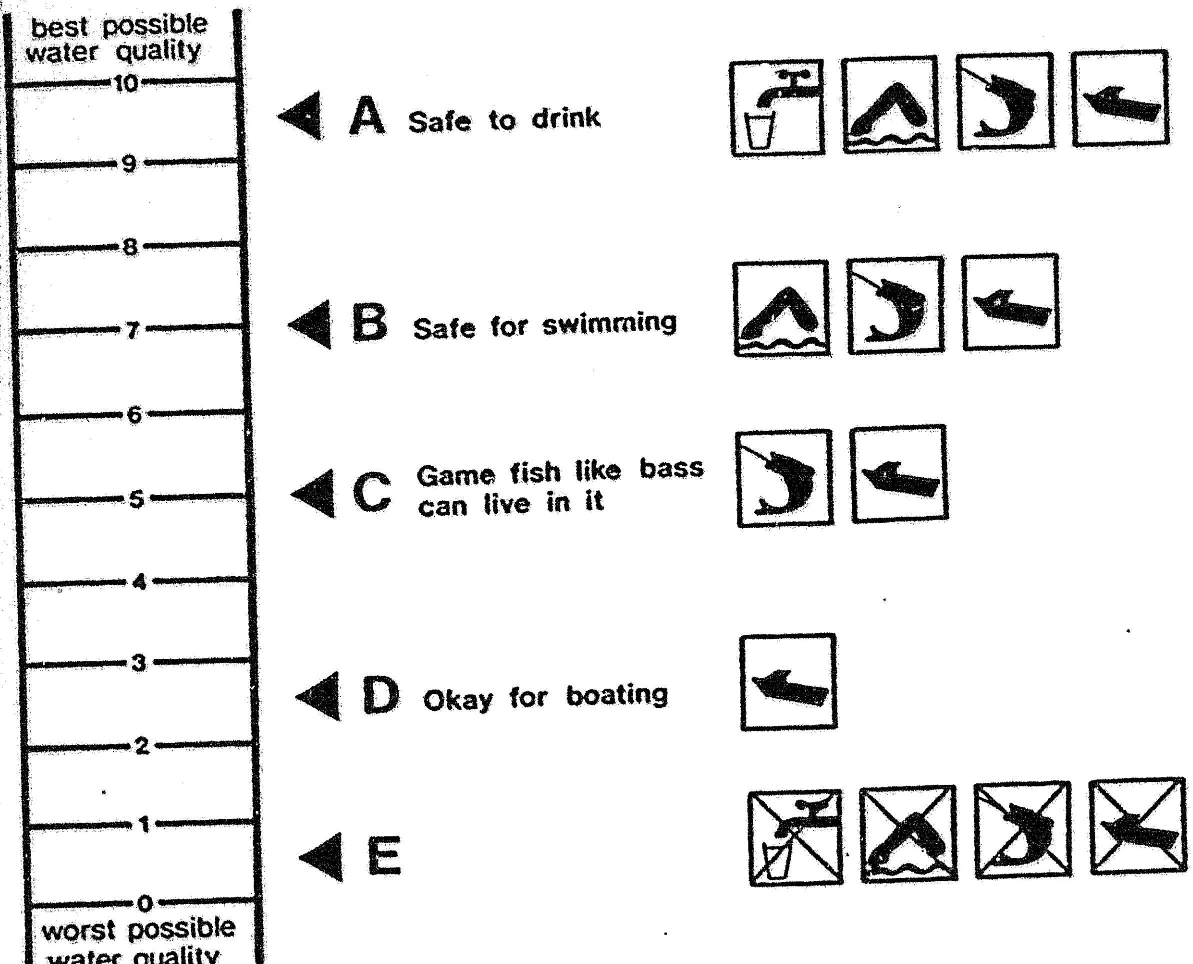

Figure 1. The water quality ladder is one way to describe the product in CV surveys. (From Desvousges *et al.* (1983).)

There are two ways of recovering this lost capacity. One is to dredge the reservoir bed; alternatively, raise the dam wall. Investigations conducted by the Yass Shire Council has ruled out the former on economic grounds, whilst the latter is being considered. Based on 1969 values, the estimated cost of raising the dam wall by 1.5 metres was $200,000 (Yass Water Supply Report No. 133, 1977).

The 25% loss in storage capacity cannot be wholly attributed to soil erosion resulting from dryland salinity, as other forms of erosion have also occurred in the valley over the years (Wagner 1986). One method of estimating the contribution of dryland salinity to storage loss would be to consider the extent of dryland salinity in the valley in proportion to total extent of severe to moderate erosion. According to Wagner's study (Wagner 1986) this proportion is estimated at about 2%

The YSADP will reduce siltation of the weir in future and prevent further costs of restoration being incurred. This will bring about savings in costs of the domestic water supply and needs to be recognised as a significant project benefit.

5.3.6 Savings in damage costs to public property

A similar project benefit will be the reduction in damage costs to public property and utilities. The Yass Shire Council maintains records of costs incurred in repairing damages to public property through soil erosion in the valley. As in the earlier case, although the total damage costs cannot be attributed to dryland salinity, a proportionate estimate as outlined above can be used. This estimate can then serve as a measure of project benefit as demonstrated by Barter (Barter 1986).

5.3.7 Other physical benefits

An improvement in the quality of water flowing in creeks and rivers in the valley as well as improvement in quality of stockwater in farm dams in the area will be another important project benefit. The former will be measured through guaging stations that will be set up at various locations within the project area. This benefit though difficult to value needs to be recognised.

A final benefit of the YSADP is that identified as a "catalytic effect on conservation ethics". This represents the increased involvement and commitment of landholders in the catchment not only to practice soil conservation, but also to adopt structural management practices such as destocking, tree planting and pasture improvement. This will also contribute to the enhancement of aesthetic values of rural landscape in Yass Valley by the rehabilitation of degraded lands and prevention of further land degradation.

These benefits though difficult to measure, are considered to be positive and needs to be recognised and appreciated.

5.4 Calculation of economic benefits (see Table 3)

Table 3: Comparison of dryland salinity/erosion costs with and without control program.

	Benefit	Present Value of damage costs ($) without project	with project	Damage costs savings ($) (net benefit)
1.	Reduction in losses agricultural productivity	x_1	x_2	$(x_1 - x_2) = x$
2.	Savings in damage costs to farm infrastructure	y_1	y_2	$(y_1 - y_2) = y$
3.	Reduction in losses to land values	z_1	z_2	$(z_1 - z_2) = z$
4.	Reduction in damage costs to public property and utilities	a_1	a_2	$(a_1 - a_2) = a$
5.	Savings in costs to rate payers for improved water supplies	b_1	b_2	$(b_1 - b_2) = b$
6.	Reduction in maintenance costs of domestic water supply	c_1	c_2	$(c_1 - c_2) = c$
7.	Increase in landholder awareness of presence of dryland salinity and techniques for its prevention and control	measured, but not monetised		
8.	Iprovements in water quality in rural waterways	measured, but not monetised		
9.	Appreciation in "conservation ethic" by landholders and enhancement of rural landscape	not measured nor monetised		

Total net benefit = $(x + y + z + a + b + c)$

= X

Total project costs = Y (present value)

Net Present Value = X - Y

6. Summary and Conclusions

Dryland salinity is emerging as a major form of land degradation in New South Wales. While saline scalds are more widespread than saline seepage, from an economic viewpoint the latter is the more serious. Total losses of $ 5 to 6 million in land values and $ 1 to 1.2 million in production losses exemplify the magnitude of the problem. Furthermore 80% of saline seepage occur in the Southern Tablelands with the Yass river catchment being a major problem area.

The YSADP is the first dryland salinity project in New South Wales and aims to demonstrate viable land management practices to control dryland salinity throughout the Murray-Darling Basin. During the four years demonstration phase of the project methods of rehabilitation will be refined in conjunction with associated monitoring and economic evaluation. This will provide a catalytic effect on dryland salinity control throughout the surrounding Yass River Valley and the rest of New South Wales. It is expected that the lessons learnt and demonstrated here will also have an effect on dryland salinity control on other parts of the Murray-Darling Basin as well as in other parts of Australia.

A number of project benefits are envisaged, some more tangible than others. Amongst the former are reduction in losses in agricultural productivity and land values, savings in onfarm damage costs, savings in the cost of domestic water supply and reduction in damage costs to public property and utilities. The measurement of these benefits will be achieved through field surveys and other information held at public and local government offices.

Intangible project benefits such as reduction in sallnity levels in natural waterways, increasing the "conservation ethic" of landholders and enhancement of the aesthetic value of the rural landscape are identified as positive project impacts.

The methodology outlined in this paper will achieve a comprehensive economic evaluation of the project.

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