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# PRIVATE AND SOCIAL VALUES OF WETLANDS RESEARCH REPORTS

## FARMER PERCEPTIONS OF WETLANDS AND WETLAND MANAGEMENT IN THE UPPER SOUTH EAST OF SOUTH AUSTRALIA

By S.M. Whitten and J.W. Bennett

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# Abstract

In recent times much attention has been paid to wetlands conservation and management. Relatively little of this attention has been paid to the trade-offs land manager's face when deciding on the use of privately owned wetlands. In this Report, the results of a survey of wetland management trade-offs in the Upper South East region of South Australia are reported. The results indicate that farmers obtain considerable non-monetary benefits from their wetlands. The type of benefits received from wetlands are not related to the socio-economic characteristics of the farmers who enjoy them but are influenced by the type of wetland that produces the enjoyment. Wetland management practices alter the benefits and costs created by the wetlands. Decisions to implement wetland management practices are influenced by both monetary and non-monetary characteristics of wetland outputs. Wetland type, physical management constraints and socio-economic characteristics of managers also influence decisions to adopt management practices. When making management decisions non-monetary benefits from wetlands are traded-off against monetary opportunity costs (mainly from restrictions to grazing livestock) and additional management costs. Wetland policy needs to take account of the benefits enjoyed and costs incurred by wetland owners and managers when evaluating potential incentive schemes.

# 1 Introduction

Wetland owners and managers face a range of alternatives when deciding how they use their wetland resources. Some wetland uses increase the monetary benefits available while others increase non-monetary benefits. Benefits and costs of alternative wetland uses are not restricted to individual wetland owners and managers. They may spill over to other members of the community. Hence decisions by private owners and managers alter the available benefits and costs of wetlands to society as a whole. A conflict of interest frequently arises when making decisions about wetland use. A potential conflict at the farm management level arises between the desire for monetary and non-monetary benefits from wetlands and the costs of various management options. At the community level, the potential for conflict lies between net benefits to the community and private net benefits. The conflict of interest has increased with increasing wetland scarcity and with growing community awareness of environmental issues.

The focus of recent conflict between community and private benefits has been on the hydrological and environmental functions of wetlands. In particular, the impact of agricultural systems on the supply of nature conservation values provided by wetlands has been examined (see for example Briggs 1988, Robertson 1997, Brock, Smith and Jarman 1997 or Crome 1988). Hence wetland managers are now better informed about the biological consequences of decisions about how wetland resources are used. Previous analysis of conflicts over wetland management has focused on the trade-offs faced by the community rather than individual wetland owners and managers although Briggs (1998) notes the importance of wetland owner and manager motivations (see for example Morrison and Bennett 1997, van Vuuren and Roy 1993). Other analysis has focussed on the ways of achieving community goals using, in part, aspects of individual wetland owner's and manager's values (see for example, Young, Gunningham, Elix, Lambert, Howard, Grabosky and McCrone 1996 and Binning and Young 1997).

Despite the increasing attention devoted to wetland management conflicts and trade-offs within agricultural systems there have been few attempts to analyse the monetary and non-monetary trade-offs faced by individual wetland owners and managers when making decisions about wetland uses. Analysis of the wetland owners and managers trade-offs gives an improved understanding of the processes that underpin resource use decisions in wetlands. A better understanding of the processes improves the ability to design policies that will improve resource allocation from a societal perspective.

A survey of farmer wetland management attitudes and practices was undertaken to examine the potential conflicts faced by private wetland owners and managers when trading-off monetary and non-monetary benefits and costs of wetlands. The survey population comprises wetland owners and managers in the Upper South East (USE) region of South Australia (SA). Large-areas of wetlands are located in the region, some of which meet the criteria for 'wetlands of international importance' under the Ramsar convention (White 1997). USE wetlands are mainly located on privately owned land and are potentially subject to degradation via grazing, feral animals and other impacts of agricultural production. The survey forms part of a larger research project aimed at the examination of the private and social values of wetlands.

Within the USE region, wetland owners and managers trade-off a range of monetary and non-monetary consumptive values and non-consumptive values generated by their wetlands when making resource management decisions. These trade-offs are analysed in this paper together with a brief analysis of the policy context. In Section 2, a set of hypotheses is developed to identify the monetary and non-monetary benefits and the trade-offs between these made by wetland owners and managers. Survey design, collection and respondent demographics are described in Chapter 3. In Section 4 the results of the survey analysis are presented. The report concludes with a brief assessment of the implications of the results for future policy generation and a summary of the main conclusions.

# 2 Hypotheses

The aim, in this paper, is to identify the nature of the benefits and costs facing wetland owners and managers and examine the trade-offs they face when making decisions about wetland use. Wetlands can be expected to provide both benefits and costs to wetland owners and managers. The benefits and costs to wetland owners define the nature of the values received by wetland owners and managers. However, a complete array of potential net benefits may not be available to a wetland owner simultaneously. The particular array of benefits available normally depends on the characteristics of the wetland and the management strategies employed. That is, wetland management strategies alter the type of benefits available from wetlands. Hence wetland owners

trade-off the benefits available under alternative management strategies when making decisions about wetland use. The hypotheses developed in this section, and tested subsequently in this paper, are constructed to afford a structure for the analysis of:

- The range of benefits and costs associated with wetlands;
- The use of alternative management practices; and,
- The trade-offs faced by wetland owners and managers when deciding which strategies to employ.

Wetland values, or the benefits and costs of wetlands, can be divided between use, indirect-use and non-use values (see for example Wills 1997). Use and indirect use values can be further divided into consumption and non-consumption values.[1] Wetland benefits include monetary benefits from grazing or eco-tourism as well as non-monetary benefits from recreation or their scenic beauty. Likewise wetland costs include additional monetary costs associated with feral animals or water management, non-monetary costs associated with odours and opportunity costs due to foregone wetland uses. It is expected a full array of potential wetland uses, and hence values, are available to USE wetland owners and managers. Wetland uses are summarised in hypotheses 1 to 4.

*Hypothesis 1: Wetland owners receive monetary use benefits from their wetlands.*

*Hypothesis 2: Wetland owners receive non-monetary use benefits from their wetlands.*

*Hypothesis 3: Wetlands impose monetary costs upon wetland owners and managers.*

*Hypothesis 4: Wetlands impose non-monetary costs upon wetland owners and managers.*

The costs and benefits involved in hypotheses 1 to 4 are all direct use values provided by wetlands. The level of each use is defined by a particular description (for example how often the wetland is grazed, degree of feral animal problem). Other benefits are more difficult to define, in particular some non-consumptive values (such as scenic value, flora and fauna conservation), indirect-use values and non-use values. Hypothesis 5 considers additional non-consumptive use values and indirect use values. The potential values involved have both direct and indirect implications for agricultural production.

*Hypothesis 5: Wetland owners receive a range of values including non-consumptive and indirect-use benefits from their wetlands.*

The types of values drawn from wetlands have been grouped as in economic literature throughout the discussion so far (see for example Wills 1997 or Turner, Pearce and Bateman 1994). For example, values have been divided into use and non-use, monetary and non-monetary effects. It is useful to test whether wetland owners and managers think in terms of similar groups. Thinking in terms of groups of values is useful for comparative purposes and for identifying general changes in the nature of values between alternative management strategies (increased use but reduced non-use values for example). If wetland owners and managers perceive value groups that are markedly different (or do not occur at all) comparisons of this type are much less useful. Hypothesis 6

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[1] The different types of values are defined as follows:
***Direct-use values*** 'are based on the conscious use of environmental resources in production and/or consumption' of goods and services (Wills 1997, p. 147). Examples of direct-use wetland values in the USE are grazing, tourism, recreation and research.
***Indirect-use values*** 'are based on the contribution of natural resources to human life support' (Wills 1997, p. 147). Examples of indirect-use wetland values in the USE are carbon fixation and nutrient removal and storage. The distinction between direct use and indirect-use is the ability of respondents to directly benefit. For example, use of wetlands for water extraction directly relates to water provision for stock or other purposes. Indirect-use values are less defined because either the benefit is diluted with an unclear distribution (eg. the pest control benefits of birds) or the nature of the benefit received may be unclear (eg. regional tourism benefits).
***Non-use values*** 'involve no tangible current interaction between the environmental asset and those who benefit (value) it' (Wills 1997, p. 147). Examples of non-use wetland values in the USE are bio-diversity and the knowledge they continue to exist.
***Consumptive values*** reduce the conservation value of wetlands in some way. Such uses normally require transformation of the wetland either directly, for example by clearing and draining, or indirectly, for example via over use by recreation.
***Non-consumptive values*** are uses that derive values without reducing the conservation values of wetlands. Examples include scenic values, bio-diversity values and research.

considers whether wetland owners and managers distinguish between wetland values in the same way that economists do.

*Hypothesis 6: Wetland values can be divided into groups arising from direct and indirect uses and their impact on agricultural production systems.*

The array of potential monetary and non-monetary benefits and costs facing all wetland owners and managers has been assumed constant over variable wetland conditions up until this point. In reality a number of external influences change the actual and potential uses of wetlands. Hydrology, geology and climate can interact to produce differing wetland types and hence contrasting potential uses and values. While climatic influences across the study area are reasonably constant, hydrology varies greatly resulting in a number of different wetland types. For example Tea-tree wetlands are densely vegetated while open shallow water wetlands have little or no vegetation. Therefore wetland type can influence the benefits and costs of wetlands and hence impacts on wetland owners' and managers' trade-offs. Hypothesis 7 frames an analysis of differences in uses between wetland types.

*Hypothesis 7: Wetland type influences wetland values.*

Other socio-economic factors such as level of education and income can also influence wetland values. Education can alter the perception of benefits obtained or available from wetlands, both in their current state and under alternative management regimes. Differing levels of income may lead to changing demands for uses available from wetlands. Economic factors can also constrain wetland management options and hence potential uses. Hypothesis 8 considers differences in use across variations in respondent's socio-economic factors.

*Hypothesis 8: Socio-economic factors influence wetland values.*

When making decisions about how to manage their wetlands, owners and managers may be expected to compare the benefits and costs they receive currently (and into the future) and the benefits and costs that they would receive if they changed their management strategy. The net benefits and costs of alternative strategies can be divided between monetary and non-monetary benefits. The monetary returns from wetlands must be maintained if farm viability is to be maintained. Hence, one goal of management may be the maintenance of (at least a minimum level of) monetary returns. However, private wetland owners also receive non-monetary benefits directly from wetlands through, for example, recreation, hunting and appreciation of wetland beauty. Hence, another goal of management may be maintenance of non-monetary benefits (or at least a minimum level thereof). Hypotheses 9 and 10 allow analysis of the monetary and non-monetary impacts of management changes influence decisions to adopt.

*Hypothesis 9: Monetary impacts of management practices influence adoption.*

*Hypothesis 10: Non-monetary impacts influence adoption of wetland management practices.*

Maximisation of monetary benefits may reduce or remove some non-monetary benefits and vice-versa. For example increasing grazing or timber sales from wetlands will reduce surrounding vegetation decreasing the quality of the scenic vista. Hence wetland owners and managers in agricultural systems are subject to two potentially conflicting goals: maximising monetary net benefits and maximising non-monetary net benefits from wetlands. That is, owners and managers trade-off monetary and non-monetary benefits and costs of alternative management strategies when making decisions about wetland resource use. Hypothesis 11 considers whether managers are trading off between monetary and non-monetary benefits.

*Hypothesis 11: Wetland owners and managers trade-off monetary and non-monetary benefits and costs when making decisions about wetlands.*

Hypotheses 7 and 8 afford the analysis of whether physical and socio-economic factors affect wetland uses directly. Likewise these factors may affect the adoption of wetland management practices directly or indirectly. Some wetland practices are more appropriate or yield greater returns when applied to certain wetland types. Education may influence the perceived costs and benefits of applying certain wetland management practices. Economic constraints may restrict adoption, particularly of relatively expensive strategies. In addition physical management constraints also influence management decisions. Physical constraints likely to vary within the region mainly relate to wetland size and total property productivity. Hypothesis 12 considers wetland management practices in terms of the effect of physical and socio-economic constraints.

*Hypothesis 12: Adoption of wetland management practices is influenced by physical and socio-economic factors.*

# 3 Survey Methodology

To address these hypotheses, a survey was carried out. The questionnaire used in the survey was composed of five parts. In each part, the questions were designed to gather:

1. Descriptive information relating to the size and production of land managed, size and production of wetlands and wetland type.
2. Descriptive information relating to wetland benefits and costs, a qualitative assessment of the net monetary and non-monetary cost of wetlands and attitudes towards wetlands.
3. Types of wetland management strategies implemented, the type of benefits expected, additional management costs imposed by such strategies and incentives received.
4. Reasons for not adopting wetland management strategies, perceptions regarding the impact of wetland management strategies on farm viability and desired incentives to increase adoption of wetland management strategies.
5. Demographic information about respondents.

The population surveyed consisted of both owners and managers of properties containing wetlands, located in the USE region of SA. The total population of owners and managers of properties with a wetland present is 73. A useable response of 51 surveys was received of which 29 were mail-out and pick-up and 22 mail-out. The survey was undertaken between February and April 1998.

Table 1 summarises respondent demographics. Seventy one percent of respondents lived on the property surveyed. The average time respondents had lived on the property is 24 years. Ninety six percent of respondents had some farming and grazing experience with an average of 30 years.

***Table 1: Summary of respondent demographics***

| | **Yes** | **No** |
|---|---|---|
| Live full time of property | 71% | 29% |
| Own the property | 83% | 17% |
| Actively involved in decision making about property | 98% | 2% |
| Fully employed as a farmer | 80% | 20% |

| | **Male** | **Female** | **Together** |
|---|---|---|---|
| Survey answered by | 88% | 6% | 6% |

| **Age range of respondents** | | **Education** | **Highest level** |
|---|---|---|---|
| 20-29 | 2% | Intermediate or leaving certificate | 10% |
| 30-39 | 22% | South Australian Certificate of Education or Matriculation Certificate | 2% |
| 40-49 | 30% | TAFE or other short course (1-2 weeks) | 37% |
| 50-59 | 28% | Other tertiary qualifications | 12% |
| 60+ | 18% | Tertiary qualifications in agriculture | 24% |

The total area of respondents' properties was 223,117 hectares. Average property size was 4,462 hectares. The median property size was 1,535 hectares compared to the USE average of 1,500 hectares (Upper South East Dryland Salinity and Flood Management Plan Steering Committee (USEDSFMPSC) 1993). Total wetland area surveyed was 30,475 hectares. Wetland areas and types are reported in Table 2. Average stocking rate on respondents' properties is 4.05 dry sheep equivalents (dse) per hectare compared to the USE average of 4.6 dse per hectare (USEDSFMPSC 1993). A total of 1,054,594 dse were grazed on respondents' properties. The survey covered 33 percent of total agricultural land and 41% of total dse in the USE region emphasising the significance of wetlands within the region. The total area of properties containing wetlands is unknown. No cropping is undertaken in the region except as part of pasture improvement programs.

*Table 2: Respondent wetland types and areas*

| Wetland type | Wetland Area (ha)* | Percentage of wetland area | Proportion of respondents |
|---|---|---|---|
| Red gum swamps | 1,154 | 6.7% | 40% |
| Tea-tree swamps | 10,250 | 59.9% | 65% |
| Sedge-lands | 455 | 2.7% | 6% |
| Native herb-lands | 475 | 2.8% | 10% |
| Open shallow water | 2,418 | 14.1% | 41% |
| Open deep water | 2,109 | 12.3% | 16% |
| Tall reeds/rush swamp | 258 | 1.5% | 16% |
| Pasture flooded annually/regularly | 7,365 | | 63% |

* Wetland areas do not sum to total respondent wetland area as some respondents did not report wetland type.

# 4 Results

## 4.1 Wetland benefits

The range of wetland uses reported by respondents and displayed in Table 3 describes the benefits wetland owners and managers are currently receiving from the direct use of their wetlands. The range of wetland uses gives rise to monetary and non-monetary benefits. Monetary benefits include direct income from grazing, timber sales, reduced stock water supply costs and costs avoided via drainage. Non-monetary benefits include recreation and hunting. The individual uses reported may be in conflict. For example, using wetlands as sinks for saline drainage may conflict with (reduce) recreational benefits but this does not necessarily mean all recreational benefits are destroyed. Hence wetland owners using wetlands for saline drainage may be trading-off recreational benefits against benefits to production (among other trade-offs).

The proportion of respondents undertaking various activities in their USE wetlands is shown in Table 3. In summary the results indicate:

- 86 percent of respondents regularly graze their wetlands;
- 38 percent of respondents extract timber for use as firewood or farm timber;
- 62 percent alter the hydrological regime either via water extraction from or drainage to their wetlands; and,
- 96 percent of respondents indicate undertaking some form recreational use such as hunting or pleasure.

No respondent indicated undertaking no activities in their wetlands. An additional use not included in Table 3 is native seed production (1 respondent, non-commercial).

*Table 3: Wetland uses (benefits)*

| | Unrestricted | Seasonal | Never or drought |
|---|---|---|---|
| **Sheep grazing** | 22% | 49% | 29% |
| **Cattle grazing** | 27% | 46% | 27% |
| **Total grazing** | 35% | 51% | 14% |
| | **None** | **Family and Friends** | **Commercial** |
| **Hunting pests** | 24% | 74% | 2% |
| **Other hunting** | 61% | 35% | 4% |
| **Fishing** | 84% | 16% | 0% |
| **Pleasure/recreation** | 12% | 86% | 2% |
| **Total** | 4% | 96% | |
| | **Farm timber** | **Firewood** | **No harvesting** |
| **Farm use** | 4% | 32% | 64% |
| **Commercial** | 2% | 6% | 92% |
| **Total timber use** | 38% | | 62% |
| | **Whole farm** | **Part of farm** | **None** |
| **Water supply** | 6% | 20% | 74% |
| **Drainage** | 52% | | 48% |
| **Total** | 62% | | 38% |

The results reported in Table 3 clearly indicate the range of benefits wetland owners and managers derive from their wetlands. In total, 88 percent of respondents derive some direct monetary benefit from their wetlands via either grazing, commercial hunting or eco-tourism. Hence hypothesis 1 can be accepted: *wetland owners receive monetary benefits from their wetlands.*

Respondents also nominated the attributes of their wetlands they liked and disliked most. Non-consumptive, non-monetary attributes such as scenery, aesthetics, fauna habitat and natural land / ecosystem dominated likes (70 percent of responses). This confirms the result that some 96 percent of respondents undertake some form of recreation (hunting, fishing or other) in wetlands. Hence, hypothesis 2 is accepted: *wetland owners receive non-monetary benefits from their wetlands*.

## 4.2 Wetland Costs

The existence of wetlands also imposes additional costs upon land managers. Costs may result from undertaking agricultural production in wetlands (such as loss of bogged stock) or from additional costs imposed on non-wetland production by wetlands (such as a source of weeds or access problems). Other wetland costs may not affect agricultural production (such as odours). A further class of costs relates to the opportunities foregone once a particular management strategy is chosen. This group of costs is called opportunity costs. Respondents' perceptions of a suite of potential costs are reported in Table 4.

In summary, 98 percent of respondents indicated at least one negative impact on agricultural production capacity. Some of the costs indicated are monetary (such as loss of bogged stock and additional weed control requirements) and others non-monetary (such as management complications due to access, odours etc.). Respondents were also asked what they disliked most about having wetlands on their properties. Dominant dislikes were costs such as unproductive land (26 percent) and associated management costs (52 percent). Interestingly, the majority of dislikes indicated by respondents are related to undertaking agricultural production in wetland areas whereas the majority of likes were related to non-production aspects of wetlands. While it is difficult to distinguish clearly between monetary and non-monetary production costs, most respondents face both. Hence hypotheses 3 and 4 can be accepted: *wetlands impose monetary costs upon wetland owners and managers*, and, *wetlands impose non-monetary costs upon wetland owners and managers*.

***Table 4: Wetland costs***

| | Severe or moderate | Minor | No problem |
|---|---|---|---|
| **Weed source** | 26% | 49% | 25% |
| **Harbours feral animals** | 34% | 54% | 12% |
| **Harbours nuisance animals** | 38% | 30% | 32% |
| **Waterlogging** | 31% | 37% | 31% |
| **Contributes to soil salinity** | 33% | 43% | 24% |
| **Access problems** | 14% | 56% | 39% |
| **Loss of bogged Stock** | 0% | 16% | 84% |
| **Total production impacts** | 98% | | 2% |
| **Noxious odours** | 22% | 6% | 73% |

## 4.3 Other wetland values

Some wetland impacts are not uniformly regarded as costs or benefits. For example, birds attracted to wetlands may be regarded as assisting in pest control by some wetland owners and managers, but as pasture damaging by others (it may also depend on the bird species attracted). Table 5 reports respondent attitudes towards three such potential impacts. In summary, the majority of owners and managers (86 percent) regard government intervention as a result of wetlands being present as neutral or harmful and 30 percent regard their wetlands as a fire hazard.

***Table 5: Other wetland impacts***

| | Negative impact | No impact | Positive impact |
|---|---|---|---|
| **Pasture damaging birds** | 8% | 80% | 12% |
| **Government intervention** | 36% | 50% | 14% |
| **Natural fire break** | 30% | 8% | 62% |

All the benefits and costs considered up to this point are direct effects on wetland owners and managers. As discussed above wetland owners and managers are also hypothesised to receive a range of less easily defined or less direct benefits and costs. The level of these benefits or costs is also more difficult to measure. Respondents were asked their attitudes about:

- non-consumptive wetland uses such as providing a place of beauty;
- production related uses such as prevention of flooding;
- indirect uses such as reducing water pollution and conservation of native flora and fauna; and,
- potential wetland uses such as hunting and fishing.

Respondents' attitudes towards each use of their wetlands were recorded using a five point Likert scale plus an additional 'not applicable' category. Responses are reported in Table 6. Non-monetary, non-consumptive uses of wetlands such as place of beauty, conserve flora and fauna scored very highly. Wetland attributes such as soil erosion and fish habitat / recreational fishing are rarely present within the region or not recognised by respondents (as shown by the high don't know, not applicable and/or disagree proportions). Respondent attitudes were divided over indirect benefits of wetlands such as reducing water pollution and trap and recycle nutrients. Other values such as bird life reducing pests, recreational hunting and to a lesser extent contributing to tourism and recreation opportunities had higher proportions of agreement rates. Respondents were also divided over production impacts such as controlling floods and to a lesser extent preventing salinity. From the results in Table 6 it is clear that hypothesis 5 can be accepted: *wetland owners receive a range of values including non-consumptive and indirect-use benefits from their wetlands*.

***Table 6: Farmer attitudes towards their wetlands***

| **Statement** | **Agree** | **Don't know** | **Disagree** | **Not applicable** |
|---|---|---|---|---|
| **Non-consumptive use values:** | | | | |
| My wetlands provide a place of beauty | 76% | 4% | 18% | 2% |
| My wetlands beautify the rural landscape | 80% | 2% | 14% | 4% |
| My wetlands conserve native plants and animals | 72% | 6% | 16% | 6% |
| My wetlands help native animal movements | 71% | 12% | 16% | 2% |
| My wetlands provide native fish habitat | 20% | 6% | 28% | 47% |
| **Indirect use values:** | | | | |
| My wetlands increase bird life which in turn decreases pests | 65% | 12% | 18% | 6% |
| My wetlands reduce water pollution | 20% | 22% | 30% | 27% |
| My wetlands help to trap and recycle nutrients | 35% | 24% | 36% | 6% |
| **Production impacts of wetlands:** | | | | |
| My wetlands help prevent salting | 26% | 10% | 58% | 6% |
| My wetlands help control floods | 44% | 8% | 40% | 8% |
| My wetlands help prevent soil erosion | 14% | 12% | 35% | 39% |
| **Direct use values:** | | | | |
| My wetlands provide for recreational fishing | 10% | 4% | 31% | 55% |
| My wetlands provide for recreational hunting | 51% | 2% | 30% | 18% |
| My wetlands provide tourism/recreation opportunities | 43% | 6% | 31% | 20% |

Economists often divide the values arising from eco-system attributes between use, indirect use and non-use values (see for example Wills 1997). When considering the values of wetlands in alternative uses, economists normally combine values from these groups. It is useful to ask whether wetland owners and managers think in terms of similar groupings for ease of communication and in accounting for wetland trade-offs. In order to identify any groupings a factor analysis can be conducted. Factor analysis considers the interrelationships among the variables and explains them in terms of underlying dimensions which are called factors (Hair, Anderson, Tatham and Black 1992). The aim of the factor analysis is to reduce the number of variables reported in Table 6 to groupings based on the type of value represented.

Economic theory suggests that some groupings are likely to be strongly correlated. That is, individuals with high non-consumptive use values may also have high non-use and indirect use values. Direct, consumptive use values (such as grazing) will not necessarily be highly correlated with indirect or non-use values. Hence the factor analysis was conducted using the more flexible methodology offered by 'principle axis factoring' and an oblique rotation (Oblimin with Kaiser Normalisation) (Hair et.al. 1992, Norusis 1993 and Kim and Mueller

1978a,b). The reliability of the factors was assessed using Cronbach's alpha. Alpha values in excess of 0.7 are regarded as a guideline for acceptable reliability (Hair et.al. 1992).

Table 7 reports the factor pattern matrix from the factor analysis undertaken on the variables reported in Table 6. The factor pattern matrix contains the rotated factor loadings of each variable. Factor loadings refer to the regression weights of variables to the common factors. Only loadings with an absolute value greater than 0.3 are reported. Variables with high loadings on more than one factor were removed during the analytical process in order to produce 'clean' factors. 'Clean' factors have only one underlying dimension. Cronbach's alphas for each factor are also reported in Table 7.

***Table 7: Pattern matrix of attitudinal questions regarding wetlands.***

| | **Factors** | | |
|---|---|---|---|
| | **Non-con** | **ID-use** | **P-imp** |
| My wetlands beautify the rural landscape | 0.922 | | |
| My wetlands provide a place of beauty | 0.887 | | |
| My wetlands conserve native plants and animals | 0.690 | | |
| My wetlands help native animal movements | 0.575 | | |
| My wetlands help to trap and recycle nutrients | | 0.710 | |
| My wetlands provide tourism/recreation opportunities | | 0.704 | |
| My wetlands increase bird life which in turn decreases pests | | 0.578 | |
| My wetlands help prevent salting | | | 0.832 |
| My wetlands help control floods | | | 0.692 |
| Eigenvalues | 4.933 | 1.106 | .928 |
| Percent of variance | 51.415 | 5.897 | 8.657 |
| Cronbach's Alpha | 0.908 | 0.766 | 0.778 |

As shown in Table 7 three factors have been extracted as opposed to the hypothesised four. The three factors extracted are hypothesised to represent non-consumptive uses of wetlands (Non-con), production impacts of wetlands (P-imp) and indirect uses of wetlands (ID-use). Cronbach's alpha is greater than 0.7 in each case indicating acceptable reliability (Hair et.al. 1992). The fourth hypothesised factor (direct use values) was not extracted due the impact of the recreational fishing variable (with a high 'not applicable' and 'disagree' proportion) and probable confusion about how direct the impacts of tourism and recreation might be. It can be seen that tourism and recreation load highly on the indirect use factor. Recreational hunting was also removed as a single variable factor due to a low eigenvalue and use of a scree plot (Tabaschnick and Fidell 1996 and Hair et.al. 1992). Other variables removed were native fish habitat, water pollution and soil erosion. These variables all exhibited relatively high 'not applicable' and 'disagree' proportions. A high non-applicable and disagree proportion indicates that the value is less likely to be present (or recognised) in USE wetlands and does not contribute to the underlying factors. As three clear factors have been extracted hypothesis 6 can be accepted: *wetland values can be divided into groups arising from direct and indirect uses and their impacts on agricultural production systems*.

The factor scores for each of the factors derived in Table 7 are used in later analyses. Factor scores are calculated by multiplying the un-rotated factor weights by individual's responses. For each individual, three 'scores' are calculated, one relating to each factor. Hence three new variables (factor scores) are created relating to individuals composite responses for the three groups of variables. These factor scores are referred to as *wetland attitudinal factor scores* in later analyses.

## 4.4 Impact of wetland type on values

Hypotheses one to six address the alternative benefits and costs that wetland owners and managers are able to extract from their wetlands. As noted above, there are a number of different wetland types present in the USE region of SA. Each of these differing wetland types is likely to provide an alternative mix of values. For example, red-gum wetlands are typically seasonal and comprise an open grassy understorey providing easy productive grazing, Tea-tree provides good stock shelter for lambing, calving or off-shears and deep water may provide a relatively permanent stock water supply.

Hypotheses testing whether the type of wetland alters the range of values provided can be carried out in two ways:

1. By considering the relationship between each potential wetland use and wetland type.
2. By considering the relationship between groups of wetland uses (factors) and wetland type.

Only three wetland types are owned or managed by greater than 20% of respondents, namely Red gum, Tea-tree and Shallow open water. These types comprise 81% of reported wetland area. Hence tests of significance of wetland type are only conducted on these three types. Fortunately the attributes of these wetland types differ significantly and they cover the majority of wetland areas present within the region. Red gum wetlands are open woodlands of large trees with a grassy understorey. Tea-tree wetlands are usually an open or closed scrub of *Melaleuca* species with little understorey. Shallow open water wetlands possess little or no emergent vegetation and dry back to either a saline pan or may grow some fodder. Shallow open water wetlands are often fringed by Tea-tree. All wetland types are seasonal and may not fill every year.

Table 8 reports the results of Chi-square tests of association between the wetland benefits and costs reported in Tables 3, 4 and 5 and wetland type. The results indicate that fishing, farm timber harvesting and recreation are positively associated with red gum wetlands while noxious odours and bogged stock are negatively associated. These associations are expected as red gum woodlands commonly posses yabby populations, large trees that are more useful for both fire-wood and farm timber and provide shade for recreation.[2]

***Table 8: Relationship between wetland type and values***

| **Type of wetland** | **Red gum** | **Tea-tree** | **Shallow open** |
|---|---|---|---|
| Wetland benefits: | | Chi-square test p-values | |
| All grazing use | 0.924 | 0.078 (~) | 0.003 (~) |
| Hunting feral species | 0.651 | 0.215 | 0.063 (+) |
| Other hunting | 0.257 | 0.908 | 0.257 |
| Fishing | 0.001 (+) | 0.331 | 0.428 |
| Farm timber harvesting | 0.005 (+) | 0.675 | 0.266 |
| Commercial timber harvesting | 0.152 | 0.355 | 0.783 |
| Pleasure/recreation | 0.073 (+) | 0.011 (+) | 0.741 |
| Stock water supply | 0.749 | 0.012 (-) | 0.585 |
| Outflow area for farm drains | 0.368 | 0.896 | 0.216 |
| Wetland costs: | | | |
| Harbours feral animals | 0.103 | 0.107 | 0.001 (+) |
| Source of weeds | 0.241 | 0.394 | 0.683 |
| Harbours nuisance animals | 0.115 | 0.013 (+) | 0.305 |
| Creates noxious odours | 0.011 (-) | 0.669 | 0.263 |
| Limits access to parts of property | 0.512 | 0.771 | 0.257 |
| Contributes to waterlogged / impoverished soil | 0.146 | 0.094 (+) | 0.501 |
| Contributes to dryland salinity | 0.390 | 0.126 | 0.418 |
| Loss of bogged stock | 0.009 (-) | 0.170 | 0.048 (+) |
| Other wetland uses: | | | |
| Attract pasture damaging birds | 0.598 | 0.228 | 0.183 |
| Attracts government intervention | 0.212 | 0.078 (-) | 0.412 |
| Is a natural fire break | 0.390 | 0.244 | 0.899 |
| Groups of wetland values: | | ANOVA F-test p-values | |
| Non-consumptive use values (Non-con) | 0.063 (+) | 0.000 (+) | 0.804 |
| Production impacts (P-imp) | 0.930 | 0.000 (+) | 0.126 |
| Indirect use values (ID-use) | 0.101 | 0.003 (+) | 0.476 |

\+ Indicates wetland type significantly increases probability.
\- Indicates wetland type significantly decreases probability.
~ Indicates wetland type significantly increases probability of maximum use *and* minimum use.

Tea-tree wetlands are positively associated with recreation, nuisance animals, and waterlogging, negatively with stock water supply and have a mixed association with grazing. Once again the associations are largely expected. Tea-trees are very salt tolerant and often grow where little else will. Hence they are not suitable for stock water supply and commonly exhibit waterlogging or impoverished soils. Tea-tree scrub also provides shelter for

[2] Red gum trees are protected under the native vegetation act. Only dead timber can be felled or removed although other species less than 150mm in diameter can be felled for firewood or fence posts.

native and nuisance species. The mixed grazing result is likely due to some respondents reporting successful grazing use at low intensity or seasonally while other Tea-tree wetlands are very saline and unsuitable for grazing. The mixed grazing result for shallow open wetlands is also due to fresh wetlands growing some feed following drying while others are too saline for any significant growth. Shallow open wetlands allow relatively easy hunting when dry, while Tea-tree fringes provide shelter for feral animals. The development of a salt crust in some saline wetlands may contribute to stock becoming bogged.

Table 8 also reports the results of analysis of variance F-tests (ANOVAs) between wetland type and the wetland attitudinal factor scores calculated from Table 7 variable groups. Pearson correlations were used to determine the direction of association between the variables. The tests indicate Red gum wetlands are positively associated with non-consumptive use values while Tea-tree wetlands are positively associated with all three groups (non-consumptive use values, production impacts and indirect use values). Shallow open wetlands are not associated with any of the groups.

The results of the Chi-square tests clearly indicate particular benefits and costs are more strongly associated with particular wetland types. In addition, the ANOVA tests verify that groups of wetland values are more strongly associated with particular wetland types. Hence hypothesis 7 can be accepted: *wetland type influences wetland values*.

## 4.5 Other impacts on wetland values

Other influences on the values available to wetland owners and managers may result from socio-economic factors. Education can inform wetland owners and managers about current and potential use values, or impacts that are not immediately obvious. For example, education could increase knowledge about native birds and animals living in and around, or making use of wetlands or the impact of wetland birds on pest species in pasture. Economic factors can alter the relative value of wetland uses. For example, individuals with high debt loadings or low cash incomes may place a greater priority on monetary returns from wetlands and may correspondingly value monetary returns more highly. Age may also be an important socio-economic factor.

The impacts of socio-economic influences on wetland values can be tested in two main ways (as for wetland type and values):

1. By testing association between wetland use and socio-economic variables.
2. By regressing level of value against socio-economic explanatory variables.

Five of the 60 tests undertaken to detect relationships between wetland use and socio-economic variables were significant at the five- percent level of significance. Closer examination showed four results appeared spurious due to the small number of respondents in each group, and, in one case, a neutral conclusion despite a significant result.

The second potential method involves estimating a regression of wetland value against age, education and a proxy for income. While levels of wetland value are not directly collected within the survey, the wetland attitudinal factor scores (reported in section 4.3) are continuous variables based on responses measured on a Likert scale. The wetland attitudinal factor scores are higher for consistent disagreement with wetland uses suggested and lower for consistent agreement with the wetland uses.

Explanatory variables used in the regression were age, level of education, full time farmer and wetland type. Income variables were not collected within the survey due to difficulties in defining and collecting a consistent income measure from farmers, however data were collected distinguishing between full-time farmers and other wetland owners and managers (including farmers with outside employment). Respondents who are not full time farmers are likely to have other sources of income and given depressed farm product prices, higher incomes overall.

Model summary data, reported in Table 9, show adjusted $R^2$ between 0.17 and 0.33. Levels over 0.3 are acceptable for cross-sectional data and indicate adequate goodness-of-fit. The regressions provide additional evidence that wetland type is a significant influence on use values obtained by wetland owners and managers. However, only one socio-economic indicator is significant; full time farming for productivity implications. That is, the only significant socio-economic factor suggests full time farming is negatively related to attitudes about wetland production impacts. Education and age are not significant explanatory variables in any of the regressions. Further, the signs of the socio-economic explanatory variables are generally not as expected. Hence hypothesis 8 is rejected: s*ocio-economic factors* ***do not*** *influence wetland values.*

*Table 9: Socio-economic and physical influences on values regression results*

| Model summary data | Number of observations | $R^2$ Adjusted | Std error of estimate |
|---|---|---|---|
| **Non-consumptive use values** | 46 | 0.308 | 0.763 |
| **Indirect Use values** | 46 | 0.177 | 0.779 |
| **Productivity implications** | 46 | 0.330 | 0.721 |

| Model specifications | Constant | Red gum wetlands | Tea-tree wetlands | Shallow open water | Age | Level of education | Full time Farmer |
|---|---|---|---|---|---|---|---|
| **Non-consumptive use values** | 0.143 | -0.553 | -1.167 | 0.057 | 0.115 | 0.083 | 0.155 |
| | (0.801) | (0.023) | (0.000) | (0.814) | (0.361) | (0.303) | (0.214) |
| **Indirect Use values** | 0.064 | -0.449 | -0.892 | 0.163 | 0.083 | 0.084 | 0.109 |
| | (0.912) | (0.067) | (0.002) | (0.153) | (0.514) | (0.309) | (0.389) |
| **Productivity implications** | 1.077 | -0.043 | -0.996 | -0.466 | -0.104 | 0.052 | 0.276 |
| | (0.050) | (0.848) | (0.000) | (0.049) | (0.382) | (0.494) | (0.022) |

Note: Numbers in brackets are t-test significance levels.

## 4.6 Adoption of wetland management practices

The benefits and costs wetland owners and managers experience can be altered via adoption of alternative management strategies. At one extreme wetland management may be directed towards maintaining benefits or values associated with a natural ecosystem. That is, designed to minimise the impact of consumptive uses on the wetland. Alternatively, at the opposite extreme, management actions may be directed at completely altering the available benefits to a set bearing little resemblance to the initial suite, for example by clearing and draining wetlands. Wetland management options are constrained by physical constraints (for example saline wetlands will not grow pasture), financial constraints or by outside agencies such as government (for example wetland owners are no longer allowed to clear and drain wetland areas in South Australia).

*Table 10: Adoption of wetland management practices in the USE region*

| Wetland management practice | Respondents adopting |
|---|---|
| Exclude stock from wetland | 35% |
| Manage grazing access to wetland | 35% |
| Facilities to water stock away from wetlands | 39% |
| Maintaining native vegetation around wetland | 55% |
| Maintaining tree/vegetation filtering strip around wetland | 29% |
| Directing saline drainage away from wetland | 16% |
| Maintaining a natural wetting / drying regime | 29% |
| Control of feral animals in wetland | 47% |
| Control of weeds in wetland | 47% |
| Revegetation using local native species | 33% |
| Fire prevention/control around wetland | 14% |
| Seeking and implementing management advice on specific problems | 18% |
| Preparing a list of plants and animals observed in/near the wetland | 29% |
| Developing a farm management plan incorporating wetland conservation initiatives | 27% |
| Restoring wetland basins/habitat | 22% |
| Measures to encourage native wildlife | 35% |
| Drains to manage dryland salinity impacts on wetlands | 27% |
| | |
| Total respondents undertaking wetland management practices | 73% |

In Table 10 respondent adoption of a range of potential management practices are reported. Seventy three percent of respondents reported implementing at least one management practice. Since many respondents own more than one wetland, management strategies vary from wetland to wetland, especially if different wetland types are owned. For example 14 percent of respondents reported never grazing their wetlands but 35 percent exclude stock from at least one wetland. The most common management practices are maintenance of native vegetation, control of weeds and control of feral animals in wetlands (all undertaken by approximately 50 percent of wetland owners and managers).

Adoption of management practices reflects benefits from wetlands (maintenance of vegetation) and costs of wetlands (88 percent reported some degree of feral animal problem and 75 percent a weed problem). The least commonly adopted strategies were fire prevention, directing saline drainage away from wetlands and restoration of wetland basins or habitat. The low adoption rate of fire prevention reflects the 62 percent of respondents indicating their wetlands are natural fire breaks. The low protective drainage and restoration adoption rates reflect the current construction of a regional salinity and flood management drainage network. Many respondents are awaiting its completion to either facilitate restoration and/or re-direction of saline drainage.

## 4.7 Perceived costs and benefits of wetland management practices

Management decisions are likely to be based on the type and quantity of expected benefits and costs arising from alternative management strategies. Hypotheses 1 to 4 indicated that wetland benefits and costs are both monetary and non-monetary in nature. The monetary returns from wetland management can either be immediate (via increased cash returns from livestock) or in the future (via increased property values or avoided land degradation) and can result from highly consumptive uses (timber extraction) or less consumptive uses (eco-tourism).

The types of financial returns expected by respondents are reported in Table 11. In summary, 45 percent of respondents, or over half of those adopting management practices (65 percent), expected financial benefits from wetland management activities. Of those respondents expecting financial benefits, nearly all (91 percent) expected increased market value of their properties and approximately half expected improved pasture growth or health and hence livestock growth. Less than ten percent of respondents expecting benefits felt that they would receive financial benefits from hunting, fishing, new industries or timber sales.

***Table 11: Expected benefits of wetland management actions***

| **Type of financial benefit expected** | **Of all surveys** | **Of respondents undertaking management** | **Of respondents Expecting benefits** |
|---|---|---|---|
| Increased market value of your property | 41% | 56% | 91% |
| Reduction in the need for insect pest control | 14% | 19% | 32% |
| Increased growth rate of cattle/sheep | 22% | 31% | 50% |
| Increased pasture/crop yield in paddocks adjacent to wetland | 27% | 36% | 59% |
| Reduced need for general pest control | 10% | 14% | 23% |
| Increase in quality/health of pastures/crops | 27% | 36% | 59% |
| Income from hunting / hunters | 4% | 6% | 9% |
| Income from fishing / fishers | 2% | 3% | 5% |
| Sales of firewood / farm timber | 2% | 3% | 5% |
| Sales of sawn timber | 2% | 3% | 5% |
| Farm stay tourism | 8% | 11% | 18% |
| Guided / unguided eco-tourism | 12% | 17% | 27% |
| Reduced costs from soil salinity | 18% | 25% | 41% |
| Development of new industries using wetland outputs | 4% | 6% | 9% |
| Respondents expecting financial benefits | 45% | 65% | 100% |

From Table 11 it can be concluded that a significant proportion of wetland owners and managers expect financial benefits from undertaking wetland management practices. It cannot be directly concluded whether financial benefits directly influence the decision to adopt or whether they are peripheral. That is, to draw a conclusion regarding hypothesis 9, more information is required regarding farmer decision making.

In Table 12 respondent perceptions regarding the impact of wetland management strategies on farm viability are reported. Excluding stock from wetlands is expected to reduce farm viability by 50 percent of respondents while around a quarter of respondents believe restoring wetland basins and measures to encourage native wildlife result in reduced farm viability. Approximately 80 percent of respondents indicated management of saline drainage would improve farm viability, however adoption of these strategies is very low (16 percent and 27 percent respectively). This is due to managers awaiting construction of an integrated dryland salinity and flood management drainage scheme (currently under construction) either prior to, or to facilitate, altering management. Additional strategies leading to increased farm viability included developing a farm management

plan (42 percent), control of weeds in wetlands (41 percent), control of feral animals (33 percent), vegetation maintenance and revegetation (approximately 30 percent).

***Table 12: Monetary impact of alternative wetland management practices***

| **Management Practice** | **Effect on farm viability** | | |
|---|---|---|---|
| | Decrease | No change | Increase |
| Exclude stock from wetland | 49% | 40% | 11% |
| Manage grazing access to wetland | 13% | 77% | 10% |
| Facilities to water stock away from wetland | 9% | 82% | 9% |
| Maintain native vegetation around wetland | 11% | 62% | 27% |
| Maintaining a tree/vegetation filtering strip around wetland area | 11% | 57% | 31% |
| Directing saline drainage away from wetland | 8% | 14% | 78% |
| Facility to restore natural wetting and drying of wetland | 6% | 68% | 26% |
| Control of feral animals in wetland | 6% | 61% | 33% |
| Control of weeds in wetland | 6% | 53% | 41% |
| Revegetation using local native species | 11% | 57% | 31% |
| Fire prevention/control around wetland | 6% | 91% | 3% |
| Seeking and implementing management advice on specific problems such as dying trees | 3% | 68% | 29% |
| Preparing a list of plants and animals observed in/near wetland | 3% | 82% | 16% |
| Developing a farm management plan which incorporates wetland conservation initiatives | 16% | 42% | 42% |
| Restoring wetland basins/habitats | 23% | 49% | 28% |
| Measures to encourage native wildlife | 22% | 59% | 20% |
| Drains to manage dryland salinity impacts on wetlands | 8% | 8% | 83% |

***Table 13: Farm viability increases and management practice adoption***

| **Management Practice** | **Percentage expecting an increase in farm viability** | **Proportion (of total) who adopted strategy** | **Chi Square test of association** (p-value) |
|---|---|---|---|
| Exclude stock from wetland | 11% | 35% | 0.300 |
| Manage grazing access to wetland | 10% | 35% | 0.756 |
| Facilities to water stock away from wetland | 9% | 39% | 0.209 |
| Maintain native vegetation around wetland | 27% | 55% | 0.323 |
| Maintaining a tree/vegetation filtering strip around wetland area | 31% | 29% | 0.128 |
| Directing saline drainage away from wetland | 78% | 16% | 0.726 |
| Facility to restore natural wetting and drying of wetland | 26% | 29% | 0.532 |
| Control of feral animals in wetland | 33% | 47% | 0.021 |
| Control of weeds in wetland | 41% | 47% | 0.734 |
| Revegetation using local native species | 31% | 33% | 0.019 |
| Fire prevention/control around wetland | 3% | 14% | - |
| Seeking and implementing management advice on specific problems | 29% | 18% | 0.736 |
| Preparing a list of plants and animals observed in/near wetland | 16% | 29% | 0.814 |
| Develop farm management plan incorporating wetland conservation initiatives | 42% | 27% | 0.006 |
| Restoring wetland basins/habitats | 28% | 22% | 0.258 |
| Measures to encourage native wildlife | 20% | 35% | 0.566 |
| Drains to manage dryland salinity impacts on wetlands | 80% | 27% | 0.389 |

If monetary impacts influence adoption we would expect a relationship between perception of farm viability effect and the rate of adoption. That is, respondents who expect an increase in farm viability would adopt the wetland management practice while those who expect a decrease would not adopt. If the practice is not

perceived to affect farm viability, adoption may proceed due to non-monetary benefits. Hence for monetary impact to influence adoption strongly, it is expected that both a high proportion of respondents adopting would expect an increase in farm viability and vice-versa.

Table 13 shows the proportion of respondents expecting an increase in viability and adopting particular management actions including a chi-square test of association. Significant associations were found for control of feral animals (p=0.021), revegetation (p=0.012) and farm management plan (p=0.006). Neither of the drainage related management strategies were significant despite a large proportion of those respondents adopting the practice perceiving an increase in profitability. This is due to a low actual adoption rate as a proportion of those expecting an increase for the reasons noted above. It is also surprising that weed control is not significant. This may be due to the smaller proportion reporting a severe or moderate weed problem compared to feral animal problems.

It is clear that *monetary impacts of management practices do influence adoption* and hypothesis 9 can be accepted. It is equally clear that monetary impacts of adoption do not always influence adoption. For example some strategies commonly adopted include measures to encourage native wildlife, excluding stock from wetlands and managing grazing access to wetlands. As considered under hypotheses two and four above, wetland owners and managers receive non-monetary costs and benefits from their wetlands. When owners and managers make management decisions about wetlands they also take into account the non-monetary benefits they obtain. As reported in section 4.3 some wetland values can be grouped into non-consumptive, production impacts and indirect impacts. The non-consumptive and indirect impacts are non-monetary and the monetary impact of 'production impacts' is indirect. The 'wetland attitudinal factor scores' are use to represent respondent values for these groups. By examining the association between the wetland attitudinal factor scores and adoption of management practices the association between non-monetary benefits and wetland management decisions the relationship can be tested.

***Table 14: Relationship between wetland attitudes and management practices***

| **Wetland management practice** | **p-values** | | |
|---|---|---|---|
| | **Non-con** | **ID-use** | **P-imp** |
| Exclude stock from wetland | 0.356 | 0.425 | 0.179 |
| Manage grazing access to wetland | 0.099* | 0.001** | 0.184 |
| Facilities to water stock away from wetlands | 0.107 | 0.116 | 0.819 |
| Maintaining native vegetation around wetland | 0.001** | 0.001** | 0.004** |
| Maintaining tree/vegetation filtering strip around wetland | 0.041** | 0.024** | 0.157 |
| Directing saline drainage away from wetland | 0.425 | 0.399 | 0.484 |
| Maintaining a natural wetting / drying regime | 0.004** | 0.010** | 0.019** |
| Control of feral animals in wetland | 0.000** | 0.182 | 0.337 |
| Control of weeds in wetland | 0.004** | 0.212 | 0.122 |
| Revegetation using local native species | 0.004** | 0.019** | 0.041** |
| Fire prevention/control around wetland | 0.768 | 0.349 | 0.553 |
| Seeking and implementing management advice on specific problems such as dying trees | 0.086* | 0.137 | 0.535 |
| Preparing a list of plants and animals observed in/near the wetland | 0.002** | 0.011** | 0.082* |
| Developing a farm management plan which incorporates wetland conservation initiatives | 0.004** | 0.003** | 0.111 |
| Restoring wetland basins/habitat | 0.009** | 0.006** | 0.010** |
| Measures to encourage native wildlife | 0.002** | 0.002** | 0.021** |
| Drains to manage dryland salinity impacts on wetlands | 0.187 | 0.526 | 0.050** |
| Total respondents undertaking wetland management practices | 0.000** | 0.001** | 0.217 |

** Indicates significance at the 5% level.
* Indicates significance at the 10% level.

Table 14 reports the results of ANOVAs between the wetland attitudinal factor scores and wetland management practices. In aggregate, only production implication does not show a significant difference in means. That is, respondents who expressed positive non-consumptive and/or indirect use attitudes are more likely to adopt wetland management practices. Productivity implication's lack of significance is probably due to the indirect nature of the benefits and a lack of direct management influence by individual respondents over the constituent variables (flood control and prevention of salting). Significant relationships exist between several variables for

all three factors (maintain native vegetation, natural wetting drying, list of plants and animals, restoring wetland basins and measures to encourage native wildlife). That is, respondents with positive attitudes towards factors are more likely to adopt these particular management practices. The set of practices (maintain native vegetation, natural wetting drying, list of plants and animals, restoring wetland basins and measures to encourage native wildlife) comprises all the remaining commonly adopted management practices with the exception of excluding stock. Hence hypothesis 10 can also be accepted: *non-monetary impacts influence adoption of wetland management practices*.

The results in Table 14 also indicate that management practices influenced by monetary benefits (hypothesis 9) may also be influenced by non-monetary impacts. For example, revegetation is related to all factor scores, farm management plan to two (Non-con and ID-use) and control of feral animals to one (Non-con use). Hence non-monetary values are also influential in the adoption of some management practices with monetary benefits. The joint significance of monetary and non-monetary influences on the adoption of wetland management practices indicates the duality of goals (monetary and non-monetary benefits) faced by farmers when undertaking wetland management decisions.

## 4.8 Overall impact of wetlands

Wetland owners and managers receive both monetary and non-monetary benefits from their wetlands. Wetland owners and managers implement management strategies to enhance, alter or maintain wetland benefits. The choice of management strategies is influenced by both the expected monetary and non-monetary benefits. Hence wetland owners undertake a variety of management strategies, both influenced by, and receiving monetary and non-monetary benefits. That is, wetland managers are influenced by a duality of monetary and non-monetary goals when managing their wetlands. Maximisation of either goal (monetary returns or non-monetary benefits) may require compromising the other goal to some extent. For example, maximising grazing returns is likely to reduce the recreational benefits from wetland areas while maximising timber returns will reduce native flora and fauna and the scenic beauty.

Wetland owners and managers express the conflict between their dual management goals in a variety of ways. For example wetland owners and managers were asked what impact draining their wetlands would have on the long-term profitability of their farm (illegal in SA):

| | |
|---|---|
| Profits increase more than 10% | 43% |
| Profits increase 5% | 22% |
| No change in profits | 22% |
| Profits decrease 5% | 2% |
| Profits decrease more than 10% | 10% |

In total 65 percent of respondents indicated that if their wetlands were drained, farm profitability (monetary benefits) would increase. Similarly respondents indicated wetlands have an impact on their property values:

| | |
|---|---|
| Property values reduced more than 10% | 44% |
| Property values reduced 5% | 14% |
| No effect on property values | 20% |
| Property values increased | 22% |

Hence respondents indicated that the presence of wetlands reduced the monetary benefits they were able to obtain from their properties.

When asked to consider all the monetary and non-monetary benefits and costs of their wetlands:

| | |
|---|---|
| 49% | Regarded their wetlands as an asset; |
| 18% | Regarded their wetlands as neither; and, |
| 33% | Regarded their wetlands as a liability. |

Some respondents continue to regard their wetlands positively despite recognising that they are foregoing monetary benefits. That is, they are receiving non-monetary benefits in excess of their monetary opportunity costs. These trade-offs are more clearly defined in Table 15. Fourteen percent of respondents regard their wetlands as an asset despite recognising they reduce property values. Twelve percent indicated wetlands reduce property values (reducing monetary returns) but regard their wetlands as neither an asset nor a liability, hence

the wetland benefits are sufficient to cancel out. Another 14 percent regard their wetlands as an asset but suggest no change in property values indicating that the wetland benefits exceed the monetary costs. Hence a total of 40 percent of respondents indicate wetland benefits exceed the monetary cost to property values.

***Table 15: Wetland trade-offs***

| | Net impact of wetlands | | |
|---|---|---|---|
| **Wetland impact on property values** | Asset | Neither | Liability |
| Reduces property value | 14% | 12% | 32% |
| No effect on property value | 14% | 4% | 2% |
| Increases property value | 20% | 2% | - |
| *Pearson Chi-square 18.549 (p=0.001)* | | | |
| | | | |
| **If wetlands drained:** | Asset | Neither | Liability |
| Profits would increase | 20% | 12% | 33% |
| No Change | 18% | 4% | - |
| Profits would decrease | 10% | 2% | - |
| *Pearson Chi-Square 14.433 (p=0.006)* | | | |

Similarly, Table 15 also shows 50 percent of respondents attested that the monetary and non-monetary benefits arising from wetlands exceed the monetary benefits available if their wetlands were drained. Both results are significant at the one- percent level using Chi-square tests of association. Hence we can accept hypothesis 11: *wetland managers trade-off monetary and non-monetary benefits and costs when making decisions about wetlands.*

A cross tabulation between grazing use and net benefits of wetlands, reported in Table 16, reveals additional information about the trade-offs made by wetland owners and managers. Respondents who never graze their wetlands indicated their wetlands were an asset or neither an asset nor a liability. These respondents also reported no timber or water extraction (but one respondent used their wetlands as an endpoint of farm drainage). For these respondents the benefits of wetlands relate to non-monetary uses (except one respondent who reported commercial eco-tourism and hunting). Respondents who only graze wetlands when completely dry show the opposite response. For this group, profits increase if their wetlands were drained and the opportunity cost of wetlands exceeds the benefits. Respondents who seasonally or unrestricted graze exhibit a cross section of responses. These respondents are obtaining both monetary and non-monetary benefits from their wetlands. In some cases, their net benefits are positive (overall an asset), and in others negative (overall a liability). Again the chi-square test is significant at 5 percent.

***Table 16: Grazing use and net benefits of wetlands***

| | Net impact of wetlands | | |
|---|---|---|---|
| **Grazing use of wetlands** | Asset | Neither | Liability |
| Unrestricted | 16% | 8% | 12% |
| Seasonally grazed | 22% | 6% | 8% |
| Only grazed when completely dry | 2% | - | 14% |
| Never grazed | 10% | 4% | - |
| *Pearson Chi-square 15.658 (p=0.016)* | | | |

***Table 17: Wetland management actions and impact of wetlands***

| | Wetland management actions | |
|---|---|---|
| **Net impact of wetlands** | Yes | No |
| Asset | 88% | 12% |
| Neither | 67% | 33% |
| Liability | 56% | 44% |
| *Pearson Chi-square 5.071 (p=0.079)* | | |

The trade-off between monetary and non-monetary benefits of wetlands is also important for owners making decisions about wetland management practices. Management practices are directed at maintaining or altering the costs and benefits arising from wetlands. The management practices discussed are directed at maintaining or conserving wetland areas. Hence, it could be expected that wetland owners who regard the net benefits of wetlands as positive will be more likely to make trade-offs in favour adopting management practices. Table 17 indicates that this is the case for USE wetland owners and managers. Overall 88 percent of respondents who regard their wetlands as an asset undertake management practices while only 56 percent of those regarding their

wetlands as a liability undertake such actions. The chi square test is significant at the 10 percent level in this case.

## 4.9 Socio-economic influences on adoption of wetland management practices

Decisions about wetland management practices are influenced by monetary and non-monetary benefits. Other factors may also influence adoption of wetland management practices, in particular socio-economic factors. Differences in physical constraints such as wetland type and size or total property production may also reveal important influences on management decisions. Although socio-economic factors do not influence wetland values (as concluded from hypothesis 8) they may influence respondents' views about the benefits of wetland management practices. For example, different levels of education may alter perceptions regarding the outcome of restoring a wetland basin. Economic influences may also be revealed indirectly. For example, respondents with large wetland areas may be more likely to exclude stock from some wetland areas as they form a relatively small part of total farm production. Likewise, respondents with smaller total production may be less likely to restore wetlands due to the relatively greater impact on farm production. Management practices may not be applied to particular wetland types. This may be because they are unsuitable (for example fire prevention or control on shallow open water) or because expected benefits differ (for example wildlife may be plentiful and easy to enjoy in Red gum wetlands but difficult to see or enjoy in Tea-tree wetlands).

The potential influence of socio-economic factors and of physical management factors was assessed using a logit regression of respondents undertaking each management practice. Use of logit regressions facilitates analysis of dichotomous dependent variables relating to adoption of management strategies. The logit regression performance statistics are reported in Table 18 and the logit regression results in Table 19. Due to the large number of management practices and the identical candidates for explanatory variables the analysis was conducted using stepwise methodology (using forward likelihood ratio selection criteria).

***Table 18: Logit model performance statistics***

| **Dependent variable** | **Number of observations** | **Model Log Likelihood** | **McFadden's $\rho^2$** | **Pseudo $\rho^2$** | **Overall percent correct** |
|---|---|---|---|---|---|
| Exclude stock from wetland | 45 | 34.627 | 0.396 | 0.465 | 82% |
| Manage grazing access to wetland | 45 | 48.676 | 0.169 | 0.203 | 71% |
| Facilities to water stock away from wetland | 45 | 57.111 | 0.057 | 0.090 | 62% |
| Maintain native vegetation around wetland | 45 | 48.163 | 0.221 | 0.270 | 71% |
| Maintain tree/vegetation filtering strip around wetland | 45 | 42.135 | 0.193 | 0.250 | 78% |
| Directing saline drainage away from wetland | 45 | 38.900 | 0.000 | 0.026 | 84% |
| Maintain a natural wetting /drying regime | 45 | 34.030 | 0.348 | 0.425 | 87% |
| Control feral animals in wetland | 45 | 62.361 | 0.000 | 0.016 | 51% |
| Control weeds in wetland | 45 | 62.361 | 0.000 | 0.016 | 51% |
| Revegetation using local native species | 45 | 40.005 | 0.283 | 0.355 | 78% |
| Fire prevention / control in wetland | 45 | 33.936 | 0.128 | 0.179 | 84% |
| Seeking and implementing management advice on specific problems | 45 | 37.173 | 0.117 | 0.165 | 82% |
| List of plants and animals in wetland | 45 | 38.277 | 0.267 | 0.324 | 80% |
| Developing a farm management plan incorporating wetland conservation | 45 | 32.046 | 0.360 | 0.440 | 84% |
| Restoring wetland basins / habitat | 45 | 23.594 | 0.476 | 0.587 | 93% |
| Measures to encourage native wildlife | 45 | 46.273 | 0.192 | 0.245 | 80% |
| Drains to manage dryland salinity impacts on wetlands | 45 | 52.192 | 0.000 | 0.019 | 73% |
| **All wetland management practices** | 45 | 41.368 | 0.174 | 0.233 | 78% |
| **Expecting benefits from management** | 44 | 54.355 | 0.108 | 0.157 | 66% |

The logit model performance statistics indicate a range of goodness of fit from extremely good to very poor. Hensher and Johnson (1981, p.51) state 'values of [McFadden's] $\rho^2$ between 0.2 and 0.4 are considered extremely good fits'. Ten of the seventeen logit regressions of management practices possess pseudo $\rho^2$ (McFadden's $\rho^2$ adjusted for number of explanatory variables) less than 0.2 and only seven less than 0.15. Three of the seven management practices with $\rho^2$ less than 0.15 are the most commonly adopted and hence likely to be adopted at some level by all socio-economic classes. Three management practices are adopted at very low levels (less than 20 percent) potentially providing insufficient information for discrimination. Two management practices (one with a low adoption rate) are complicated by outside influences (construction of a dryland salinity and flood management drainage scheme). Key management practices such as excluding stock, revegetation, farm management plans and restoration of wetland basins all possess good to extremely good fits.

***Table 19: Parameter estimates for regressions of management practice***

| **Dependent variable** | **Constant** | **Red gum wetlands** | **Tea-tree wetlands** | **Shallow open water** | **Large wetland area** | **Small wetland area** | **Large total DSE** | **Small total DSE** | **Level of education** | **Full time farmer** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Exclude stock from wetland** | -5.361 | | | -1.787 | 2.801 | | | | 1.321 | |
| | (0.006) | | | (0.056) | (0.010) | | | | (0.007) | |
| **Manage grazing access to wetland** | 1.295 | | | -1.909 | | | | | -0.389 | |
| | (0.136) | | | (0.014) | | | | | 0.104 | |
| **Facilities to water stock away from wetland** | 0.080 | | | -1.179 | | | | | | |
| | (0.842) | | | (0.080) | | | | | | |
| **Maintain native vegetation around wetland** | -2.257 | 1.808 | 2.526 | | | | | | | |
| | (0.015) | (0.034) | (0.006) | | | | | | | |
| **Maintain tree/vegetation filtering strip around wetland** | -3.672 | 1.838 | 2.230 | | | | | | | |
| | (0.003) | (0.019) | (0.056) | | | | | | | |
| **Directing saline drainage away from wetland** | -1.692 | | | | | | | | | |
| | (0.000) | | | | | | | | | |
| **Maintain a natural wetting /drying regime** | -4.339 | 2.530 | 1.947 | | | | 1.889 | | | |
| | (0.001) | (0.007) | (0.110) | | | | (0.062) | | | |
| **Control feral animals in wetland** | -0.045 | | | | | | | | | |
| | (0.882) | | | | | | | | | |
| **Control weeds in wetland** | -0.045 | | | | | | | | | |
| | (0.882) | | | | | | | | | |
| **Revegetation using local native species** | -1.224 | 2.464 | | | | -2.190 | | | | -0.783 |
| | (0.036) | (0.004) | | | | (0.095) | | | | (0.102) |
| **Fire prevention / control in wetland** | -2.367 | | | | | | 1.962 | | | |
| | (0.000) | | | | | | (0.027) | | | |
| **Seeking and implementing management advice on specific problems** | -2.526 | 1.833 | | | | | | | | |
| | (0.001) | (0.039) | | | | | | | | |
| **List of plants and animals in wetland** | -3.238 | 2.628 | | | 2.875 | | | | | |
| | (0.002) | (0.019) | | | (0.013) | | | | | |
| **Developing a farm management plan incorporating wetland conservation** | -5.961 | | 2.196 | | | | | | 1.116 | -1.731 |
| | (0.016) | | (0.091) | | | | | | (0.042) | (0.011) |
| **Restoring wetland basins / habitat** | -9.412 | | 10.649 | | -3.072 | | | -2.571 | | -1.123 |
| | (0.818) | | (0.795) | | (0.021) | | | (0.051) | | (0.088) |
| **Measures to encourage native wildlife** | -2.976 | 2.015 | 1.784 | | | | | | | |
| | (0.003) | (0.008) | (0.060) | | | | | | | |
| **Drains to manage dryland salinity impacts on wetlands** | -1.012 | | | | | | | | | |
| | (0.003) | | | | | | | | | |
| Note dependent changes from 0-1 to 1=yes, no=2 hence wetland type is negative | | | | | | | | | | |
| **All wetland management practices** | 0.623 | -1.772 | -1.878 | | | | | | | |
| | (0.389) | (0.062) | (0.172) | | | | | | | |
| **Expecting benefits from wetland management practices** (as for 8a Y/N) | 0.439 | -1.628 | | | | 1.764 | | | | |
| | (0.278) | (0.032) | | | | (0.090) | | | | |

Note: Figures in brackets are probabilities for significance levels.

Explanatory variables used in the regressions were wetland type, dummy variables for small and large wetland areas, small and large total productivity as measured by carrying capacity in DSE (both approximately the lower and upper quartiles), education and a dummy variable for non full time farming or outside employment. Explanatory variables generally have the expected sign and are significant at the 10 percent level. As expected wetland type influences decisions about most management practices. Wetland size influences decisions to exclude stock, compile a list of plants and animals (large wetlands increase probability), restore wetland basins (large wetland areas negatively influence probability) and revegetate (small wetland areas reduce probability). Total productivity influences decisions to maintain natural wetting and drying (large dse increase probability) and restore wetland basins (small dse reduces probability). Tertiary (higher level) qualifications increase the probability of excluding stock and developing a farm management plan. Non-full time farmers were less likely to revegetate, develop a farm management plan or restore wetlands. The regression results indicate hypothesis 12 can be accepted: *adoption of wetland management practices is influenced by physical and socio-economic factors.*

# 5 Policy considerations

Wetland owners and managers in the USE of SA receive monetary and non-monetary benefits and costs from their wetlands. The monetary and non-monetary costs and benefits influence wetland owners and managers when making decisions about wetlands. However, the decisions made by wetland owners and managers also have implications for the benefits enjoyed by the wider community. Hence the community may wish to influence decisions made by owners and managers of privately owned wetlands. Therefore some direct policy considerations for the USE of SA are discussed in this section. A detailed analysis of potential wetland policy will be presented in a later research report.

Wetland policy can alter the structure of benefits and costs within which wetland owners and managers make decisions. In particular wetland policy can change the balance between benefits and costs. At the extreme, wetland policy directly constrains wetland management practices or uses. For example wetland owners and managers in South Australia are no longer legally allowed to clear and drain wetlands and in New South Wales it is illegal to hunt ducks (except when declared a pest). Less intrusive policy mechanisms focus on altering wetland owner and manager incentives rather than restricting uses. For example grants of materials and/or subsidies for fencing and local government rate rebates. Often incentives are focused on either eliminating or achieving specific management practices. The policy analysis in this paper focuses on these less intrusive, incentive based, mechanisms as these are more easily targeted towards specifically desired outcomes.

## 5.1 Wetland management incentives

USE wetland owners and managers receive both monetary and non-monetary benefits from their wetlands. Both monetary and non-monetary impacts of management practices influence adoption. Hence effective incentives can target monetary benefits, non-monetary benefits or a combination. There is a number of wetland management related incentives currently available to USE wetland owners and managers. Incentives are provided at three levels; Commonwealth (for example the Landcare income tax rebate); State (for example free management advice); and, local/regional (for example rate and drainage levy rebates). Three main incentive questions require answering before any policy conclusions can be drawn, namely:

1. What incentives are currently available?
2. Are these incentives used?
3. Do these incentives influence management decisions?

Incentives available to USE wetland owners and managers are reported in Table 20. Not all the incentives contained in Table 20 are directed specifically at wetland management. For example Landcare income tax rebates are directed towards prevention of land degradation and historically have not applied to non-agricultural land. Landcare incentives aim to decrease the monetary costs to owners and managers and reduce the costs imposed on the community.

Many of the incentives require particular wetland management strategies. For example local council rate rebates, drainage levy rebates[3], and heritage agreements are only available for non-agricultural land, while

[3] A local government rate rebate applies to land covered by a heritage agreement in SA. Drainage levy rebates apply to heritage agreement land, areas of native vegetation greater than 40 hectares and wetlands with a

government grants are often dependent on adoption of specific management strategies. The objective of these incentives is to increase community benefits by reducing the opportunity costs faced by wetland owners and managers (they also increase the non-monetary benefits). Grants of materials under SA vegetation heritage agreements and revegetation grants are directly targeted towards achieving changed management practices. The aim is to reduce owner and manager monetary costs (hence increasing net benefits) while increasing community benefits.

Table 20 shows the total proportion of respondents, and the proportion of respondents undertaking wetland management practices, claiming each incentive.[4] A third of all respondents and nearly half of those respondents undertaking wetland management receive at least one incentive. The most commonly claimed incentives are local council rate rebates and drainage levy rebates followed by free management advice. Only one respondent claimed a land degradation tax deduction, no respondent claimed a tax rebate for wetland conservation related incentives. Landholders must either earn less than a certain amount but still have sufficient cash flow to pay for Landcare works to qualify for a rebate or, alternatively, they must earn beyond the taxable threshold to claim a deduction. Hence the proportion of landholders qualifying for tax rebates or deductions may be small. Australian Bureau of Agricultural and Resource Economics (ABARE) data indicates negative 'average farm business profit' for two of the last three available years (ABARE 1997).

***Table 20: Incentives received for wetland management***

| **Type of incentive** | **Proportion of all respondents** | **Proportion of wetland managers** |
|---|---|---|
| Landcare tax rebate or land degradation tax deduction | 2% | 3% |
| Local council rate rebate | 12% | 16% |
| Materials under South Australian Vegetation Heritage Agreements | 6% | 8% |
| Free management advice from government agencies | 10% | 14% |
| Grants from Natural Heritage Trust | 2% | 3% |
| Revegetation grants | 2% | 3% |
| Drainage levy rebate | 16% | 22% |
| Other government grants/ financial assistance | 2% | 3% |
| Local Landcare group demonstration project | 4% | 5% |
| Other incentives | 4% | 5% |
| Total receiving incentives for wetland management | 33% | 46% |

It is difficult to assess the impact of incentives on adoption of alternative management strategies. Many of the potential incentives preclude or specify certain management practices. For example, only three of the 15 respondents receiving incentives did not exclude stock from their wetlands indicating a strong linkage. Chi-square tests of association were conducted between adoption of management strategies and whether incentives were claimed. Results indicate an association between incentives and exclusion of stock, facilities to water stock away from wetlands, revegetation, wetland restoration and water regime, measures to encourage native wildlife and list of plants and animals (all significant at the five percent level). However, as only respondents undertaking management practices are able to receive incentives, these tests are likely to be biased. Specifically the association between particular incentives and adoption of particular practices cannot be tested from our survey data.

An alternative approach is to examine the constraints to further adoption of wetland management practices, shown in Table 21. If it is assumed that all management strategies increase the benefits to the community from wetlands, the most important constraint to greater adoption of wetland practices appears to be a lack of interest. Lack of interest or non-applicability accounts for between half and three quarters of all respondents not adopting specific management practices. The second most important constraint is the financial cost or impact on profits of adopting particular management strategies.

management plan that includes fencing out stock and eliminating grazing. Drainage levy rebates refund the levy undertaken to facilitate construction of a regional dryland salinity and flood management scheme.

[4] The Wetlands Waterlink and Salt to Success programs in the USE region have recently commenced offering a greater range of incentives for wetlands management since the survey was undertaken.

***Table 21: Constraint to adoption of wetland management practices***

| Management practice | AA | C or P | TC | KC | NA |
|---|---|---|---|---|---|
| Exclude stock from wetland | 33% | 53% | 2% | 0% | 44% |
| Manage grazing access to wetland | 33% | 45% | 3% | 0% | 52% |
| Facilities to water stock away from wetland | 37% | 23% | 0% | 0% | 77% |
| Maintain native vegetation around wetland | 53% | 44% | 4% | 8% | 44% |
| Maintaining a tree/vegetation filtering strip around wetland area | 27% | 38% | 7% | 10% | 45% |
| Directing saline drainage away from wetland | 16% | 27% | 8% | 8% | 57% |
| Facility to restore natural wetting and drying of wetland | 27% | 19% | 6% | 10% | 65% |
| Control of feral animals in wetland | 45% | 13% | 13% | 4% | 71% |
| Control of weeds in wetland | 45% | 5% | 9% | 5% | 82% |
| Revegetation using local native species | 31% | 32% | 15% | 0% | 54% |
| Fire prevention/control around wetland | 14% | 3% | 12% | 6% | 79% |
| Management advice on specific problems such as dying trees | 18% | 6% | 9% | 12% | 73% |
| Preparing a list of plants and animals observed in/near wetland | 27% | 3% | 28% | 14% | 56% |
| Farm management plan incorporating wetland conservation initiatives | 25% | 16% | 22% | 16% | 46% |
| Restoring wetland basins/habitats | 22% | 28% | 11% | 6% | 56% |
| Measures to encourage native wildlife | 33% | 10% | 13% | 13% | 65% |
| Drains to manage dryland salinity impacts on wetlands | 25% | 29% | 7% | 11% | 54% |

***Key:***
AA = Already adopted
C or P = Cost or profit constraint
TC = Time constrain
KC = Knowledge constraint
NA = Will not adopt as either not interested or not applicable

Additional information regarding adoption constraints is given by respondent requests for particular incentives. Incentive types nominated included:

- Financial assistance (30%);
- Federal or local tax breaks (28%);
- Fencing assistance (25%);
- Completion of regional dryland salinity and flood management scheme (20%);
- Wetland or property management training/assistance (16%); and ,
- Revegetation Assistance (12%).

The majority of incentives requested were either monetary or cost reducing. Hence wetland owners and managers seek to increase the monetary benefits of wetlands as compensation for increasing non-monetary benefits to the community and themselves. The relatively high proportion of respondents desiring tax breaks indicates either a lack of knowledge regarding the available rebates and deductions or difficulty in qualifying as noted previously.

## 5.2 Conclusions

USE wetland owners and managers receive both monetary and non-monetary benefits and costs from owning wetlands. The monetary and non-monetary benefits and costs of their wetlands are traded-off when making decisions about wetland management practices. The benefits and costs of wetlands are influenced by wetland type. Likewise wetland type influences management decisions together with physical operating constraints and socio-economic factors. Alternative wetland management practices change the type and level of benefits and costs available to wetland owners and managers and to the wider community. Hence the community may desire to influence management decisions about wetland use in order to improve the level of overall societal net benefit.

Wetland policy influences the decisions made by wetland owners and managers by altering the trade-offs they face. That is, by altering monetary or non-monetary costs or benefits of particular wetland management

practices. For example, fencing subsidies reduce the cost of management practices such as excluding stock, managing grazing access, maintaining fringe vegetation and revegetation. Alternatively, development of tourist infrastructure and promotion of wetland based farm stay or eco-tourism increases the potential monetary benefits available from wetlands. Hence such policies increase the monetary benefits of management practices such as measures to encourage native wildlife and maintaining a natural wetting and drying regime.

Incentives should be based on achieving resource allocations desired by the community. That is, incentives need to be linked directly, or indirectly, to management practices promoting resource allocations preferred by society. Appropriate incentives differ depending on the aim and scope of wetland policy. For example fencing subsidies are relatively direct, immediate and can be targeted (to specific wetland types, landholder classes etc.). Hence such policies are suited to a local or regional level. Other policies such as promotion of tourism or development of infrastructure are indirect, longer term and difficult to target towards small regions or groups. Consequently these types of policies are more suitable to State or Commonwealth levels.

Finally, effective incentives need to be focused on key constraints to adoption of targeted management practices. Wetland policy that ignores the physical, financial or other constraints experienced by wetland owners and managers will not succeed. In the USE, while wetland owners and managers clearly receive non-monetary wetland benefits, their financial constraints may well be binding. For example, there is little point in providing tourist infrastructure when financial constraints prevent conversion from conventional agriculture to farm-stay or eco-tourism. However, ignoring the substantial non-monetary benefits received by landholders and traded-off when making decisions about wetland management could result in unnecessary incentives and waste of scarce resources. A key outcome of the study is to emphasise the importance of finding ways in which wetland owners and managers can convert non-monetary wetland benefits into monetary benefits.

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