DRYLAND SALINITY IN NEW SOUTH WALES

LANDHOLDER AWARENESS AND ECONOMIC FACTORS

B. SAPPIDEEN

SOIL CONSERVATION SERVICE OF NEW SOTH WALES

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EXECUTIVE SUMMARY

Dryland salinity is a form of land degradation with significant site and catchment effects. Saline seepage though responsible for only 10% of dryland salinity in Australia, is by far the more serious when compared to saline scalds due to its impact on agricultural productivity, land values and other off site effects costing around 180 million dollars (WPDSA 1982). In NSW it is emerging as a major form of land degradation affecting around 14,000ha and spreading at an estimated annual rate of 2%.

The Yass Salinity Abatement Demonstration Program (YSADP), is a four year program to demonstrate viable land management practices to control dryland salinity within the Murray-Darling basin. An early objective of the above program was to identify current levels of knowledge amongst landholders of the main issues relating to dryland salinity such as causal factors, control measures, land use and management practices.

A landholder survey was conducted in the Yass valley catchment, which has been declared as a project area under Section 10 of the Soil Conservation Act. Two landholder samples, one from the YSADP area - the subcatchment of Dicks, Williams and Back Creeks within the project area and another from the project area itself were interviewed in March-May 1989 using structured questionnaires. The program area has been selected for intensive research and demonstration activities because of its advanced degree of dryland salinisation.

The survey revealed that all landholders were aware of dryland salinity, with many being able to recognise the more obvious signs of salinity such as bare eroding patches and surface salt crusts. On the other hand, there was an apparent lack of knowledge of early salinity symptoms, particularly in the presence of high water tables. Excessive tree removal resulting in high presence of high water tables was recognised as the major cause of dryland salinity, though a clear understanding of this relationship was not evident amongst landholders. Landholders perception of the severity of salinity was dependent on the proportion of their property affected. However, their perception of salinity within this localities and on a wider geographical scale was limited. Nevertheless, it is very promising to note that a favourable attitude exists amongst landholders towards tree planting, pasture improvement and better management levels to overcome salinity. In general landholders in the program area are more aware of salinity issues and are more positive towards its control than their counterparts in the project area. This suggests that the YSADP is having some effect on landholder attitudes in the area.

As livestock farming is the mainstay of the local rural economy grazing pressure on the land will continue. Therefore a proper balance between pasture and tree cover is imperative to keep salinity under control. As current stocking rates appear to be higher than the carrying capacity, continued emphasis on pasture improvement with deep rooted perennial species and a high level of management is necessary to maintain productivity levels and prevent land degradation.

Three indicators, namely, carrying capacity, wool cut per head and gross margin per head were selected to compare the relative performance of farms with and without salinity in the program and project areas. There were no significant differences in carrying capacity or average wool cut per head between farms with and without salinity in either area. Following from the above, wool gross margins are also not significantly different in the presence or absence of salinity on farms. It therefore appears, that salinity at least at current levels, do not significantly influence productivity and income on individual farms due to the small areas affected.

Around two thirds of landholders in the program area and half in the project area derive less than 25% of their total annual income from the farm. This indicates that farming is more of a "hobby" type activity for the above category of landholders. The latter are mostly small holdings averaging between 40ha and 50ha. Being non-primary producers and thereby disqualified from many fiscal incentives, the activities of this group of landholders could have an adverse effect on exacerbating land degradation.

1. INTRODUCTION

Land degradation is the decline in the condition or quality of the land, as a consequence of misuse or overuse. Land degradation occurs in many forms such as soil erosion, mass movement, soil structure decline, soil acidity, water logging, irrigation salinity and dryland salinity. Unless the processess of land degradation are reversed, the land eventually becomes unproductive. Effects multiply from the immediate consequences at a particular site, to affect whole catchments. Dryland salinity is one form of land degradation that has significant site and catchment effects.

1.1 Dryland salinity in Australia

Soil salinity is the accumulation of soluble salts in some parts or all of the profile, irrespective of there ultimate origin and source or of there immediate place of storage. In Australia soil salinity occurs in two main forms - irrigation salinity and dryland salinity.[1] Induced dryland salting - the result of European settlement - is estimated to affect 4.2 million ha in Australia (WPDSA 1982).

Ninety percent of induced salting, covering 3.8 million ha, is scalding, which is the absence of surface cover. This usually results from over-grazing and subsequent erosion of the topsoil to reveal original saline or sodic subsoil. About a third of the problem is found in South Australia with New South Wales, Northern Territory, Queensland and Western Australia respectively being the other states with major outbreaks (table 1).

The other form of induced salinity - saline seepage - though affecting only a smaller extent of land, is from an economic viewpoint by far the more serious of the two. Saline seepage has been estimated to affect around 426,000 ha in Australia. Most severe outbreaks have been recorded in Western Australia (60% of total), Victoria and South Australia.

The effects of saline seepage occur both on site and off site. They include losses in agricultural productivity and land values, damage to landholder infrastructure, public property and utilities such as roads and culverts through sediment deposition, and lowering in water quality due to high salt levels. In economic terms these losses were estimated in 1982 to amount to a decline in capital value of land of $135 million together with an annual decline in productivity of about $16 million and a restoration cost of $34 million (WPDSA 1982).

Inspite of considerable research being done over the last decade to come to grips with the problem, it will be a very long time before any reversal of the processes that cause dryland salinity becomes evident. It is also quite unlikely that it will ever be economic to completely restore all affected lands. However, if further spread of the problem is arrested and continuing economic losses avoided, then significant progress would have been made in coming to terms with a problem described in Australia as a "cancer of the earth" (SCS 1988b).

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[1] The term dryland salinity and salinity are used interchangeably from this point in the report.

LE 1: AREAS OF NON-IRRIGATED SALT-AFFECTED LAND IN AUSTRALIA (in thousands of hectares).

Type	State	Queensland	New South Wales	Victoria	Tasmania	South Australia	Western Australia	Northern Territory	Australia	As a % of total
	Salt Marsh	620	Not estimated	n.e.	3	108	1150	620	2501	7.7
	Salt Pans	950	450	100	0.5	1800	3450	500	10915	33.7
	Salt Flats	8			6	50	3600	nil		
	Saline Seepages	8	4	90	5	55	264	nil	426	1.3
.	Dry Saline Lands (Saline Loams)	n.e.	2364	n.e.	nil	n.e.	2800	n.e.	14780	45.6
.	Dry Saline Lands (Saline Clays)	265		-	-	5100	351	3880		
.	Scalds	582	920	60	-	1200	335	680	3777	11.7
3.	Dry Salinised Land	n.e.	n.e.	nil	nil	n.e.	8	2	10	
9.	All Non-Irrigated Salt-Affected Land	2453	3738	250	14.5	8313	11958	5682+	32409	100
10.	As a percentage of total	7.6	11.5	0.8	<0.1	25.7	36.9	17.5	100.0	

Source: Salting of non-irrigated land in Australia, SCA, Victoria, 1982.

1.2 The New South Wales scenario

Dryland salinity in NSW was seen in the past as a problem "just around the corner". Today it has emerged as a major form of land degradation. Though not as widespread as other forms of land degradation such as wind and water erosion or soil structure decline in terms of land area affected, yet it has the potential to cause significant economic losses.

A recent comprehensive study of land degradation in NSW (Graham 1988) has indicated that dryland salinity is more widespread than previously thought. Around 14,000 ha are affected by saline seepage mainly in the eastern and central divisions, and this area is increasing at an annual rate of 2%. Areas of major outbreaks are Canberra - Yass - Boorowa - Crookwell, the Hunter Valley from Cessnock to Muswellbrook, the Macquarie Valley particularly in the Mudgee - Gulgong district and the Braidwood - Bungonia area (figure 1).

Saline scalds, though affecting a larger land area in NSW are of less serious concern than saline seepage. Current estimates of the area affected by saline scalds are around 920,000 ha (WPDSA 1982, SCS 1988a). However, a general decline in the area affected by scalding has been observed following response to reclamation techniques such as pitting and ponding, reduced grazing pressure and better rabbit control (SCS 1988a).

Economic losses due to dryland salinity are also significant. Though no exact figures are available, land values and productivity losses have been estimated to exceed $20 million per annum (SCS 1988b), whilst prevention and rehabilitation can also be costly. Thus, one approach would be to undertake a demonstration pilot treatment of dryland salinity affected lands within a suitable subcatchment. Such an approach has been adopted in the Yass River Valley catchment in south east NSW and has the potential to demonstrate the benefits of dryland salinity control.

The latter program titled "Yass Salinity Abatement Demonstration Program" (YSADP) is described more fully elsewhere (SCS 1988b). One of the components of the program is to establish a data base through a survey of landholders in the Yass River catchment, so as to set a baseline for assessing the outcome of the project against objective criteria. This component is described in the following Sections.

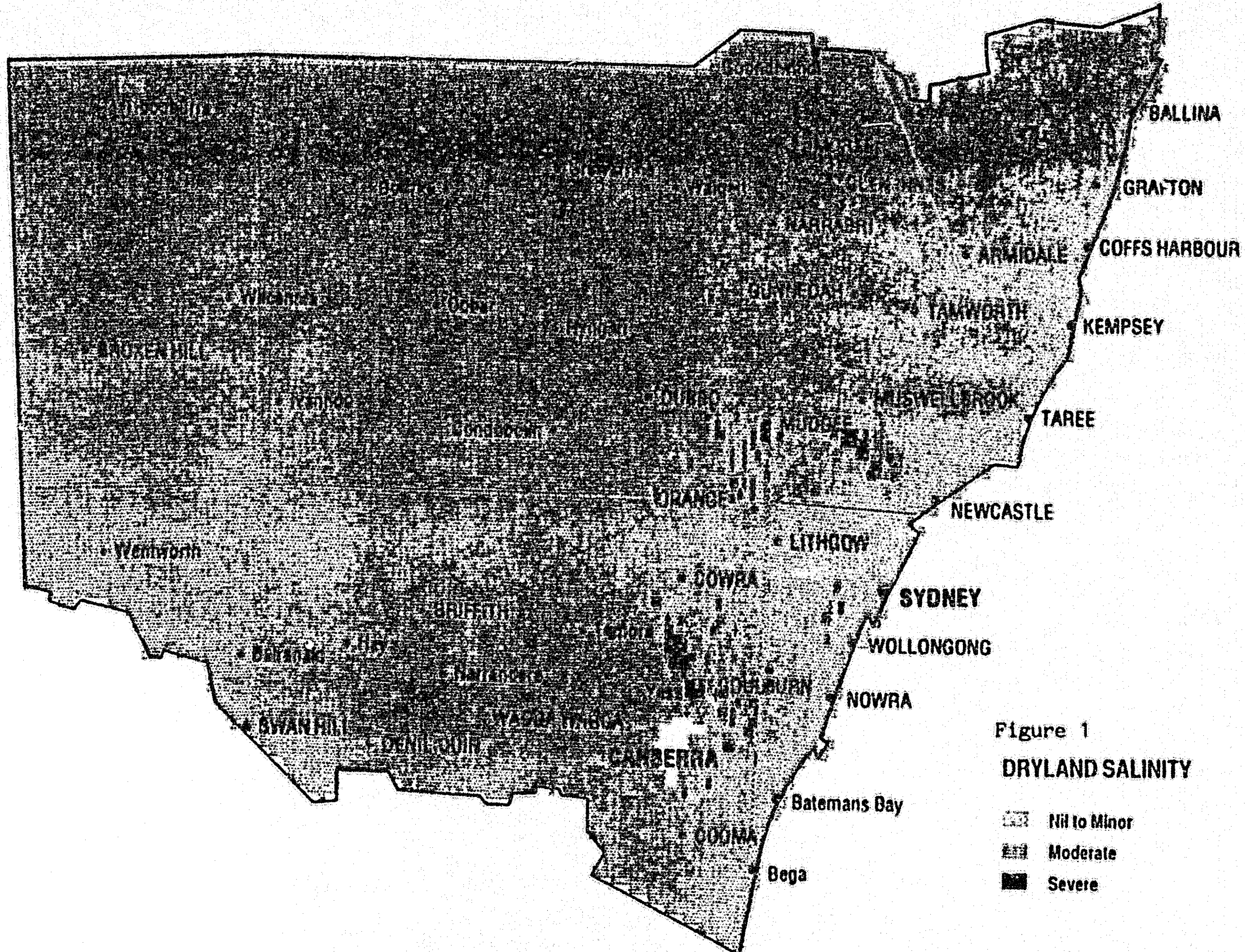

Figure 1

DRYLAND SALINITY

2. METHOD OF STUDY

2.1 Objectives of study

The study thus has two main objectives:-

1. To determine current levels of awareness amongst landholders of issues relating to dryland salinity.

2. To identify the nature of enterprises, management practices and productivity levels in the study area.

2.2 Study area

The study is conducted within the Yass River Valley catchment in south east NSW. The 122,500 ha Yass River catchment consists of 14 subcatchments (table 2) and has been declared as a project area under section 10 of the Soil Conservation Act of 1938 (hereafter referred to as the project area). The YSADP covers one of the subcatchments, Dick's, William's and Back Creeks (hereafter referred to as the program area). This 9,615 ha subcatchment is seriously affected by dryland salinity. It accounts for 5% of the State's total saline seepage problem and represents around 50% of the salt affected areas in the Yass Valley. The study area is described in detail in Wagner (1987). Figure 2 shows the location of the study area, while table 3 illustrates the erosional status in each of the subcatchments.

2.3 The study

For the purpose of study it was decided to take two sets of sample landholders, one sample from the program area (subcatchment of Dick's, William's and Back Creeks) and the second sample from the project area. The objective was to compare the performance of landholders within the program and project areas, particularly in view of the intensified activities within the former area.

Forty eight landholders were selected at random from the program area and 70 landholders from the project area. These numbers represented 57% and 9% of the total number of landholders within the program and project areas respectively.

The survey was conducted by personal interview using structured questionnaires. Data were collected on landholders level of awareness on dryland salinity issues, enterprise patterns, management practices, production costs and productivity levels. On average an interview took about one hour. The survey was conducted between 12 March and 12 May 1989.

The collected data were put into a D-Base III data base and analysed using SAS Version 6.03.

Table 2 - Yass River Catchment - Subcatchments

Sub-Catchment*		Area ha.
1	Manton Creek & Bald Hill Creek	8,494
2	Corregans & Mundoonen Creeks	6,447
3	Misery Hill**	4,552
4	Hickeys, Johnnys & Nowlands Creeks	6,605
5	Kittys & O'Briens Creeks	5,769
6	Murrumbateman Creek	18,655
7	Dicks, Williams & Back Creeks	9,615
8	Nelanglo & Five Mile Creeks	4,905
9	Gundaroo & McLeods Creeks	10,145
10	Talagandra Hill**	2,861
11	Shingle House Creek	14,883
12	Bungendore & Donnellys Creek	6,875
13	Cohens & McLaughlins Creek	10,256
14	Spring Flat Creek	12,468

	YASS RIVER CATCHMENT TOTAL	122,530

* Subcatchments of the smaller streams have been combined to give units of manageable size for soil conservation purposes.

** Misery Hill and Talagandra Hill represent drainage areas with no principally defined stream, draining directly to the Yass River.

Source: Yass Water Supply Catchment Study, 1987.

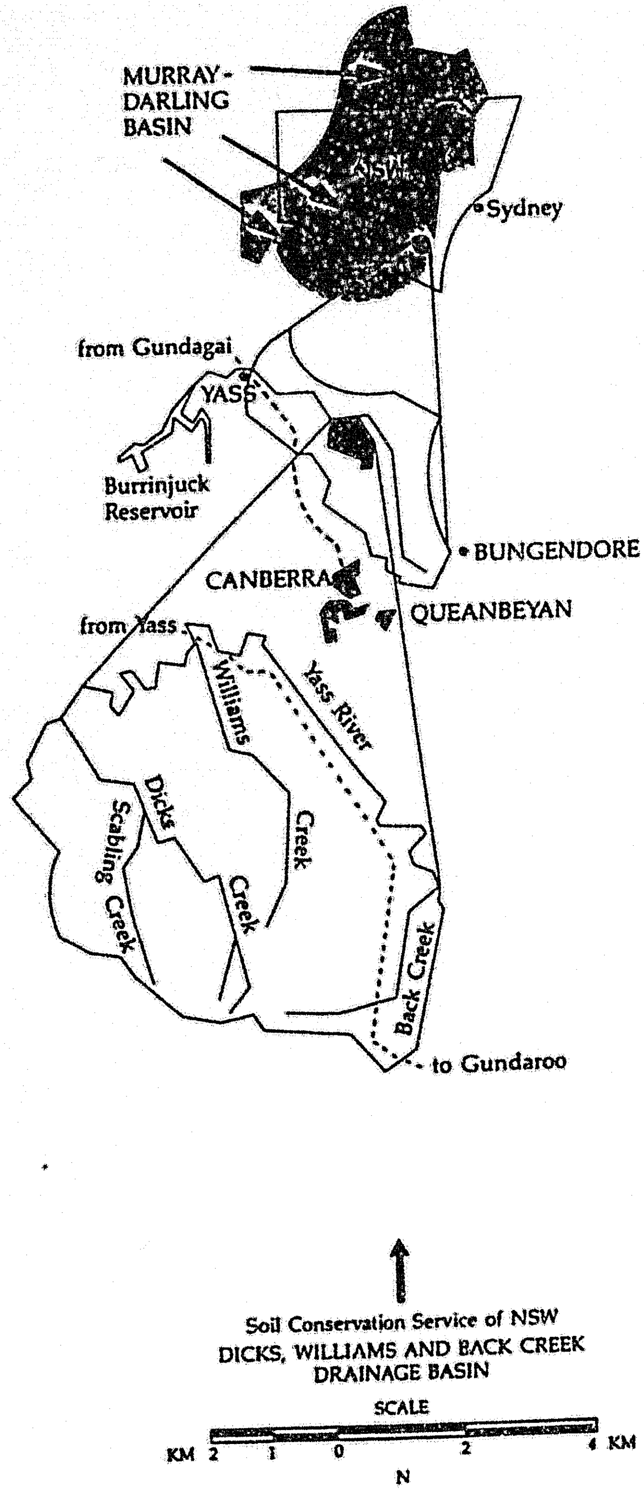

Figure 2 **LOCATION OF THE DICKS, WILLIAMS AND BACK CREEK DEMONSTRATION AREA**

Table 3 - Yass River Catchment Erosion Status*

Sub-Catchments	No	Sheet	Rill	MI Gully	MO Gully	S Gully	VS Gully	Salting	STM Bank	M Move	TOTAL
Manton Creek & Bald Hill Creeks	4413	1489	0	1393	745	111	0	76	239	28	8494
Corregans & Mundoonen Creeks	2072	2648	28	855	465	204	0	0	167	9	6447
Misery Hill	2276	1208	0	483	195	28	0	19	334	9	4552
Hickeys, Johnnys & Nowlands Creeks	2801	2508	0	1013	455	177	149	93	130	0	6605
Kittys & O'Briens Creeks	4682	9	0	465	260	177	0	19	158	0	5729
Murrumbateman Creek	9736	5230	0	1821	604	167	65	130	864	37	18655
Dicks, Williams & Back Creeks	1802	5574	0	948	297	56	0	687	251	0	9615
Nelanglo & Five Mile Creek	1849	1756	0	530	325	37	0	139	260	9	4905
Gundaroo & McLeods Creek	3326	4274	0	1115	632	260	74	0	465	0	10145
Talagandra Hill	1905	409	0	232	93	0	9	65	149	0	2861
Shingle House Creek	5314	5026	0	1997	957	381	214	158	827	9	14883
Bungendore & Donnellys Creeks	2676	1700	0	1059	604	139	214	0	465	19	6875
Cohens & McLaughlins Creeks	3976	3261	0	1579	706	65	74	56	539	0	10256
Spring Flat Creek	6596	3400	0	1245	334	251	37	9	595	0	12468
Total	52704	38492	28	14735	6672	2053	836	1451	5443	120	122530
Percent of Total	43.01	31.41	0.02	12.03	5.45	1.68	0.68	1.18	4.44	0.10	100.00

* EROSION CLASSES The ten classes used are a summary of the thirty five classes defined in the survey.

These are:

1. No Erosion
2. Sheet Erosion
3. Rill Erosion
4. Minor Gully Erosion
5. Moderate Gully Erosion
6. Severe Gully Erosion
7. Very Severe Gully Erosion
8. Salting
9. Stream Bank Erosion
10. Mass Movement

Source: Yass Water Supply Catchment Study, 1987

3. LANDHOLDER AWARENESS OF DRYLAND SALINITY

The earliest sign of salinity damage is often the death of salt sensitive trees. This is followed by changes in pasture composition such as a decrease in clover content and the dominance of more salt tolerant species such as rye grass and barley grass. Eventually the clovers will disappear leaving only the salt tolerant grasses. Finally bare patches appear in the paddock, the topsoil erodes away exposing the subsoil and white crusts of salt become evident on the soil surface. These are the sequential changes indicating the increasing effect of dryland salinity. Unless a landholder is very observant and is aware of the early signs of salinity, the presence of bare patches will be the first signs that he may recognise indicating the presence of salinity on his property.

3.1 Level of Awareness

Three questions were put to landholders to determine their level of awareness of salinity. Landholders were asked how they first became aware of the problem of salinity, the signs of salinity and, if they recognised salinity on their own property how bad they thought the outbreak was.

3.1.1 Awareness of salinity

All landholders were aware of dryland salinity having heard about it prior to this survey. The YSADP was widely publicised in the media and a public meeting of all landholders in the program area was held in September 1988. These two sources were commonly cited by landholders in the program area whilst the media was the main source in the project area (table 4). Apart from the above, other landholders and field observations were also reported as sources of awareness.

Table 4 - Sources of awareness of dryland salinity (percentage of landholders reporting)*

Source	Program Area (N=48)	Project Area (N=70)
1. Media	42	50
2. YSADP	52	17
3. Other Landholders	21	13
4. Other Sources	50	54

* multiple responses permitted

Just over half of the landholders in the program area reported outbreaks of salinity on their own properties compared to 26% in the project area (table 5). This is not surprising as almost half the outbreak in the Yass River Catchment is within the program subcatchment. For convenience of further discussion landholders reporting salinity and no salinity in the program area are identified as groups PM1 and PM2 respectively. Similarly, the salinity and no salinity landholders in the project area are identified as groups PT1 and PT2 respectively.

Table 5 - Landholders perception of the presence and severity of dryland salinity on their properties (percentage of landholders reporting)

Presence of Salinity	Program (N=48)	Project (N=70)
Salinity present	52 (PM1, n=25)	26 (PT1, n=18)
No salinity	48 (PM2, n=23)	74 (PT2, n=52)
Perceived severity of outbreak	**PM1 (n=25)**	**PT1 (n=18)**
Severe	32	17
Moderate	44	44
Minor	24	39

There is also a difference in the perceived severity of salting between the two areas. Of those reporting salinity in the program area, 32% thought salting was serious on their properties with 24% reporting the outbreak as minor. In the project area the trend was reversed with only 17% thinking the problem severe while 39% considered it minor. These figures are also shown in table 5.

Unfortunately, it is not possible to determine how accurately landholders perceive the severity of salinity on their properties. However, from the SCS land capability map (extended to include limitations such as salinity, high water tables etc. as subscripts) we estimated the extent of each property affected with salinity with respect to our sample landholders. These figures are presented in table 6.

Table 6 - Extent of salinity on sample holdings in the program area

No. of holdings affected	Area affected by salinity (ha)	Size of holdings (ha)	Affected area as a % of holding size
8	under 1 (av:0.5)	78 - 480	0.07 - 0.51
5	1.1 - 2.5 (av:1.5)	32 - 259	0.48 - 5.39
3	2.6 - 10.0 (av:6.5)	240 - 472	0.85 - 4.93

Source: Rural Land Capability, YSAD, SCS of NSW August 1989

Table 6 indicates that "perceived severity" is a relative factor depending on the area affected and the size of holding. For instance, salinity outbreaks of around 1.5 ha may represent between 0.48% and 5.39% of the total holding. The latter figure is seen by the landholder as a severe outbreak. On the other hand a salinity outbreak of around 6.5 ha was seen in one case as minor because, less than 1% of the holding was affected.

Following from tables 5 and 6, table 7 shows a comparison of landholder perception of salinity presence in the program area, as against the estimated status as mapped by the SCS.

Table 7 - Comparison of landholder perception of presence of salinity in the program area versus estimated situation as mapped by SCS (no. of landholders reporting, N =48)

	Presence of salinity		Absence of salinity	
Salinity status	as perceived by landholder	as mapped by SCS	as perceived by landholder	as mapped by SCS
1. Salinity present	25	16 (78)*		6 (26)
2. salinity absent			23	5 (22)
3. High water tables		7 (28)		12 (52)
4. No data		2 (8)		
Total	25	25 (100)	23	23 (100)

* figures within parentheses are percentages

Of the 25 landholders (52%) who reported salinity on their properties (group PM1), only 16 (78%) holdings had salinity outbreaks according to the land capability map. These holdings also have high water tables[2]. Of the remaining 9, whilst there were no data on 2, the other 7 properties all had high water tables. Of the 23 landholders (48%) who reported no salinity on their properties (group PM2), 18 (78%) had high water tables, including 6 with salinity outbreaks according to the land capability map. Properties with high water tables are potential salinity sites. The divergence between landholders' perception and land capability assessments raises the question "how well are landholders aware of the signs of salinity?"

[2]High water table implies a situation when the water table is within capillary reach of the soil surface, or is at or above the soil surface.

3.1.2 Signs of salinity

The most common signs of salinity recognised by landholders are the appearance of bare patches on paddocks and white crusts on the surface. As outlined earlier, these are characteristics in extreme cases of salinity and are quite obvious. On the other hand knowledge of early signs of salinity such as the gradual dieback of trees and changes in pasture composition were reported only by 20-30% of landholders in both program and project areas (table 8). Findings along these lines have been reported by Barr and Cary in Victoria (Barr and Cary 1984:69-72).

Table 8 - Knowledge of signs of dryland salinity (percentage of landholders reporting)*

Signs of Salinity	Program (N=48)	Project (N=70)
1. Emergence of bare patches	77	60
2. White crusts on soil surface	65	37
3. Changes in pasture composition	27	31
4. Death of trees	25	21
5. Don't know any	6	16

* multiple responses permitted

The above responses were further analysed with respect to the groups reporting salinity and no salinity in both the areas. Although the trend of responses is much the same as can be seen from table 9, it is clear that those with salinity were more aware of signs than those reporting no salinity. The small percentage of landholders who were totally unaware of salinity signs in both areas belonged to the groups reporting no salinity.

Table 9 - Knowledge of dryland salinity signs reported by landholders with and without salinity (percentage of landholders reporting)

	Salinity reported by landholders in			
	Program area (N=48)		Project area (N=70)	
Signs of Salinity	Yes PM1(n=25)	No PM2(n=23)	Yes PT1(n=18)	No PT2(n=52)
1. Emergence of bare patches	84	70	78	54
2. White crusts on soil surface	76	52	67	27
3. Changes in pasture composition	28	26	33	31
4. Death of Trees	28	22	6	27
5. Don't Know any	0	13	0	21

As was pointed out above, although 78% (18) of landholders reported no salinity, the land capability assessment mapped high water tables on these properties. Ninety percent (16) of these landholders were unaware of this fact, whilst only 2 landholders in the group thought that water tables had risen on their properties. Whilst investigations are currently underway to measure water tables in the study area, it is generally believed, that at a water table depth of 1 to 2 metres significant salinity begins to occur. A recent study of changes in ground water levels in the Yass area revealed that there has been a general rise in water tables of up to 10 metres or more (Gates and William 1988). It is therefore possible that on some properties early signs of salting such as changes in pasture composition are present, though landholders may not be aware of it. That this maybe so is supported by the fact that, out of 25 properties mapped with high water tables, but no salinity, only 6 of the landholders reported awareness of early symptoms of salinity.[3]

The implications of the above findings are that a majority of landholders who think they do not have salinity, may not become aware of its presence until clear signs such as bare patches are observed. According to Barr and Cary, knowledge of the correct cues used by landholders to detect salt is a necessary, but not sufficient factor in the accurate perception of early signs of salt (Barr and Cary 1984:72). In their study in a Northern Victoria irrigation area, they report that every individual who suggested bare patches and bare checkbanks as early evidence of salting, thought his farm showed no sign of salt (Barr and Cary 1984:72).

Early detection of salinity may assist in taking remedial measures to prevent the problem progressing to a more advanced stage. It is thus imperative that landholders not only be educated in detecting early symptoms of salinity, but also be made aware of the depth of ground water tables on their properties.

3.2 Factors causing dryland salinity

As hypothesised by Wood in 1924, it is now firmly established that dryland salinity occurs due to the modification of native vegetation primarily by clearing catchments of timber for agriculture. A cleared catchment increases infiltration, while the amount of water used up is reduced. The end result is a rise in the water table, in the process of which salts which are naturally in the soil and rock are dissolved and brought towards the surface. When the water table is within approximately one to two metres of the ground surface, usually on footslopes and drainage depressions, saline seepages develop.

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[3] Three more landholders with high water tables in the program area reported knowledge of early signs of salinity However, they are all professionals working in Canberra.

The relationship between tree clearing and rise in water table has been very well demonstrated in a controlled catchment study in West Australia. One catchment (Wights catchment) was completely cleared in 1977, while a second catchment (Salmon catchment) was left forested. The rise in the water table in Wights catchment was dramatic and by 1983 was within a few metres of the soil surface in lower-slope locations vis-a-vis the forested Salmon catchment where the water table remained stable (Davidson and Bell 1989). These results are graphically illustrated in figure 3).

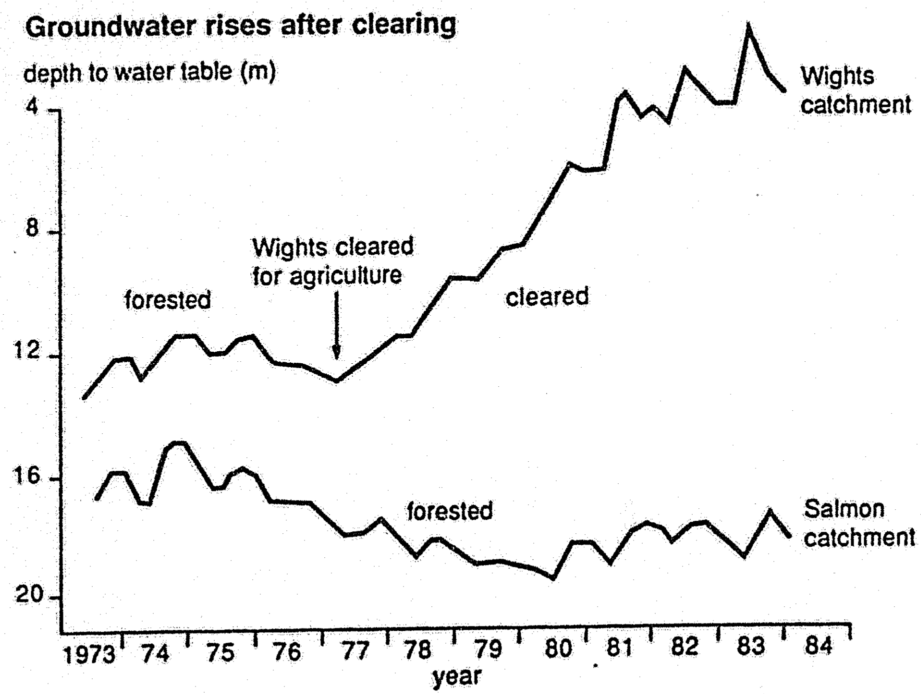

Figure 3:- Relationship between clearing and groundwater rise in Wights Catchment and Salmon Catchment, West Australia.

Source:- Davidson and Bell, Rural Research 143, 1989, page 17.

Although it appears that there is a lag time of about 50 years or more between clearing and the development of salinity, land use such as intensive cropping can significantly accelerate the process. The influence of cropping has also been demonstrated in Western Australia's wheat belt, where experience and research shows a time lapse of about 15-20 years between clearing and the appearance of saline seeps in valleys (Anon.). In a recent survey of private bores carried out in south east NSW, observations and discussions with landholders also revealed that bores which recorded largest groundwater level rises (>10 metres) all had large areas of their catchment under cropping, mostly wheat (Gates and Williams 1988).

Climatic and physiographic factors also play an important role in the development of salinity. Wagner (1986) observed that most outbreaks of salinity in south east NSW occurred within a rainfall regime of 600 mm to 700 mm, while a few wet seasons followed by normal or drier years tend to accentuate the problem. The majority of affected areas are also on low footslopes and drainage depressions on duplex soils over ordovician meta sediments (Wagner 1986).

3.2.1 Awareness of factors causing dryland salinity

Landholders' awareness of factors causing dryland salinity was determined by asking the question, "Could you suggest some factor/s that cause dryland salinity?" Landholders were also requested to rate the importance of the factor/s on an increasing scale of 1 to 5. Those who could not suggest any factors were shown a prompt card and requested to point out the factor/s they thought most likely to cause salinity. The results are presented in table 10.

Table 10 - Awareness of factors causing dryland salinity amongst landholders in program and project areas (percentage of landholders reporting)

Factors causing dryland salinity	Landholders suggesting causal factors		Landholders prompted as to causal factors	
	Prog area	Proj area	Prog area	Proj area
Reporting no.	(n=38)	(n=43)	(n=10)	(n=27)
Excessive tree removal	84 (55)*	74 (49)	80	78
High water table	56 (32)	67 (51)	100	48
Overgrazing	39 (10)	42 (28)	90	65
Shallow rooting vegetation	16 (6)	17	60	30
Overcropping	5	11	60	35
Abnormally wet seasons	3	5	70	26

* Figures within parentheses represent the percentage of landholders who gave a scale of 4-5 to these factors.

Seventy nine percent of landholders in the program area compared to 61% in the project were able to suggest causal factors of dryland salinity. Similar causal factors were suggested in both areas, with excessive tree removal, high water tables and overgrazing being commonly cited. Furthermore, the parenthetical figures in the table show that up to 50% of landholders citing the above causes also gave them a high rating of 4-5 on the scale of importance.

These findings are not surprising as tree clearing and high water tables are the most commonly talked of factors whenever dryland salinity is discussed. However, only some landholders were able to explain the relationship between tree clearing and high water tables in causing dryland salinity. On the other hand, the effect of factors such as overcropping, shallow rooting vegetation and abnormally wet seasons in predisposing land to dryland salinity were reported only by a small number of landholders.

Amongst the landholders who were prompted with a list of causal factors, the ranking of factors was similar to that given by the other group. The highor percentage of responses compared to the awareness positive group was expected due to the use of a prompt card to elicit answers.

Between the groups with and without salinity, more landholders in the former group were aware of causal factors.

Landholders awareness of causal factors was further determined by asking them what effect the following factors have had in the development of dryland salinity in the district.

1. Lack of knowledge of long term effects of overclearing by earlier farmers.

2. Mistakes made by <u>inexperienced</u> farmers in recent years.

3. Mistakes made by <u>experienced</u> farmers in recent years.

Over two-thirds of landholders in both program and project areas were of the opinion that any incorrect actions of landholders in recent years have had no or little effect in the development of salinity. Many landholders reported that the problem had been on their properties since childhood and was a legacy of past land use practices. More than 70% of landholders agreed that the overclearing of land by their predecessors was a major factor in the development of dryland salinity. They acknowledged that this was done due to lack of knowledge of the long term effects of overclearing.

The general conclusions that can be drawn from this section are that a majority of landholders are aware of the role of tree clearing and high water tables as main factors that cause salinity. At the same time many landholders are not fully aware of the implications of land use and management which predisposes land to salinity. The impact of such a situation will be most on those properties with high water tables and therefore, with high salinity risks.

3.3 Landholders perception of the seriousness of dryland salinity

Landholders were requested to rate the seriousness of salinity on neighbouring properties, in the shire, the southern tablelands, the whole of NSW and in Australia. The scale measured 0 = don't know, 1 = no problem, 2 = minor to 5 = very serious. Responses to the above question are shown in table 11.

Table 11 - Landholders views as to the seriousness of dryland salinity (percentage of landholders reporting)

Geographical Level	0 dont know	1 No problem	2	3	4	5 very serious	Total
On neighbouring properties	6* (24)**	13 (37)	21 (16)	17 (13)	21 (3)	21 (7)	100
In the shire	19 (33)	2 (7)	13 (17)	23 (16)	23 (17)	19 (10)	100
In the southern tablelands	45 (46)	4 (1)	17 (11)	11 (13)	17 (13)	6 (16)	100
In N.S.W.	34 (40)	9 (1)	11 (7)	13 (19)	30 (17)	4 (16)	100
In Australia	30 (37)	6 (3)	4 (6)	11 (7)	32 (27)	17 (20)	100

* Non-parenthesised figures are for the program area.
** Parenthesised figures are for the project area.

A little over 40% of landholders in the program area thought dryland salinity serious or very serious on neighbouring properties (scale of 4-5), while only 10% had similar views in the project area. This is consistent with the fact as mentioned before, that 47% of dryland salinity in the Yass river catchment occurs within the program area. Furthermore, while 7% of the program area is affected with salinity, in the project area only 0.7% is similarly affected. On the other end of the scale, a greater percentage of landholders in the project area compared to the program area, were either unaware of how serious salinity was on neighbouring properties (scale 0), or thought that salinity was no more than a minor problem (scale 1-2).

There was also a difference in response between the two groups regarding the seriousness of the problem in the Shire. Here too just over 40% of landholders in the program area ranked salinity as serious or vey serious compared to 27% in the project area. Once again the difference is explained by the fact that the program area is totally within the Yass Shire where dryland salinity is more widespread in comparison to the project area, which in addition to the Yass Shire also includes the Shires of Gunning and Yarrowlumla where the outbreak is less severe. Fifty seven percent of landholders in the project area either were unaware of the seriousness of the problem in their shire or thought the problem minor, compared with 34% of landholders in the program area. Therefore, in spite of 15% of dryland salinity in NSW being present in the Yass River catchment, many landholders are either not aware of the full extent of salinity in their district or do not regard it as a serious problem. Barr and Cary in their study reported similar findings in the districts of Rochester and Stanhope in Victoria (Barr and Cary 1984:185).

Looking at dryland salinity on a wider geographical level, around 30% of landholders in both areas thought the problem serious in the southern tablelands and in NSW as a whole. On the other hand over 40% had no idea, while less than 20% thought the problem minor. As to the seriousness of the problem on a national scale, almost 50% of landholders in both areas viewed the problem as serious, whilst around 30% did not know.

Amongst landholders with salinity in the program area, around 60% thought the problem serious on their neighbours lands. Of those without salinity, only 22% expressed a similar view. Parallel statistics for the project area are 17% and 7% respectively.

Only a few landholders believe that dryland salinity is overestimated. The majority are of the view that many landholders do not know enough about the problem, while other landholders simply take it for granted. These expressions of feelings are aptly reflected in the preceding discussion where many landholders were not able to state an opinion as to the seriousness of the problem. Furthermore, we are not certain whether those landholders who reported dryland salinity as a serious problem did so with definite knowledge or whether it was just an expression of feelings. The results of the survey indicate that landholders need to be better informed about the whole process of dryland salinity and the seriousness of the problem not only locally, but on a national scale.

3.4 Awareness of management techniques to control dryland salinity

Having established the level of awareness of dryland salinity it is relevant to determine whether landholders have any idea of management techniques to control the problem. Landholders were requested to name any method/s they know to control salinity and prevent its spread in future. Results are displayed in table 12.

Table 12 - Awareness of management techniques to control and/or prevent dryland salinity (percentage of landholders reporting)*

Management Techniques	Landholders reporting awareness of methods		Landholders reporting no awareness of methods	
	Program Area	Project Area	Program Area	Project Area
Reporting percentage	71 (n=34)	54 (n=38)	29 (n=14)	46 (n=32)
1. Plant trees	74	89	71	59
2. Revegetate with salt tolerant spp	59	55	57	50
3. Fence off affected areas	47	18	71	53
4. Destock/do not overgraze land	41	29	50	69

* multiple responses permitted

Seventy one percent of landholders in the program area and 54% in the project area were able to name one or more methods to control dryland salinity. Planting trees and salt tolerant vegetation, destocking and not overgrazing and fencing off affected areas were the main methods mentioned. Those landholders who were unable to name any techniques were shown a prompt card and requested to identify methods they thought were most likely to help control the problem. The pattern of responses is similar for both groups of landholders in both program and project areas.

Amongst the landholders with perceived salinity problems in both the program and project areas, a majority were able to name control methods. The same same was true for landholders reporting no salinity on their properties (table 13).

Table 13 - Awareness of management techniques to control and/or prevent dryland salinity amongst landholders with an without perceived salinity (percentage of landholders reporting)

Landholder Group	Landholders reporting awareness of methods		Landholders reporting no awareness of methods	
	with salinity	no salinity	with salinity	no salinity
Program Area	80	61	20	39
Project Area	61	52	39	48

It is clear from the above findings that a majority of landholders feel that there are actions they may undertake to control and/or prevent dryland salinity. Many landholders see planting trees as the most effective method of tackling the problem, some already having initiated the process on their properties. To have any major effect on ground water tables extensive plantings will have to be undertaken, whilst the lag period between planting and full effect on lowering the water table is yet to be determined. Some landholders may feel a sense of guilt in not having sufficient trees on their properties and as expressed by Barr and Cary, derive psychological satisfaction from undertaking an action in the face of a serious future threat (Barr and Cary 1984:132).

Landholders awareness of control methods is further reflected in their strong statements of agreement with the need to change their current land use/management practices. Responses to this proposal were elicited using a prompt card with a scale of 0 = don't know, 1 = strongly disagree to 5 = strongly agree. The results shown in table 14 indicate that although a small percentage of landholders had reservations on the proposed options, the majority were in agreement.

Table 14 - Expression of agreement by landholders on potential measures that maybe required to control and/or prevent dryland salinity (percentage of landholders reporting)

Potential Measures	Level of agreement 0 don't know	1 strongly disagree	2	3	4	5 strongly agree	Total
1. It maybe required to have a certain extent	8*	-	2	7	20	63	100
of land under tree cover permanently.	(4)**	(2)	(7)	(11)	(24)	52	100
2. It maybe required to adopt strategic	6	2	7	7	28	50	100
management practices on affected land.	(4)	(4)	(4)	(10)	(19)	(59)	100
3. It maybe required to improve pasture	15	-	4	11	24	46	100
management over the next 5 years.	(7)	(10)	(4)	(18)	(15)	(46)	100
4. It maybe required to totally retire	9	7	4	13	20	47	100
affected land from production of 5 - 10 years.	(11)	(9)	(12)	(13)	(16)	(39)	100

* Non-parenthetical figures are for the program area.
** Parenthetical figures are for the project area.

The confidence landholders place on tree planting to tackle dryland salinity is once more endorsed with over 75% in agreement to such an option (scale 4-5). Whilst good management and pasture improvement were also strongly supported options, some reservations were expressed in having to retire affected land from production totally for some time. The latter reservation was highest in the project area (21% on a scale of 1-2) compared to the program area (11% on a scale of 1-2).

The above findings however, are not to be taken as any positive commitment on the part of landholders to implement any of the above options. On the other hand such a favourable disposition by landholders suggest that they may be more amenable to such changes in future. Despite the above situation only about a third of the landholders felt they could undertake the above strategies on their own. The other landholders expressed the need for financial incentives such as tax concessions or compensation if they were to implement any of the options. No attempt was made to determine the level of incentive landholders believed would be necessary.

4. LAND USE

Land use describes the rural, urban, industrial or recreational activities undertaken on the land. The types of land use are limited to those which appear to be relevant under the general physical, economic and social conditions prevailing in an area. To a large extent these variables determine the sustainability of a particular type of land use. This Section discusses the nature of land use in the study area and its impact on salinity.

4.1 Size of holdings

As discussed in section 3.1, the severity of salinity on a property has to be seen in relation to the size of the property. For instance a few hectares of salinity on a 1000ha property may seem insignificant vis-a-vis a similar outbreak on a 50ha property. Furthermore, the size of the property can also influence the successful implementation of salinity control strategies. This is more so where salinity has affected whole catchments comprising of several properties. Table 15 presents the distribution of property sizes in the study area.

Table 15 - Distribution of property sizes

Size class (ha)	Program area (N=48) reporting %	av size (ha)	% of salinity affected lands	Project area (N=70) reporting %	av size (ha)	% of salinity affected lands
up to 50	25	34	20	33	29	6
51-100	40	79	32	17	79	11
101-250	23	190	32	16	161	22
251-500	12	348	16	17	406	39
501-1000				13	737)	) 22
over 1000				4	1369)	)
all classes	100	127	100	100	270	100

The above figures show that in the program area almost two thirds of holdings are up to 100 ha while in the project area this proportion is half. The relatively large percentage of small holdings in the project area (33% under 50 ha), is due to recent subdivision of larger properties, particularly those in close proximity to Canberra. Also within the program area all properties are under 500 ha in contrast to the project area with 17% over this size. the average size of holdings for the program and project areas are 127ha and 270 ha respectively.

Looking at salinity outbreaks on the properties, just over half of the affected properties in the program area are holdings up to 100 ha. This contrasts sharply with the situation in the project area where salinity affects only 17% of similar sized properties. Over 60% of the salinity outbreaks in the latter area are on holdings over 250 ha in extent. The implications of the above findings are that when treating salinity on smaller properties costs may be high and this may also affect the economic performance of the farm. Small holdings may or may not have economic activities. Those which do, may lack economies of scale and have low incomes. Such a situation may exacerbate land degradation problems such as dryland salinity. Furthermore, when a number of small holdings make up a whole catchment affected with salinity, arriving at a common consensus amongst the landholders to treat the whole catchment can also be difficult.

4.2 Land use

Wagner's study of the Yass river catchment in 1987 established that the principal land use in the area is pasture covering 86% of the catchment (Wagner 1987). The other main land use is green timber with 12%. Yet, a considerable degree of variation is found between subcatchments as shown in table 16.

4.2.1 Tree Cover

Table 16 shows considerable variation of tree cover within subcatchments with little or none in some to 20% or more in others. Within the program area (subcatchment of Dicks, Williams and Back creeks) tree cover is just over 10%, although some regeneration is taking place.

Tree cover in relation to size of holdings is analysed in table 17, which shows that, on individual properties tree cover varies from none to 100%. On average, in the program area, on properties up to 100 ha tree cover is around 20%, decreasing with size of holdings. In the project area too a similar trend is discernible. The Pearson's correlation coefficient for the relationship between mean tree cover and holding size however, is low at -0.22 and -0.29 for the program and project areas respectively.

Table 17 - Distribution of tree cover in relation to size of holdings

Size Class (ha)	Percentage tree cover					
	Program area			Project area		
	min	max	mean	min	max	mean
up to 50	0	65	20	0	100	26
51-100	0	74	22	0	100	21
107-250	2	36	12	0	65	14
251-500	1	13	5	0	26	5
over 500				0	13	5

Pearson's correlation coefficient (mean tree cover versus holding size) for
Program area = - 0.22 Project area = - 0.29

Table 16 - Yass River Catchment Land Use (percentage of each subcatchment)

Sub-catchments	1 %	2 %	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %
Manton Creek & Bald Hill Creek	.00	1.86	.15	63.08	24.70	10.21	.00	.00	.00	100
Corregans & Mundoonen Creeks	.00	2.02	.00	26.37	47.98	23.63	.00	.00	.00	100
Misery Hill	.00	1.43	.00	45.51	35.71	17.35	.00	.00	.00	100
Hickeys, Johnnys & Nowlands Creeks	.00	.00	.00	12.52	77.64	09.85	.00	.00	.00	100
Kittys & OBriens Creeks	.00	8.21	.00	84.22	7.57	00.00	.00	.00	.00	100
Murrumbateman Creek	.25	2.84	.00	52.39	38.05	06.37	.00	.00	.00	100
Dicks, Williams & Back Creeks	.00	.87	.00	13.33	75.07	10.72	.00	.00	.00	100
Nelanglo & five Mile Creeks	.00	.57	.00	26.33	44.32	28.79	.00	.00	.00	100
Gundaroo & McLeods Creeks	.37	2.29	.00	22.53	48.99	25.82	.00	.00	.00	100
Talagandra Hill	.00	3.57	.00	80.52	14.94	00.97	.00	.00	.00	100
Shingle House Creek	.00	.12	.00	19.41	64.04	16.42	.00	.00	.00	100
Bungendroe & Donnellys Creeks	.00	1.35	.00	32.70	59.19	06.62	.00	.14	.00	100
Cohens & McLaughlins Creeks	.00	1.36	.00	22.28	68.32	12.68	.00	.36	.00	100
Spring Flat Creek	.00	.07	.00	60.13	37.56	01.49	.00	.67	.07	100
Percentage of total catchment	0.07	1.68	0.01	38.09	48.19	11.83	0.00	0.11	0.01	100

* NOTES Nine land use classes as defined area:-

1. Urban
2. Arable
3. Horticulture
4. Improved Pasture
5. Native Pasture
6. Timber
7. Intensive animal production
8. Mining and quarrying
9. Water

Source: Yass Water Supply Catchment Study, 1987

Following from discussions on the relationship between salinity and tree cover, it would appear that properties with low tree cover would either be susceptible to/or have salinity outbreaks. This proposition is examined in table 18.

Table 18 - Distribution of tree cover as reported by landholders on properties with and without perceived salinity (percentage of landholders reporting)

Tree cover percentage	Salinity as perceived by landholders in			
	Program area (N=48)		Project area (N=70)	
	Yes	No	Yes	No
under 10	68	52	56	53
11-25	12	23	22	24
26-50	16	17	22	10
over 50	4	17		12

From the figures in table 18 it appears that the relationship between salinity and tree cover on individual properties is not very clear. In the absence of any data on the degree of salinity on the former properties, it was not possible to empirically test the above relationship. Nevertheless, a comparison was made between the land use and land capability in the program area. The comparison showed that on most properties with salinity, tree cover was sparse and was confined to either isolated mature trees, scattered clumps of mature trees or in some cases regeneration taking place. All those properties however have high water tables or water logged areas which make them highly susceptible to the further development of saline areas in future.

4.2.2 Pasture

The large scale clearing of the original forest in the area in the early period of European settlement for pastoral activities resulted in the establishment of native grass species in virtually all of the area. Since then, with the development of technology and need for higher productivity, there has been a gradual improvement in pasture species. Improved deep rooted pastures will help reduce recharge to saline groundwater systems in dryland areas.

Currently around 44% of the land under pasture in the Yass river catchment is improved although this varies from less than 20% in some subcatchments to over 60% in other (table 16). The situation also varies from no improved pasture in some properties to total improvement in others, with a majority of holdings being partially improved as shown in table 19. Properties with improved pasture receive regular fertiliser applications and are also sprayed for weed control.

Table 19 - Pasture improvement and management in the program and project areas

Pasture management	Program area (N=48) not improved	totally improved	partially improved	Project area (N=70) not improved	totally improved	partially improved
% landholders reporting	31	17	52	21	15	64
% of properties topdressed in 88-89	13	25	56	0	60	77
% of properties sprayed in 88-89	20	25	32	0	40	48

Comparison between the program and project areas also show that in the latter area more holdings are under improved pasture as well as being top dressed and sprayed for weeds during the 1988-89 agricultural season.

Pasture improvements in relation to size of holdings is examined in table 20. It follows from the figures in this table that the proportion of land under improved pasture increases with size of holding. the correlation coefficient of this relationship is however weak with values of 0.08 and 0.12 for the program and project areas respectively.

Table 20 - Distribution of pasture improvement in relation to size of holding

Size class	Percentage of pasture improvement Program area min	max	mean	Project area min	max	mean
up to 50	0	100	23	0	96	32
51-100	0	100	31	0	100	53
101-250	1	100	53	0	100	53
251-500	0	85	35	0	100	54
over 500				2	100	63

Pearson's correlation coefficient (mean proportion under improved pasture versus size of holding) for program area = 0.08; project area = 0.12

In table 21, pasture improvement is further examined in relation to properties with and without salinity. The findings show that contrary to expectations, there has been more pasture improvement on salinity affected properties. However, most of this improvement has been with the addition of clovers. On the other hand pasture improvement with deep rooting species such as phalarus or lucerne will have the most desirable impact in reducing accession to the water table in recharge zones. As has been discussed before, many of the properties reporting no salinity actually have high water tables making them salinity risk areas. Therefore, continued pasture improvement with deep rooting species is very important, more so in the face of encouraging evidence that this has had a very significant effect on regeneration of saline affected sites (Wagner 1986).

Table 21 - Distribution of pasture improvement on properties with and without perceived salinity
(percentage of landholders reporting)

Degree of pasture improvement	Program area		Project area	
	salinity	no salinity	salinity	no salinity
no improved pasture	20	52	6	28
up to 25% improved	8	13	11	10
26-50% improved	24	13	17	14
51-75% improved	12	9	61	31
76-100% improved	32	13	6	18

4.2.3 Arable cropping

Arable cropping has not been a significant land use in the area. In the past a small amount of crop production was practised. But over the last 3 - 4 decades this has been reduced to occasional fodder cropping. During the 1988-89 agricultural season, only 20% and 30% of landholders in the program and project areas respectively cultivated small amounts of oats. The total extent of oats cultivated was 75 ha.

4.2.4 Land use and dryland salinity

Following from the time series investigations of the Yass river catchment over a 40 year period, Wagner concluded that widespread clearing of trees would have been the major factor in increased accession of water tables and the outbreak of salinity in the area (Wagner 1986:24). Wagner also suggests that the depletion of native pasture ground cover by overgrazing could have accentuated the situation.

It follows that increasing vegetative cover, both tree cover and ground cover, should have the desired effect of reducing the accession of water tables, thereby controlling the spread of salinity and preventing future outbreaks. To this effect, the high level of tree regeneration occurring in the area as well as the positive attitudes of landholders towards tree planting and pasture improvement, particularly in salinity areas, are signs of optimism. It appears that there is some potential for further pasture improvement in view of the fact that more than half the properties in both program and project areas are only partially improved. This management option needs to be thoroughly investigated having regard to land capability limitations.

4.3 Enterprise pattern

With over 80% of land use being under pasture, the pastoral industry is the mainstay of the rural economy in the area. Fine to medium wool production and Merino sheep breeding are the major enterprises, with crossbreds for lamb and mutton playing a significant role. Cattle for meat production is becoming increasingly important on a number of holdings and in recent years quite a few landholders have gone in for goat enterprises. Mixed livestock farming is popular with a sheep and cattle combination the most common. The enterprise mix in the area is displayed in table 22 hereunder.

Table 22 - Livestock enterprise mix in the program and project areas (Percentage of landholders reporting)

Enterprise	Program area (N=48)	Project area (N=70)
1. Sheep only	40	26
2. Sheep + cattle	17	40
3. Sheep + goats	10	1
4. Sheep + cattle + goats	2	6
5. Cattle only	15	7
6. Goats only	6	6
7. No livestock	10	14
Total	100	100

Table 23 - Yass River Catchment Land Capability (in percentage)

Subcatchments	C I	C II	C III	C IV	C V	C VI	C VII	C VIII	Total
Manton Creek & Bald Hill Creek	--	7.32	19.47	38.24	18.59	11.59	4.79	--	100
Corregans & Munoonen Creeks	--	7.93	17.15	32.27	1.72	12.69	28.24	--	100
Misery Hill	--	23.07	20.41	32.45	2.24	13.88	7.95	--	100
Hickeys, Johnne & Nowlands Creeks	--	2.10	12.66	49.24	4.92	20.82	10.26	--	100
Kitty & O'Briens Creeks	--	32.68	51.36	13.04	1.46	1.46	--	--	100
Murrumbateman Creek	--	19.79	32.08	31.02	2.67	9.63	4.81	--	100
Dicks, Williams & Back Creeks	--	4.91	13.22	51.23	8.19	16.86	5.59	--	100
Nelanglo & Five Mile Creeks	--	3.98	6.44	36.36	3.79	29.35	20.08	--	100
Gundaroo & McLeods Creeks	--	5.33	12.77	41.27	3.95	25.00	11.68	--	100
Talagandra Hill	--	21.10	34.42	35.39	3.25	5.84	--	--	100
Shingle House Creek	--	3.19	15.00	54.69	3.06	18.11	5.94	0.01	100
Bungendore & Donnellys Creeks	--	7.03	18.78	45.00	4.60	17.83	6.76	--	100
Cohens & McLaughlins Creeks	--	14.40	18.58	43.75	2.81	11.95	8.51	--	100
Spring Flat Creek	--	31.55	26.40	31.69	1.20	7.30	1.86	--	100
Average Percent Total Catchment	--	13.12	21.27	39.32	4.39	14.28	7.61	0.01	100

Source: Yass Water Supply Catchment Study - 1987

4.3 Land use versus land capability

Land capability is the ability of land to accept a type and intensity of use permanently, or for specified periods under specific management, without permanent damage (SCS 1986). If land is used beyond its capability it ultimately loses its productive capacity. Table 23 shows the land capability classification for the Yass river catchment. The land classes and method of classification are described in detail in Emery (1988). What is evident from the table is that almost two thirds of the land in the catchment is under class IV and above, thereby making them unsuitable for any kind of sustained cropping activity. Consequently, grazing is the most suitable land use in the area.

In the case of pastoral enterprises, one way of ascertaining whether the land is used according to its capability is looking at carrying capacity. To this extent an estimate of carrying capacity on different classes of land was made with the assistance of the District Agronomist at Yass. These estimates are compared with actual stocking rates reported by landholders and is presented in table 24.

Table 24 - Potential and actual carrying capacities on some properties in the program area

Land class	Agric. Dept. estimates Potential dse/ha	Land class	Survey results Actual dse/ha
III improved pasture	7.5-10		
IVt* native pasture	2	IVr native pasture	2.82
IV improved pasture	6.25	IVr improved	7.5-10
VIr native pasture	0.6-1.25	VIr native pasture	0.7-1.8
VI native pasture	1.25		
VIf partially improved	3.7	VIr partially improved	4.7-4.9
VIIr native pasture	0.6	VIIr native pasture	0.73

* lower case characters represent land capability limitations, where t=terrain, r=rockiness and f=flooding hazard

Table 24 clearly illustrates that in all the sample properties the actual stocking rates are above the Agricultural Department estimates. But it needs to be borne in mind that the landholder survey was done during April-May 1989 when the land and pastures were in a better condition following the rains earlier in the year, while the Agricultural Department estimates were made in October 1989 when the season was drier. Unfortunately we do not know the extent to which landholders reduced stocking rates in the latter part of the year. Overstocking during a poor season can have deleterious effects on the land and hasten salinity development.

Stocking rates are further compared with respect to improved and unimproved pasture and with respect to properties with and without perceived salinity. These results are shown in table 25 below.

Table 25 - Comparison of stocking rates under different pasture types and on properties with and without perceived salinity in the program and project areas (in dse/ha)

Variable	Program area	Project area
natural pasture	2.95	2.03
partially improved pasture	4.73	6.57
totally improved pasture	6.39	10.00
salinity present (a)	5.04	7.04
salinity absent (b)	5.02	6.52
Test of significance between (a) and (b)		
	t = 0.02, p 0.05	t = 1.03, p 0.05

It is very clear from the above table that; (i) stocking rates increases with pasture improvement; (ii) stocking rates in the project area is higher than in the program area. This is not surprising because there are better class lands in the project area as table 23 shows. Perhaps of greater interest is the fact that a test of significance between average stocking rates on properties with and without perceived salinity indicate, that there is no significant difference in either the program (t=0.02) or the project (t=1.03) area, at a probability level of 0.05 .

It appears from the above analysis that the degree of pasture improvement and not salinity is the key variable affecting carrying capacity. This suggests that salinity is not greatly affecting carrying capacities as only a small area of each property is visibly affected. However, we should not lose sight of the fact that almost 10% of land, at least in the program area, has a high water table and is thus at risk of developing a salinity problem. Furthermore, if current stocking levels which appear to exceed carrying capacity continue, it could accelerate salinity outbreaks in future. To a great extent, rehabilitation of affected lands and prevention of further outbreaks of salinity can be achieved through a concerted effort at improving ground cover by proper land use and higher levels of management. Whilst the possibility for this exists, it will depend to a great degree on productivity levels and the economic performance of farms. This aspect is examined in the next Section.

5. ECONOMIC PERFORMANCE OF FARMS

5.1 Performance Indicators

Three indicators have been selected to study the relative performance of farms with salinity and without salinity in the program and project areas. The selected indicators are for the sheep enterprise as this is the dominant enterprise in the area. Carrying capacity is selected as an indicator of land productivity, while wool cut per head and gross margins per head are selected as an indicator of enterprise productivity. Gross margin per head of cattle is presented for comparative purposes.

5.1 Productivity Levels

As was discussed in the previous chapter, there is no significant difference in the stocking rates between farms affected with salinity and without salinity as shown by the figures in table 26. Overall, farms in the project area show a higher carrying capacity than those in the program area. The difference is probably explained by the better class of lands in the former area compared to the latter. Wool cuts per head seem to average around 5 kg per head in general. The difference in yields between farms with and without salinity are not statistically different at a probability level of 5%.

Table 26 - Main production and financial indicators 1988-89

Indicator	Program Area: With salinity	Program Area: Without salinity	Project Area: With salinity	Project Area: Without salinity
1. Stocking rate (dse/ha)	5.04	5.02	7.05	6.52
2. Wool cut (kg/head)				
all wool	5.03 (13)*	5.14 (7)	4.57 (14)	4.80 (28)
fine wool	5.05 (6)	5.50 (3)	4.24 (9)	4.52 (15)
3. Average variable cost** ($/head)	4.31 (6)	3.82 (3)	4.39 (9)	4.18 (15)
4. Wool gross margin ($/head)	62.28 (6)	78.33 (3)	59.73 (9)	6[illegible].67 (15)
5. Cattle gross margin ($/head)	290		312	

* figures within parentheses are number of farms analysed

** excluding marketing costs and wool commission

Thus, contrary to expectations of differences in productivity levels between farms with and without salinity, figures in table 26 tend to confirm that average levels of productivity are not significantly different between the two groups. It therefore appears that salinity, at least at current levels, does not significantly influence production because of the small areas affected on each farm. Similar results have been reported on the effects of irrigation salinity on production in the Campaspe Irrigation District of Victoria (Anderson 1985). On the long run however, if salinity affected properties continue to be overstocked, production losses will be inevitable.

5.2 Gross Margin Analysis

Gross margins are the difference between gross income and variable costs. Variable costs are those directly attributable to an enterprise which will vary according to enterprise size.

The gross margin for an enterprise is only as accurate as the quality and completeness of the data used in its construction. Consequently, gross margins have to be interpreted with some caution. They are generally used to compare the relative profitability between enterprises. Furthermore, gross margins once constructed, soon become historical as markets change frequently.

As discussed before, there is a mix of livestock enterprise in the area with sheep being the main enterprise. Cattle for beef production is becoming increasingly popular with a few farms carrying goats. In the program area 65% of the farms (31 farms) carry sheep of which only 42% (13 farms) are fine wool producing enterprises. Parallel figures for the project area are 73% (51 farms) and 52% (26 farms) respectively.

Gross margins are analysed only for sheep and cattle as they are the main enterprises in the area. With respect to the sheep enterprise, gross margins are calculated only for wool rather than the whole sheep enterprise as such due to the variability of operations on farms. Not all farms producing fine wool were used in the gross margin analysis due to incomplete data. Only 9 and 24 farms in the program and project areas respectively, were used in the analysis as shown in table 26. The gross margins presented in table 26 are for an average farm producing fine wool with an average level of management.

The figures in table 26 show that gross margins do not appear to be very different between the program and project areas. Average wool gross margins for the program and project areas are $62.28[4] and $61.70 respectively. With differences in productivity levels not being significant, differences in gross margins may reflect variations in other factors such as management levels or scale of operations. The latter was not investigated in more detail. Consequently, the above gross margin figures are only conservative estimates and need to be interpreted with some caution due to the incompleteness of data and the small number of farms analysed.

Analysing two small groups of farms, one with high salt and the other with low salt concentration in the Campaspe Irrigation District of Victoria, Anderson concluded that differences in financial performance of the two groups could be largely attributed to difference in factors other than the effects of salinity (Anderson 1985). Our findings which closely parallel the above, seem to indicate that the impact of salinity on productivity and gross margins is as yet not clearly evident.

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[4] This avergae does not include the three farms without salinity as their wool cuts were very much above average.

5.3 Farm Incomes

As sheep is the main enterprise, it naturally constitutes a major proportion of farm income in most cases. As displayed in table 27, between 40% and 50% of the farms in both the program and project areas derive over 75% of their farm income from sheep. Only around 10% of farms derive the same level of farm income from cattle, whilst a very small number of farms (3-6%) have goats as their main income source. The figures also show that apart from sheep, goats are more popular in the program area, while there are more farms with cattle in the project area.

Table 28 - Composition of farm income in the program and project areas.
(percentage of landholders reporting)

Income Category	Program Area (N=48) Sheep	Cattle	Goats	Project Area (N=70) Sheep	Cattle	Goats
1. No farm income	38	70	86	31	51	91
2. Up to 25%	8	18	2	9	24	6
3. 26-50%	4	2	2	6	11	-
4. 51-75%	6	-	4	6	1	-
5. 76-99%	14)	2)	2)	26)	4)	
	) 44	) 10	) 6	) 49	) 11	
6. 100%	30)	8)	4)	23)	7)	3

The distribution of total gross farm income from wool and cattle enterprises is presented in table 28. The differences between the program and project areas are very apparent. Average incomes in each category are lower in the program area compared to the project area. Also 92% of farms in the program area generate less than $50,000 gross income per year, with half the farms yielding less than $10,000. Parallel statistics for the project area are 56% and 17% respectively. Overall total annual gross incomes are much higher in the project area than in the program area.

Table 28 - Distribution of total annual gross income of wool and cattle enterprises 1988-89
(percentage of landholders reporting)

Income Category ($)	Program Area (n=25)	Project Area (n=41)
up to 10,000	52)	17)
	)	)
10,001 - 25,000	16) 92	29) 56
	)	)
25,001 - 50,000	24)	10)
50,001 - 100,000	4	12
100,001- 200,000	4	22
over 200,000	-	10
Av. income all farms ($)	56,700	90,970

Farm income in relation to total annual gross income is further analysed in table 29. Significant differences between the program and project areas are again evident from the table. In the program area only 12% of landholders received over 75% of their total annual income from the farm in contrast to the project area where this category is nearly three times more. At the other end of the scale 24% of landholders in the program area did not derive any income from their farm, while in the project area this number is only 16%. Also a much higher proportion of landholders (40%) in the program area compared to 34% in the project area received up to 25% of their total annual income from the farm.

Table 29 - Farm income as a proportion of total annual income. (percentage of landholders reporting)

Income Category	Program Area		Project Area	
1. None	24)	) 64	16)	) 50
2. Up to 25%	40)		34)	
3. 26 to 50%	18		11	
4. 51 to 75%	6		4	
5. 76 to 99%	6)	) 12	14)	) 34
6. 100%	6)		20)	

If we categorise those farms generating up to a third of total annual income of landholders as "hobby" enterprises as against those generating two thirds or more of total annual income as "commercial" enterprises, then from table 30 it is seen that nearly two thirds of farms in the program area are run as "hobby" enterprises, while in the project area only half the farms fall into this category.

Further analysis of the "hobby" farms show that over 80% of such holdings were under 100 ha, average sizes being 60 ha and 40 ha in the program and project areas respectively. Many of these farms are the ones generating less than $10,000 annual gross income.

This brings us back to an issue we raised in Section 4.1 about the economic viability of small farm enterprises. Although, the analysis in this chapter is not detailed enough to make any firm judgements, nevertheless, it appears that "hobby" farms may not be generating sufficient income to attract expenditure towards land degradation problems. This is exarcebated by the fact that falling outside the definition of primary producers, "hobby" farms do not qualify for any tax concessions for land degradation expenses. Such a situation can only worsen land degradation problems on these type of holdings as they endeavour to farm on an already depleted resource base.

6. CONCLUSIONS

The findings from this study and others indicate that the impact of dryland salinity on productivity and incomes is as yet unclear. This highlights the need for continuing in depth research at the farm level into the economics of dryland salinity. Nevertheless, the above findings in no way undermines the concern about dryland salinity as a significant and increasing form of land degradation.

Whilst the effects of dryland salinity on farm production economics plays only a small part, the environmental effects range from severe direct effects to long term indirect losses. Severe salinisation can result in total loss of soil productivity which can be irreversible and costly. Such a situation can have a direct effect on the environment through a deteriorated quality of runoff increasing salinity levels in dams, water storages and streams. The accompanying soil erosion will exacerbate land degradation.

In the long term, rising ground water tables can affect whole catchments compounding the environmental effects. The above effects therefore, provides a strong case for government intervention to control and prevent the spread of dryland salinity.

Strategies to combat dryland salinity should be focused on two fronts. As the adage goes "prevention is better than cure", greater effort should be placed on preventative measures. This can only be achieved through more farmer education. The survey clearly revealed the inadequacy of farmer knowledge on important salinity issues such as recognising early symptoms, the conditions of land use and management which accentuate salinity as well as the potential hazards of salinity not only within their own localities but on a wider scale. The provision of such information through research, education and extension should be aimed at increasing farmer knowledge in taking measures to prevent the occurrence of dryland salinity. A well thought out community education program incorporating demonstrations, field days, printed literature, etc. targeted towards both landholders groups and school children would serve the purpose. The impact of such a program on the latter group could be enhanced by the inclusion of salinity studies in the school curriculum.

From the point of view of controlling salinity, strategies should be focused on a combination of agricultural practices and land use changes. The survey findings show that a favourable disposition exists amongst landholders for such changes. Emphasis should be on control measures that would cause least disruption to current farm management systems as these would be adopted more readily. Whilst tree planting and deep rooted pastures seem to be the most promising options at present, detailed investigations as to species type, planting densities, costs of establishment, opportunity costs of foregone production and potential returns are necessary before farm level recommendations are made.

The extension of any potential land use/management options to control salinity is based on the premise that farmers will normally adopt new strategies if they will generate more income. Available evidence indicates that expenditure on soil conservation works is most profitable in non-arid grazing and extensive cropping zones affected by water erosion (Alcock 1980; Junor et at 1979; DEHCD 1978 in Haynes and Sutton 1985:10). Evidence on the potential returns to investment on conservation works regarding salinity is less certain. This assumes greater importance in the face of evidence presented in the previous chapter that there is no significant difference in gross margins between properties with and without perceived salinity. Therefore, substantially greater incentives maybe necessary to induce action to prevent and control salinity.

Notwithstanding the above, even if financially attractive strategies to control salinity are conceived, yet farmers may lack the capital necessary to adopt them, particularly in the case of small enterprises and "hobby" farms. For instance it has been pointed out that one of the most promising measures to control salinity is planting trees. On the other hand, the prevailing taxation provision for tree planting and maintenance by non-primary producers, is considered as expenditure incurred in not gaining or producing assessable income and therefore, not tax deductible (Roberts 1989:11). Furthermore, tax deductions with regard to expenditure on preventing or combating land degradation is applicable only to primary producers.

The survey findings have revealed that in the program area over 50% of properties with perceived salinity were on holdings below 100ha, 80% of which were "hobby" farms. On the other hand existing fiscal measures are not in the best interests of such holdings. This can only increase resistance of such landholders to adopt measures to abate salinity. This in association with the existence of many small holdings in a catchment affected with salinity will only make any salinity abatement program difficult to implement. Therefore, more liberal fiscal measures such as tax concessions and subsidies with emphasis on land management practices may prove desirable.

An alternative to fiscal measures would be to have direct controls. This may be in the form of regulations, public ownership, land retirement prohibition of practices causing land degradation or mandatory adopting of specific practices designed to meet soil conservation standards (Oram 1987:27). In the case of salinity abatement the latter three measures have greatest potential. These can take the form of completely retiring affected land from production on a medium to long term, prevention of felling trees on potential recharge areas, cultivating deep rooted vegetation, ensuring a certain level of ground cover at times, etc. However, there are a number of shortcomings in enforcing direct government controls, primarily the lack of appeal of such measures amongst landholders. Historically landholders have also shown a resistance to the "stick" approach.

Fiscal measures and direct controls each have their merits and demerits and it is beyond the scope of this study to evaluate them. On the other hand any measure/s that improves efficiency or lowers (total) costs or both would be the obvious choice as a policy tool to combat dryland salinity (Oram 1987:33).

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