

Local government perceptions of water related issues in rural Australia

J.R. DAVIS and C.A. PARVEY

Water supply has long been regarded as a limiting resource in the further development of Australia. Active management has been necessary in both more densely settled areas and in areas of moderate settlement density but low rainfall such as the Murray-Darling system. The recently released Water 2000 Report details current knowledge about the quality and distribution of these resources. Following on from this Report this article presents perceived problems with water quantity and quality (in particular, salinisation) obtained from a survey sent to rural local governments in late 1982. The survey requested information on the relevance of twenty-two land use issues, known from earlier work to be representative of common concerns throughout Australia. Public perceptions were remarkably similar to the results of the Water 2000 Report. Water quantity/quality and salinisation issues were the sixth and seventh most commonly cited issues throughout Australia, but were of much greater concern in specific areas. Tasmanian local governments reported major problems of water supply, those in southwest Western Australia exhibited a very high level of concern with dry land salinisation, local governments in the Murray-Darling Drainage Division reported concern with salinisation, droughts, floods and general water quality, while local governments in the Gulf of Carpentaria Drainage Division consistently cited flooding as being a major problem. Information from surveys such as this, and others where the respondents are the end-users, need to be combined with expert opinion in order to increase the effectiveness of the management of our water resources.

The reports of many Government bodies have identified the management and usage of Australia's water resources as one of the major environmental issues facing Australia (e.g. Australian Water Resources Council (AWRC), 1978; Senate Standing Committee on National

Division of Water and Land Resources, Commonwealth Scientific and Industrial Research Organization, G.P.O. Box 1666, Canberra, A.C.T. 2601.

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Fig. 1 Drainage Divisions of Australia. See Table I for names of numbered Divisions.

Resources, 1976, 21; Department of Resources and Energy, 1983), but a concern to actively manage this critical resource has only been evident in the last twenty years (Australian Academy of Science, 1963; Crabb, 1982). At a national scale, detailed information on the extent of water availability and degradation has been progressively updated through a series of articles and reports produced since the Second World War (Nimmo, 1949; Bauer, 1954; AWRC, 1965, 1976; Department of Resources and Energy, 1983).

These reports, including the recently released *Water 2000* series of consultants reports (Department of Resources and Energy, 1983), have relied upon data provided by the various State water control authorities from their gauging of the major surface and groundwater resources in their jurisdictions. The revision of their data comes from both additions to long-term stream gauging records and from the gauging of remote areas for special purposes such as development proposals. Thus the *Water 2000* reports have altered previous estimates of the quantity of surface water in poorly gauged catchments by up to 124 per cent (Brown, 1983, 20).

TABLE I
DISTRIBUTION OF POPULATION AND WATER RESOURCES IN AUSTRALIA

Drainage Division		Population per cent	Total estimated yield of water resources per cent
I	North-east Coast	14	14
II	South-east Coast	54	10
III	Tasmania	3	26
IV	Murray-Darling	11	13
V	South Aust. Gulf	8	0
VI	South-west Coast	8	2
VII	Indian Ocean	1	0
VIII	Timor Sea	1	19
IX-XII	Other Divisions	1	15

Sources: Brown, 1983; Department of Resources and Energy, 1983.

The spatial framework which forms the collection and reporting units for these reports consists of twelve Drainage Divisions (see Fig. 1) and 224 Basins (Department of Minerals and Energy, 1975). The Basins have been aggregated to fifty-six Basin Groups in some studies (e.g. AWRC, 1981). The Basin Groups are numbered with their leading digit equal to that of the enveloping Drainage Division.

Both in absolute terms and in proportion to its area Australia has the second lowest rainfall and runoff of all the continents (Brown, 1983, 10). Only 12 per cent of the annual average rainfall (465 mm) is available as runoff. In addition to these surface water resources, there is estimated to be 70×10^6 megalitres per annum available groundwater in Australia. These figures, however, do not necessarily imply that Australia suffers from a shortage of water. The Department of Resources and Energy (1983, 34) estimates that, by the year 2000, aggregate demand for water is likely to be only 10 per cent of possible exploitable yield.

Australia has sufficient aggregate water resources to service its likely population needs but the present pattern of utilisation of these resources is highly uneven. According to Department of Resources and Energy (1983, 11) the Tasmanian Drainage Division with the greatest quantity of exploitable surface water has one of the lowest utilisation rates at 1 per cent (excluding hydro-electric storage), while the Murray-Darling Drainage Division, with the fifth largest quantity of exploitable surface water, has the highest rate of 85 per cent. Many authors have commented on the implications of this high rate of usage in the Murray-Darling Drainage Division (e.g. Fleming et al., 1982). Table I illustrates the relationship between exploitable surface water and groundwater and the distribution of Australia's population.

Water quantity is also highly uneven in its availability over time. Not only are there major seasonal variations in rainfall (particularly in the northern Drainage Divisions) but the annual rainfall is highly variable over much of Australia. The possible exploitable yield of water, taking into account these factors and the difficulty of impounding much of the runoff because of low relief, is estimated to be only 27 per cent of the runoff (118×10^6 megalitres per annum).

The quality of surface water resources has been discussed in a number of *Water 2000* reports (e.g. Brown, 1983; Brown et al., 1983; Garman et al., 1983; Peck et al., 1983). The problems of water quality vary with location. In near-urban areas effluent disposal and related water

pollution is the major problem, while in two cities, Adelaide and Perth, dissolved salts constitute a major problem (Peck et al., 1983 quote 175-479 mg/l and 250-500 mg/l respectively) with turbidity and hardness being additional problems in Adelaide.

Garman (1983, 109) found, from a survey of reticulated water supplies conducted in rural areas, that turbidity and colour were the major perceived problems with salinity being the least reported problem. However, for non-reticulated rural water use, salinity is widely acknowledged to be a major water quality problem (Talsma and Philip, 1971; Department of Resources and Energy, 1983, 38), whether groundwater or surface water supplies are used. Information is not yet available on the importance of salinity compared to other environmental hazards although one recent authoritative source costed the loss in capital value from non-irrigated salinity alone at A\$157 million (Senate Standing Committee on Soil Conservation, 1982, iv). The majority of non-irrigated salinisation occurs naturally with only 13 per cent being human-induced and most of this occurs as scalds rather than as seepage salinisation (Senate Standing Committee on Soil Conservation, 1982, 17).

In arid central Australia (Drainage Divisions X, XI and XII), groundwater is almost exclusively the source of supply. Although there is less known about groundwater quality than about surface water quality, it is clear that the former varies considerably from location to location. Throughout the Great Artesian Basin, which underlies almost a quarter of Australia, the groundwater is generally free from major impurities, although shallow groundwater in this area is likely to suffer from either point sources of contamination or from increases in nitrogen concentrations from pasture improvement (Garman, 1983). In areas relying on groundwater sources known to possess concentrations of dissolved salts well above the World Health Organization (1971) desirable level and the Department of Health (1980) long-term objective of 500 mg/l, few respondents to Gorman's survey reported dissolved salt problems. His comment — that they had probably grown accustomed to their saline water — illustrates the need to assess both objective measures and user perceptions before embarking upon ameliorative action.

Most reviews of Australia's water quantity and quality problems have drawn upon the knowledge of experts — generally the various State authorities in the field of water usage and management — and until the publication of Garman (1983), there had been no national survey of the perceptions of water users. Garman surveyed rural local governments for the quantity and quality problems associated with reticulated water supply in their jurisdictions. His questionnaire, to which he received a 55 per cent response rate, requested information on the source of supply, frequency of water restrictions, details of quality problems, costs of water treatment, details of sewerage treatment, etc. and these replies formed the principal source for the maps of surface water quality problems in *Water 2000* reports.

SURVEY OF LOCAL GOVERNMENT LAND USE ISSUES

A survey of a broad spectrum of experts in land use conducted in 1979 (Cocks et al., 1980) uncovered over 2000 land use issues in Australia. The most commonly cited issues formed the basis for a subsequent survey of local government officials, in which twenty-two issues pertinent to rural areas and eighteen issues pertinent to urban areas were canvassed among all rural and urban local governments respectively in late 1982 (see Table II). Respondents were asked to nominate the five most important issues in their local government area and, if they wished, to comment on the single most significant land use issue in a free-form answer. Respondents were also asked to delete those issues not relevant to their area.

TABLE II
ISSUES SENT TO AUSTRALIAN LOCAL GOVERNMENTS

RURAL LAND USE ISSUES

1. Effects of subdivision of prime agricultural land
 2. Impacts of current agricultural practices (e.g. clearing, irrigation, cropping, stocking rates)
 3. Impact of mining on other land uses and the community
 4. Increasing demands to use areas which might contain significant mineral deposits for recreation, national parks etc.
 5. Problems of revegetation of mined areas
 6. Increasing demands for use of rural land for recreation purposes
 7. Impact of increasing numbers of visitors or residents on the natural resources of the coastal zone
 8. The impact of recreation activities and/or mining on forested areas
 9. Clearing of forested areas for wood chipping
 10. Conversion of timber producing areas to national parks
 11. Costs of re-forestation
 12. Effects of the population concentrating into fewer centres
 13. Effects of changing population numbers
 14. Protecting the quantity and quality of water and air supplies
 15. Prevention and control of salting of rivers and soils
 16. Soil erosion
 17. Impact of natural disasters on the community (e.g. drought, floods, cyclones)
 18. Size and location of national parks
 19. Preservation of wilderness areas, national parks and sites of national heritage
 20. Siting of industrial developments and major works (e.g. airports, industry, waste disposal areas)
 21. Demands for land rights for Aborigines
 22. The impact of mining and other activities on Aboriginal communities
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An intensive follow-up campaign attained a high response rate of 95 per cent from rural local governments. The results have been published in Parvey and others (1983a, b). Two of the twenty-two issues proffered to rural local governments 'the prevention and control of salting of rivers and soils' and 'protecting the quality and quantity of water and air supplies' were specifically concerned with water usage and management. None of those proffered to urban councils, however, unambiguously concerned water quantity or quality problems. Consequently this report will examine water related issues in rural areas only.

Parvey and others (1983b) discuss some of the limitations of such surveys: it is highly likely that transient environmental issues will be emphasised at the expense of chronic issues (although the request to select five (unranked) issues should ensure that endemic issues are at least included); it is hazardous, in the absence of external standards, to compare the relative importance of issues between local governments; and the breadths of understanding of the local government issues presumably varied widely, even though respondents were all Shire clerks, planners or engineers. While these officials are not the end-users of water they are generally knowledgeable about the attitudes and problems faced by domestic, industrial and agricultural

end-users. However, they are also representatives of land owners facing the other issues nominated in the survey, and their response will be biased by the frequency of their contact with each of the issues.

Some specific points also need to be made about the two water related issues. The first issue includes the salinisation of both soils (dryland and irrigated land salinity) and surface water bodies. Research points to the close connections between these types of salinity (e.g. Senate Standing Committee on Soil Conservation, 1982, 3; Peck et al., 1983, 4). In contrast the second issue encompasses a broad range of problems including, by implication, salinisation.

The questionnaire requested information on both water and air quantity/quality problems but respondents in rural areas were only concerned with water quality and quantity issues. Thus only one rural local government mentioned air quality problems in the free-form answer section of the questionnaire although twenty-nine others mentioned water quantity/quality problems. Consequently we will assume that responses to this issue referred to general water related problems.

This data set contains valuable information about rural land use issues, complementing that of Garman (1983) in several ways. Firstly, Garman requested details of water quality from local governments providing reticulated supplies only, whereas the present survey requested information from all local governments. Secondly, the present survey sets water related issues in the context of the broad spectrum of issues facing rural areas. Thirdly, the higher response rate to the present survey provides a more complete picture of user perceptions of water quantity and quality problems throughout rural Australia.

For analysis, the responses were aggregated to the fifty-six Basin Groups (and the three Drainage Divisions without Basin Groups), with each local government spanning more than one Basin Group being attributed to that Basin Group containing the largest percentage of its area. This aggregation permitted the analysis to be based on relevant spatial units.

The intensity of an issue within a Basin Group was measured by the number of local governments within that Group responding to the issue. In order to calculate reliable percentages it was necessary to amalgamate Basin Groups, containing five or fewer local governments which responded to the survey, with adjacent Basin Groups within the same Drainage Division. Consequently Basin Groups 130, 250, 430, 480, 720 and 930 result from amalgamations. Since rural areas in the Northern Territory are unincorporated, the six Basin Groups constituting the Timor Sea Drainage Division and that part of the Gulf of Carpentaria Drainage Division within the Northern Territory (Basin Groups 910 and 920) were eliminated from the analysis. Drainage Divisions 010, 020, and 030 were also eliminated since they are arid areas largely relying on groundwater resources and containing few people. These adjustments resulted in a study area of thirty-nine Basin Groups for the analysis. Table III provides statistics on the number of local government areas and populations within each.

The two water related issues (salting of rivers and soils, and general water related problems) will each be analysed using two measures. Firstly, the percentage of respondents who cited the issue provides a measure of the extent of that issue within each Basin Group. For the reason outlined previously, this measure cannot be reliably compared between local government areas or between Basin Groups. An alternative measure is provided by those local governments which voluntarily nominated an issue in the free-form answer, and which, it is contended, clearly felt that issue to be of major concern. While this is not as objective as an external standard it does allow the issues to be compared between Basin Groups. Sixty-three per cent of the rural respondents in the study area felt that a land use issue in their jurisdiction was severe enough to fill in this free-form answer.

TABLE III
DESCRIPTIVE STATISTICS OF BASIN GROUPS USED IN THIS STUDY

<i>Drainage division</i>	<i>Basin group</i>	<i>LGAs no.</i>	<i>Rural LGAs responding no.</i>	<i>Rural population of responding LGAs thous.</i>
I	120	8	6	72
	130	12	10	118
	140	15	13	82
	150	15	12	46
	160	11	7	163
	170	12	10	188
II	210	16	13	174
	220	7	5	67
	230	11	6	62
	240	13	7	118
	260	5	5	26
	270	24	17	131
	280	8	8	88
	290	36	29	209
III	295	17	14	48
	310	23	21	158
	320	17	17	66
IV	330	6	6	21
	410	59	51	26
	420	8	5	18
	430	30	26	156
	440	12	12	82
	450	14	11	74
	460	21	20	134
	470	31	28	104
	480	28	24	120
	490	19	17	65
V	495	10	9	41
	510	12	10	35
VI	520	37	30	67
	610	9	7	19
	620	13	13	33
	630	9	7	42
	640	27	26	42
	650	8	8	17
VII	660	13	13	17
	710	10	9	14
IX	720	7	7	49
	930	13	11	34

This study, like that of Garman (1983, 111-17), provided approximate estimates of the significance of the issues by weighting both measures by the population of the local government areas. Clearly, these are upper estimates, since not everyone in the local government area is

TABLE IV
RANK ORDER OF RESPONSES TO THE RURAL ISSUES

<i>Issue</i>	<i>Response to issue</i>		<i>Most important issue</i>	
	<i>Unweighted</i>	<i>Population weighted</i>	<i>Unweighted</i>	<i>Population weighted</i>
1	1	1	1	1
2	2	4	3	3
3	12	11	9	8
4	21	19	—	—
5	16	17	15	16
6	14	13	—	—
7	9	7	8	2
8	15	16	—	—
9	18	18	10	12
10	16	15	13	13
11	19	21	14	15
12	8	9	—	—
13	3	2	6	5
14	6	3	5	6
15	7	10	3	7
16	5	8	6	9
17	4	5	2	4
18	11	14	13	14
19	13	12	12	11
20	10	6	10	10
21	20	20	—	—
22	22	22	15	17

affected, but they provide measures of the severity of an issue based upon the potential population affected. The actual populations affected cannot be determined from the present survey data.

THE RELATIVE IMPORTANCE OF WATER RELATED ISSUES

Parvey and others (1983a, 6) list the land use issues for rural Australia in order of their frequency of citation. For the study area, water quantity/quality and salinisation were the sixth and seventh most frequently cited issues (Table IV), with 44 per cent and 28 per cent of rural local governments mentioning them. When the populations affected were used to weight the replies, water quantity/quality issues rose to third position while salinisation dropped to being the tenth most important issue.

The effects of subdividing prime agricultural land (issue 1) and the effects of population changes (issue 13) were more frequently cited (using either measure) than were water quantity/quality issues, and an even larger number of issues (e.g. soil erosion, effects of agricultural practices) were cited more often and affected potentially more people than did salinisation.

A similar ordering emerged when the single most important issue in each local government area (the free-form answers) was examined. Water quantity/quality issues were ranked fifth and salinisation was ranked third equal when measured by the frequency of their citation, and sixth and seventh when weighted by population. The most significant result to emerge from

the free-form answers was the depth of concern expressed about the subdivision of prime agricultural land. This accounted for 34 per cent of the free-form replies, three times the frequency of the next most commonly cited issue.

This picture changes markedly however when the importance of the issues is examined regionally. Parvey and others (1983a) have mapped the distribution of each issue by local government area. For the present analysis the replies were aggregated to Drainage Divisions. In eastern Australia (i.e. Divisions 1,2,3,4) the loss of prime agricultural land was consistently the most frequently cited rural issue but was seldom mentioned in Divisions 6 and 7 (Western Australia). Salinisation was the most frequently cited rural issue in Division 6, the only Division to rate it so highly. In the Murray-Darling Drainage Division salinisation was only the seventh most frequently cited issue in contrast to the concern expressed about this problem in official reports. Tasmania was, surprisingly (given its low rate of usage and high total possible yield of water), the only Division to frequently cite water quantity/quality problems; it was the (equal) second most frequently cited issue.

Again an examination of the free-form replies revealed regional patterns similar to those from the proffered list. Loss of prime agricultural land was seen to be the single most important issue in eastern Australia, but salinisation was markedly the single most important issue in southwest Western Australia (31 per cent of free-form replies in this region). In the Murray-Darling Drainage Division salinisation was only the fourth most commonly cited issue in the free-form replies, and even in the most affected Basin Groups cited in official reports it was never the most frequently cited free-form issue.

This perception of subdivision of prime agricultural land and the effects of population change being the two most important issues is, as already noted, probably biased by the occupation of the survey respondents. Shire clerks, planners and engineers must daily deal with these concerns, lending even greater significance to the high citation rate of salinisation in Western Australia and water quantity/quality problems in Tasmania.

In summary, the water related issues reported upon in this study are (with one exception) not seen to be the major issues facing rural Australia. The subdivision of prime agricultural land, the impacts of agricultural practices, and natural disasters (including drought) consistently outrank both water quantity/quality and salinisation issues in all regions of Australia. The exception is southwest Western Australia where salinisation is regarded as being the major issue in rural areas. Summarising over the range of measures examined, the two water related issues ranked about equal (nationally) with concern over soil erosion, but invoked more widespread concern than did more commonly reported issues such as clearance of forests and Aboriginal land rights.

WATER QUANTITY/QUALITY ISSUES

Table V provides statistics on the local governments citing water quantity/quality problems. These problems occurred throughout most of Australia, but the underlying causes for the concern about water quantity and quality varied considerably.

Figure 2 shows the percentage of people in each Basin Group potentially affected by water quantity/quality problems. The data have been categorised into five classes (> 60 per cent, 50-60 per cent, 40-50 per cent, 0-40 per cent, not included), and this figure will form the focus of the following discussion. The three regions most affected were the Murray/Riverina region, southwest Western Australia, and the Gulf of Carpentaria, all with over 50 per cent of their rural populations living in affected areas. However the numbers of people potentially affected are quite different in the three regions. The Murray-Darling Drainage Division has over 550,000

TABLE V
UNWEIGHTED AND WEIGHTED FREQUENCIES OF CITATION OF
WATER RELATED ISSUES

<i>Basin group</i>	<i>Water quantity/quality issues</i>		<i>Salinisation issues</i>	
	<i>Frequency no.</i>	<i>Population weighted thous.</i>	<i>Frequency no.</i>	<i>Population weighted thous.</i>
120	3	15.3	0	0
130	4	36.6	1	18.4
140	4	21.7	2	17.8
150	5	24.6	2	10.8
160	3	100.2	1	16.4
170	4	80.1	1	5.3
210	3	69.3	0	—
220	0	—	0	—
230	3	36.5	0	—
240	3	38.9	0	—
260	0	—	0	—
270	7	68.2	1	9.3
280	4	31.0	0	—
290	9	44.4	8	33.6
295	10	36.6	4	9.2
310	10	51.4	—	—
320	10	28.9	1	1.8
330	1	6.7	—	—
410	29	162.8	25	125.1
420	2	5.9	0	—
430	15	95.6	10	63.7
440	6	37.8	4	33.5
450	3	16.2	0	—
460	9	59.6	0	—
470	14	59.9	6	24.9
480	11	51.9	7	36.2
490	5	23.0	12	47.8
495	6	38.0	5	36.6
510	7	27.8	0	—
520	8	13.6	3	5.4
610	4	12.6	5	10.4
620	6	19.0	10	19.4
630	4	28.3	2	21.7
640	9	20.9	22	35.9
650	6	11.4	6	9.4
660	2	4.8	10	12.8
710	2	1.5	4	4.2
720	3	22.6	2	22.4
930	5	24.7	2	1.6

people living in local governments affected by water quantity/quality problems (352,000 living in Basin Groups within the top two categories in Figure 2), compared to 97,000 living within the South West Drainage Division living in affected local government areas (71,000 living in Basin Groups within the top two categories), and there were 25,000 living in affected local government areas in the Gulf.

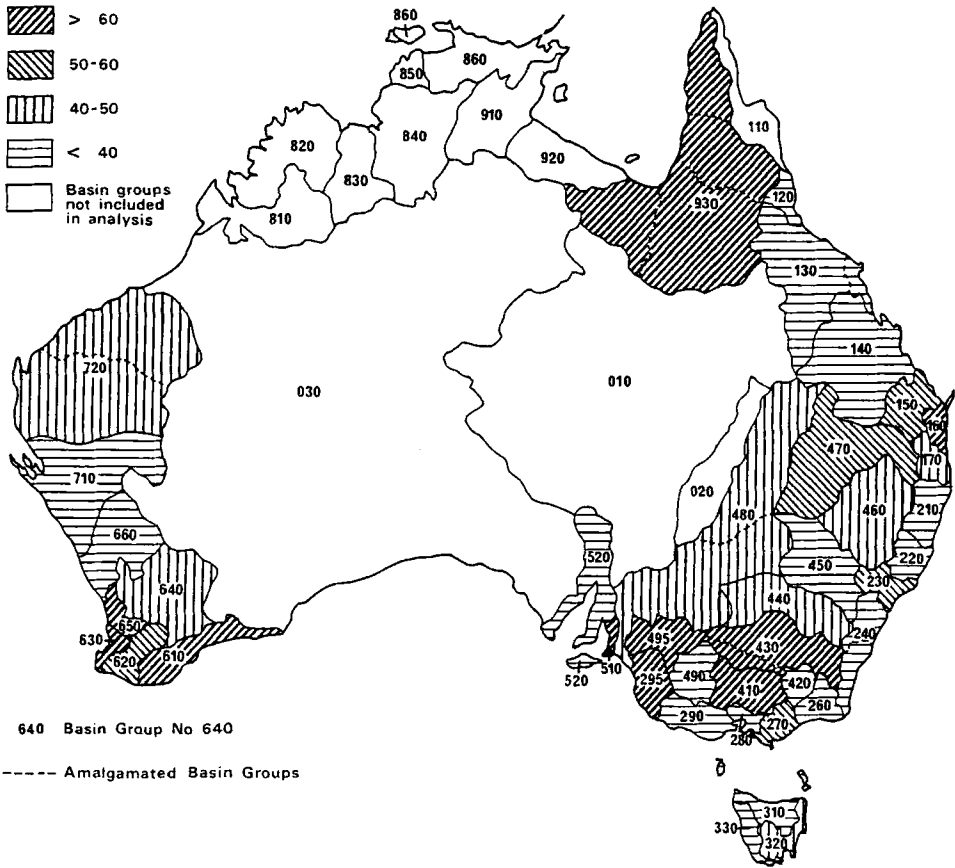


Fig. 2 Percentage of the population in each Basin Group potentially affected by problems associated with water quantity or quality. Basin Groups in northern Australia and central Australia were excluded from the analysis because of the small number of local governments in these areas.

As we have seen, the free-form answers clearly show that salinisation is the major cause for this concern in southwest Western Australia. However in the Murray-Darling Drainage Division the causes are much more widespread with drought, flooding, salinisation, and the general quality of the Murray being often mentioned. Figure 2 shows that these perceived water quantity/quality problems occurred principally in the southern section of the Division.

The high percentage of people living in affected areas in the Gulf of Carpentaria Division results from flooding that was widespread throughout the southeastern corner of the Gulf at the time of the survey. All local governments responding to this issue in the Gulf of Carpentaria Drainage Division were concentrated in this corner, three of them explicitly mentioning flooding in the free-form answer section.

There are two smaller regions of Australia exhibiting water problems affecting large numbers

of people. The east coast of Tasmania, surprisingly, responded to this issue, with 43 per cent of the population living in affected areas. Approximately 81,000 people lived in these local governments areas, representing 32 per cent of the state's population. Garman (1983, 126) commented on a similar, unexpected result. He found that Tasmania reported the highest incidences of inadequate treatment and unreliable supply as measured by the frequency of water restriction. Tasmania has much of its water supply untreated (40 per cent) or, if treated, unchlorinated (43 per cent). While Garman does not suggest reasons for either this low level of treatment or the unreliable supply Rees (1982), in examining the institutional structure of Australian water management authorities, uses the example of a Tasmanian municipality to illustrate the competition water supply infrastructure faces when there are other more visible capital works items. In the second area, the Pilbara, 46 per cent of people lived in areas of water quantity/quality problems, but the free-form answers do not indicate what the major concerns were in this area.

Local governments in five Basin Groups in eastern Australia (West Gippsland, the Hunter Valley, the Sunshine Coast, and the Darling Downs) all commonly reported water quantity/quality problems. The Gippsland Basin Group includes areas of brown coal mining and the reported water problems may be related to that industry. Similarly the replies from local governments in the Hunter Valley Basin Group reflect the widespread concern about the degradation of the Hunter River established in many official investigations (e.g. New South Wales Department of Environment and Planning, 1982). However, only 37,000 people lived in local government areas in the Hunter Basin Group citing water quantity/quality problems compared to 68,000 in the Gippsland Basin Group.

The high citation rate of this issue on the Sunshine Coast (Queensland) may result from the rapid population growth in the area and difficulty in servicing the requirements. This belief is supported by the fact that no local governments cited natural disasters on the Sunshine Coast while six cited population change. Drought was the cause of this issue being cited in the Darling Downs according to the free-form replies.

When the replies were weighted by population, the most affected area was found to be Basin Group 410, centred on Bendigo, which contained 162,000 people. Basin Group 430, also in the lower Murray-Darling Drainage Division, contained the third largest number of potentially affected people. Although a high percentage of people in southwest Western Australia live in areas reporting water quantity/quality problems the numbers potentially affected are much smaller than in the Murray-Darling Drainage Division (28,000 in the most affected Basin Group (630) and 97,000 throughout the whole Drainage Division).

In the two Basin Groups surrounding Perth and Adelaide water quantity/quality problems were cited often enough in the free-form part of the survey to account for more than 30 per cent of the resident rural population. These two areas were also identified by Garman (1983) as having the greatest quality problems in reticulated supply to rural areas. However, the Basin Groups around Melbourne and in the western Murray-Darling Drainage Division have more people living in local government areas, where water quantity/quality problems were seen to be sufficiently important to be chosen for mention in the free-form replies, than did either the Perth or the Adelaide Basin Groups.

SALINISATION

In contrast to the widespread recognition of general water quantity/quality problems throughout Australia, the perception of salinisation as a major problem was concentrated in the southwest of Western Australia and in the lower Murray-Darling region and, to a lesser

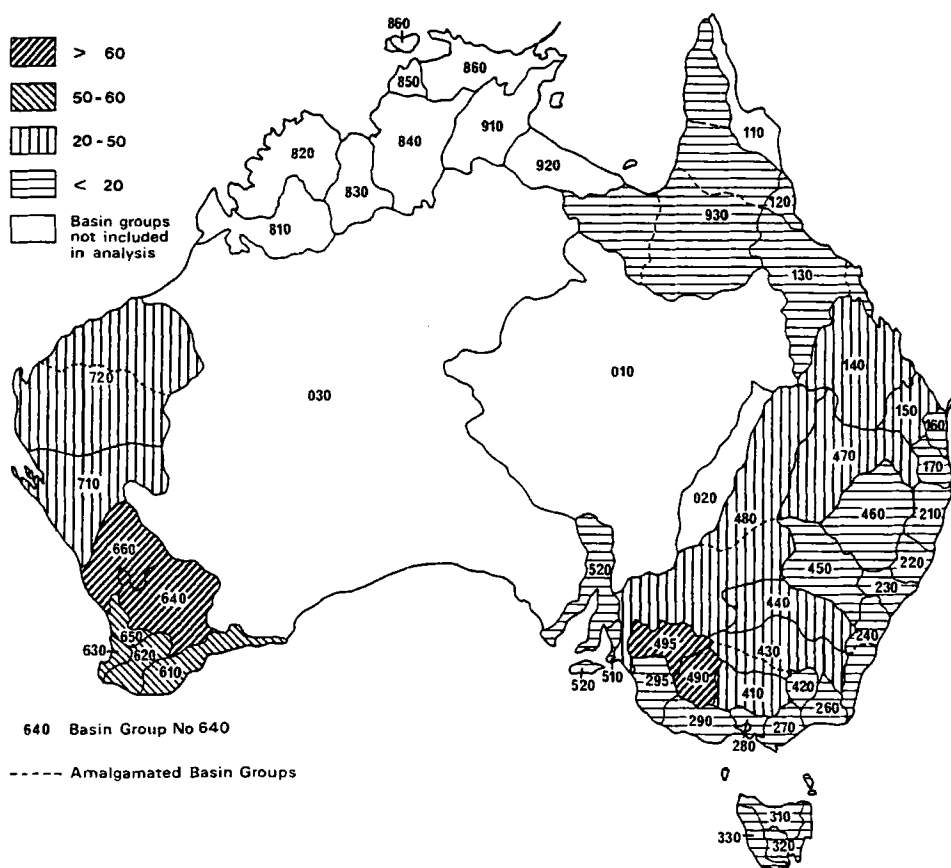


Fig. 3 Percentage of population in each Basin Group potentially affected by soil and water salinisation. Basin Groups in southwest Western Australia (610-660) and in the lower Murray-Darling Drainage Division (490 and 495) are affected by dryland and irrigation-induced salinity respectively.

degree, in the Pilbara. Although salinisation was mentioned as being an issue in other parts of Australia it was not commonly cited (Table V). This geographical distribution is similar to that reported in Peck and others (1983, 54) on human-induced salinisation.

The statement of the issue did not distinguish between natural and human-induced salinisation. Nevertheless, the respondents appeared to recognise only the latter as an issue. Figure 3 shows that there were high percentages of people affected by this problem in the two main regions identified, with Basin Group 495 having 89 per cent of its rural population living in local government areas citing this issue, and Basin Groups 640 and 660 having 85 and 75 per cent respectively of their populations living in such local government areas. In fact both Basin Groups 610 and 495 had 46 per cent of their rural population living in local government areas where salinisation was stated to be the single most important issue.

While the issue of salinisation was very commonly cited in these two regions, the problem was also recognised in a broad band running from the western section of the Murray-Darling Drainage Division to those Basin Groups encompassing the brigalow country. In all, 634,000 people lived in local government areas where salinisation was recognised to be a problem, with 112,000 living in areas where, according to the free-form replies, it was seen to be the major land use issue facing the community.

Peck and others (1983, 27) estimated that 5500 km² of land was salt-affected from human activities and 4910 million m³/yr of stream flow is highly saline. Their reported distribution of this salinisation is very similar to that found in the present study, except that the widespread area of minor scalding in western Queensland reported by them was not confirmed by us since much of this area was eliminated from the analysis. It appears that local governments clearly distinguished between dryland and irrigated land salinisation. For example, of the seventeen local governments which reported salinisation of either soil or water but no water quality problems (i.e. indicative of dryland salinisation), eleven were in Western Australia, four were in Victoria, and two were in New South Wales. This conclusion was also supported by the free-form answers where irrigation was often cited in the Murray-Darling Drainage Division as being associated with salinisation.

CONCLUSION

The value of this study lies in the broad agreement discovered between expert reports on Australia's water usage problems and the perceptions of the users as represented by rural local governments.

Nationally, the loss of prime agricultural land because of subdivision is clearly seen to be the principal rural land use issue, with water quantity/quality issue being ranked between third and sixth depending on the measure of concern used. Salinisation was of slightly less importance and both were ranked about equally with concern over soil erosion, population pressures on the coastal zone and the impact of natural disasters.

Water quantity/quality concerns are widespread throughout Australia. They result from a variety of causes ranging from floods in the Gulf of Carpentaria Division to droughts throughout much of southern Australia. Unexpectedly, this was seen to be the most important land use issue facing eastern Tasmania. On the other hand salinisation was largely concentrated in southwest Western Australia and the lower Murray-Darling Drainage Division. In the former area it was recognised as being the principal rural land use issue, but in the latter it was only the fourth or seventh most important issue depending on the measure used.

Official studies such as the *Water 2000* reports must be supplemented with surveys of user perceptions, such as the one reported here, and an understanding of the complex political and institutional framework surrounding water management (Crabb, 1982), to provide a basis for action on Australia's water problems. As Peck and others (1983, 68) say in the context of salinity management, 'Many factors affect the management response to a salinity problem. They include the physical extent and intensity of the problem, its economic, environmental and social consequences, and the perceived need for either an immediate solution or an improvement in the long term'.

A number of indicators of user concern can be developed from such surveys and each can form the basis for distinct policy responses to water related concerns. Thus if responses were to be based upon the size of the affected population, then action on salinisation should be concentrated in the irrigated regions of the Murray River. Alternatively, if they were to be

based upon either depth of expressed concern or percentage of population potentially affected, they should be concentrated in southwest Western Australia.

The survey used in this study, with its review of a broad range of land use issues, provides a context in which issues related to water quantity and quality can be viewed. However to provide specific information on user perceptions it would be necessary to undertake detailed surveys (such as that of Garman) with the respondents being not just local government officials but also domestic, agricultural and industrial users of Australia's water resources.

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