



THE SCIENTIFIC BUREAUCRACY AND THE ENVIRONMENT

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Abstract

Administrative arrangements for the expenditure of Australian government funds on the environment are discussed by way of funding and review arrangements for research and extension. The historic and current roles of publicly funded organisations are outlined and discussed in relation to the use of position to exclude industry. Case examples provide illustrations. The general implications of industry suppression are identified and discussed in relation to government industry policy.

Introduction

Environmental research and extension in Australia have traditionally been the domain of public organisations. The reason is usually identified as being the un-profitability of such activities necessarily excluding industry. However, most of the public environmental research has been conducted to support industry, particularly agriculture. The reason for the exclusion of industry therefore relates to the organisational structures used to control the flow of funds rather than a lack of a capacity to generate funds.

The circumstances are partly reflected in the slogan from mid last century that farmers capitalised their gains and nationalised their losses. Agriculture, the most extensive land use and subject to most environmental research, developed with a history of direct and indirect government subsidies. The brigalow scheme illustrates a direct subsidy whereby a State government initiated and funded the clearing of extensive areas of native vegetation to make the land available to farmers at virtually no capital cost. Excluding tariffs and tax concessions, the main indirect subsidies were provided by government funding of extension and research.

Opportunities for major land developments are now limited and government expenditures on land development address urban rather than agricultural land use. Also, expenditure on extension services, while still appreciable, has generally declined. Most agronomic advice is now provided commercially by industry rather than by government agencies as this makes it a direct cost to producers rather than an indirect subsidy. It has also improved the quality and effectiveness of the advice. The growth in most agencies has been in governance by way of the development and implementation of rules and regulations.

The main exception to the general decline in the provision of government services is conservation where there has been large growth in government expenditures in directly managing land and in funding land management activities. The activities addressed have expanded from conservation to land management generally such that the decrease in

agricultural extension is dwarfed by developments that allow agencies to exert direct control over land use.

This extensive government involvement in the environment is justified on the basis of public good. The involvement of industry is generally identified as being inappropriate because of the profit motive, the regional nature of many issues, and lack of professional skills.

Industry is identified as only being interested in profit while public organisations are solely concerned for the environment. Government officials assume the high moral ground because of a suggested disinterest in money. However, the personal motivations differ little between those employed in industry and government with money and the environment being important for everyone.

The key issue is that profit is an essential component of sustainability. For biological organisms profit is usually evaluated in terms of energy, mass or numbers, but money is used by society to broaden the scope of the evaluation. Profit, in its broadest sense, should be the central consideration in all environmental activities as it is essential for sustainability.

While it is suggested that industry lacks the skills and technical ability to address regional issues, industry has the capacity to employ and manage personnel with the requisite skills for all tasks. Indeed, industry is less constrained than public organisations as it is not bound by State borders or other legislative jurisdictions. The barriers to comprehensively addressing environmental issues deriving from departmental boundaries are more readily addressed by industry than by government.

On public benefit, businesses do not survive unless they deliver benefit to customers where the customers include the Australian and State Governments. Whether direct to the public or through governments, the benefit provided by industry should constitute public good. The main operational difference is that feedback from the public to industry is direct whereas the feedback to government organisations is indirect through being buffered by politicians. Industry has to respond to customer needs to survive. Industry may manipulate public perceptions of need but so too do governments.

The organisational system that has evolved to address the environment closely resembles the prior system for agriculture that was disbanded though being deficient. The main difference between the old system used for agriculture and that previously used for the environment was the direct Australian Government funding of community groups, such as Land Care. However, this changed and the funding now goes to Catchment Management Boards (CMBs) that are variously effectively controlled or very strongly influenced by State agencies through mechanisms such as legislation, the transfer of personnel from government agencies, the direct involvement of agency personnel, and the large contribution of State funds.

This paper examines the implications of the current organisational arrangements for environmental research and extension. It then uses an Australian Government study on dryland salinity to illustrate how public organisations manipulate these arrangements to their benefit to exclude industry. This has the effect of greatly decreasing both public benefit in the achievement of environmental outcomes and the potential for improving the economy through improved productivity. It increases environmental costs and effectively prevents the development of environmental capabilities to obtain export income.

Funding arrangements

Current arrangements for expenditures on the environment have most funds deriving from the Australian Government being disbursed through the CMBs. Smaller amounts go direct to

agencies, including government departments and statutory authorities such as CSIRO, and to community groups. The Australian Government funds are generally matched by funds from the recipients when going to State or other public organisations, and by in-kind contributions when disbursed to community groups.

Role of the Australian Government

The Australian Government funds are disbursed under a range of programs in a number of departments but most are under joint control of the Department of Environment & Heritage (DEH) and the Department of Agriculture, Forestry and Fisheries (DAFF). Of the many funding avenues the one of most consequence is the CMBs as these were established by States to facilitate implementation of the Australian Governments environmental programs.

The reason for formation of the CMBs appears to be comments from audits of the earlier Australian Government funded Land Care program that:

- The funds could not be adequately tracked to determine if expenditures complied with administrative requirements.
- There were no measures of the performance of the programs in delivering the stated environmental objectives.

The second point remains applicable and will continue into the foreseeable future. The first point, which is an administrative issue, was addressed by funding larger groups that could maintain good records and hence facilitate the tracking of funds. The change served only to address the needs of administrators.

While some public funds are always inappropriately expended the consensus was that expenditures through Land Care groups were highly cost effective because of the low overheads and the high in-kind contribution by Land Care members. By comparison the overheads of CMBs are high and the in-kind contributions have diminished. CMBs depend on being able to lever funds in 'commercial' contracts as opposed to the direct participation of the recipients in Land Care. The transition from funding Land Care groups to CMBs has diminished the direct community involvement that was meant to be the prime focus of the environmental programs for the sake of administrative expedience.

The main 'scientific' justification for CMBs is that many environmental issues are regional and cannot be addressed by dispersed local groups in Land Care. While the regional nature of some issues is undeniable the reality is that they can only be remedied by local actions. Environmental planning is regional but management is local, and environmental impacts arise and are addressed through management.

The States are responsible for the land, and the States are involved in most Australian Government funded land environmental activities, directly and indirectly. Indeed, the Australian Government uses funds to influence State activities through the requirement for a 50% contribution by the State. This desire for a 50% leverage on funds occurs at all levels of funding of environmental activities and so effectively constrains participation to public and 'not for profit' organisations. Industry is effectively excluded.

The current arrangements were developed by individuals involved in administration rather than delivery, and in land use planning rather than land management. The arrangements facilitate the administrative process at the expense of achieving desired outcomes.

Research funding

Research funding is a very small proportion of the total expenditure on the environment but is important in largely determining the direction of expenditure of environmental funds on other activities. Research serves to set the priorities and directions for expenditures and, more recently, the methods authorised to be used. This is despite such proscription being contrary to the Australian Government Trade Practices Act. Receipt of funding for anything depends on the proposal according with established paradigms that derive from research by public organisations.

There is a consistent theme that industry should contribute 50% to any government subsidised research where this appears to derive from marketing boards for primary industries (Boards¹) established by the Australian government last century. The Boards had guaranteed revenue through Australian Government mandated levies on producers, and the matching funds by the Australian Government were an incentive designed to promote expenditures of these funds on R&D. Historically all research funds dispersed by the Boards went to public organisations. The monopoly status of Boards is diminishing in the marketing of produce but effectively remains for research.

A requirement for 50% leverage with the disbursement of environmental research funds effectively restricts the provision of such funds to public organisations. Companies cannot afford to subsidise activities unless there is a potential for a large future return. This situation currently cannot occur with the provision of environmental services as government agencies deliver most of the services. Specialist service companies are effectively excluded from participating in government funded environmental research.

The main industry potential to participate arises where companies obtain most of their revenue from products rather than services, as with irrigation companies that manage the supply of water, as the environmental research funds then represent a subsidy for their other activities. With genuine industry the research is typically used for marketing but most such companies usually represent modern versions of the old marketing boards in having tight regional and/or sectoral interests. Such jurisdictional constraints prevent the effective addressing of the environment.

The prime beneficiaries of this 50% leverage requirement continue to be public organisations, but the mechanism has changed as public organisations now match the Government research grant with public monies from other sources. The Bureau of Rural Sciences (BRS) is a research arm of DAFF that gets around 50% of its funding direct from Treasury (appropriation funds). The remaining 50% has to be obtained from other sources and is generally referred to as external funding. However, DAFF is jointly responsible for disbursing most of the Australian Government environmental funds and this is the main source of the external funds for BRS. These funding arrangements are secure as DAFF/BRS advise the Australian Government on the funding priorities.

The administrative arrangements for government funding of research promote continuation of the effective monopoly of public organisations that excludes industry.

¹ While presented as being industry the Boards are statutory authorities established by government. The Australian Tax office definition is that industry is subject to direct taxes where the Boards are not.

Role of Councils

Councils are variously dismissed as being inapplicable to environmental management because of considerations such as:

1. They are too small
2. They don't have the expertise
3. They are not interested in the environment
4. The local politics

The undesirably small size is generally acknowledged, except by individual councils, but is addressed by regional organisations of councils (ROCs). Lack of expertise is usual but no different from CMBs. The cross section of environmental interest in councils should reflect the community and hence be balanced. However, the focus of CMBs is the environment. While environmentalists expect to determine environmental activities balance is needed to ensure that the expenditure of public monies on the environment does not disadvantage the community. As for politics, all groups are by definition political and differ only in their size and their range of interests.

The aspects of Councils that are seldom considered when addressing the environment are:

- They have the statutory responsibility for land planning and management. While this varies between States it is usual for the State to legislate the requirements and for councils to have the responsibilities for implementation. Indeed, it is usual for councils to bear all risks relating to that implementation. Councils have the authority to implement the changes to land management needed to effect desired environmental outcomes.
- Councils are the most local level of elected government. They therefore best represent the local community and are not restricted to representing particular interests, except for the usual promotion of personal interests.

The main reason for the effective lack of Council involvement in the environmental expenditures appears to be an unstated intent to maintain separation between the environment and other land management issues. This appeals to the more active environmentalists, who are often the main drivers for environmental activities, and it also suits government agencies. The control by agencies on Councils is constrained by legislation but this does not apply with CMBs. Moreover, agency personnel can have direct involvement in CMBs when this cannot occur with councils.

Role of Industry

The current funding arrangements have no identified role for industry, nor is there any obvious path for a role to develop. The main possibility relates to contracts for specific activities with the CMBs but, as the contracted activities reflect the interests of the public organisations advising the CMBs, such opportunities are limited.

This exclusion of industry by agencies can be extreme to the point of being corrupt. ERIC won a contract where the specification had been prepared by an agency, and where, unknown to the CMB, two of the specified tasks had been completed by the agency. The agency expected to win the contract through their control of information, and use the funds to employ a person on unrelated activities. The agency prevented a recurrence of this situation by subsequently advising another CMB that industry did not have the ability to undertake such

work. The work was handed to the agency without any evidence of a specification having been produced.

The main role of industry is the provision of products and services but also includes the conduct of research to improve that capability. Most expenditure on research in Australia is by Industry, but extremely little addresses the environment. The main role of government is governance but most governments have considerable involvement in service delivery. There is generally no overlap between government and industry in the provision of products from the land (power, timber, and water excepted), or in governance. However, there is considerable overlap in the provision of services depending on the industry sector.

The ANSLIC industry codes have no category for the provision of environmental services on the land hence there is no identified industry sector. There is not even an environmental sub-category for agriculture. Indeed, the term environmental industry has become synonymous with waste disposal which has been the antithesis of good environmental management.

This lack of a defined industry category addressing the land environment reflects reality. There are numerous small companies and some moderately sized companies that provide such services, however, the associated industry revenue is exceedingly small in relation to both the GDP and the environmental expenditures of public organisations. Public organisations have an effective monopoly in the provision of services to the land environment.

There are pros and cons to the provision of services by either government or industry but the trend has been towards an increasing role for industry. While this partly reflects cost-benefit considerations the key issue is governance. A potential conflict of interest arises when an organisation that sets and polices regulations also provides services against them, commercially or not, and that potential is almost invariably realised. The system works on a series of checks and balances built around the separation of responsibilities. The separation of regulation from service delivery is a key check.

The control of the environmental funds by public organisations is mainly effected through their specifying the needs and methods and/or standards for particular activities. The needs and methods specified reflect the agency interests and capabilities. The agencies are therefore best placed to service the identified requirement. Agencies can have direct involvement in CMB working groups and/or influence directions through the provision of advice and the setting and policing of regulations.

This situation is promoted by the effective lack of industry involvement in research as research largely sets the directions and accepted methods. Public research organisations strongly promote the use of their methods and results so as to gain further research funding, which is normal for all organisations. However, as the public research organisations also provide services, this places industry at a distinct disadvantage when competing for the few opportunities to obtain work.

One of the significant barriers to industry participation, particularly in research but now also in service delivery, is the penchant of government to lever funds. This has a historical basis in being an incentive for industry to undertake research, and hence was designed to promote industry, but for the environment now appears to reflect a desire to exercise influence, increase the funds available to support an activity, and ensure commitment. However, its main effect has been to greatly decrease the potential participants. In particular, it excludes small to medium enterprises (SMEs) with high levels of capability that can produce better results more cheaply.

The effort expended in the LWA salinity report² to denigrate radiometrics and promote airborne EM for regional salinity mapping has its origins in the great disparity in costs. Even assuming equivalent capability to address the issue³ the results from radiometrics are 50 to 100 fold cheaper than the promoted EM. Leveraging has the potential to increase costs to the community by 5,000 % as the proposed EM can only be delivered through public organisations that use public funds to meet the leverage requirements. Decisions on the expenditure of any funds should be determined by cost effectiveness rather than the level of leverage.

Another issue restricting industry involvement is that administrators are highly risk adverse. The contracting of large public organisations is seen as having no risk whereas small private companies, which are the cauldrons of innovation, are seen as having highest risk. This is despite the survival of small companies depending critically on success, large companies being buffered against failures, and public organisations being able to survive without providing any real gains.

This situation is compounded when tasks become technically complex as companies are expected to succeed regardless of the circumstances. Project managers administering funds are deemed to have failed if a contracted company fails to deliver the project outcomes, but if a public research organisation fails the project manager is absolved of blame because it is obvious that the outcomes were too difficult to be achieved.

Overall, the funding arrangements for government land environmental expenditures suppress the involvement of industry when Australian Government policy requires promotion of industry. The minor role that is slowly developing for industry involves contracting to provide selected services using methods defined by agencies. The generally low level and highly proscriptive nature of the methods effectively precludes application of the proscribed capabilities other than to a specific jurisdiction. This reduces the cost effectiveness and limits industry development, quite apart from greatly limiting any realised environmental benefits.

The specification of methods rather than outcomes by agencies has adverse effects additional to reducing competition, increasing costs, and decreasing the usefulness of results, as such methods are almost invariably specific to jurisdictions. This makes it cost prohibitive for a company to maintain expertise in all methods given the limited amount of work available. The ability to respond to a specific tender request is therefore invariably restricted to a few companies based in the jurisdiction where these increasingly represent individuals recently retired from an agency.

Case Example

In 2003 DAFF, through LWA, funded the production of a report that reviewed mapping methods for dryland salinity. The purpose of the report was to provide advice on the appropriate technologies to those needing such mapping (effectively the CMBs). As DAFF controls the funding for such activities through the review and authorisation of all proposals involving Australian Government funding, the report effectively determines what methods are authorised for funding.

² Review of Salinity Mapping Methods in the Australian Context - Technical Report and User Guide. The report was authored by Spies and Woodgate, funded by Land and Water Australia (LWA), and is available on www.ndsp.gov.au.

³ There is no possibility of the advocated EM providing a solution to dryland salinity.

2004 Report

The 2004 report, Review of Salinity Mapping Methods in the Australian Context - Technical Report and User Guide, was identified as having been developed under the auspices of the Natural Resource Management Ministerial Council through LWA and the National Dryland Salinity Program (NDSP)⁴ with support and endorsement by the Academy of Science and the Academy of Technological Science and Engineering. The technical review was authored by Brian Spies and Peter Woodgate. The affiliations of the authors are not defined despite the report containing a section on governance. Indeed, it is not clear from the report what organisation is responsible for its production (it was produced under commercial contract) or who owns it (ownership resides with DAFF through LWA).

The content of the technical review was developed by requesting submissions on mapping methods to be presented in a specified format, having technical committees review these and develop sections of the report, and then reviewing these at a public meeting facilitated by the Academy of Science and Academy of Technological Science and Engineering (the Academies). There was subsequent review by technical committees. All speakers at the public meeting were from public organisations and none were from industry. The report was finally reviewed by a committee established under the auspices of the Academies apparently comprising personnel from only public organisations.

A partial review of material in the LWA salinity report⁵ compares the use of electro magnetics (EM) and airborne gamma radiation data (radiometrics) in salinity mapping. This comparison is pertinent because the LWA salinity report promotes the use of EM and is highly derogatory of radiometrics, where the submissions on radiometrics came from industry and those on EM were primarily from public organisations.

The main recommendation in the initial LWA salinity report is that the strategic requirement relates to the regional mapping of subsurface salt stores using airborne electro-magnetics (EM) where this commercially benefits CSIRO and BRS. While this conclusion only occurs in the executive summary, and is not substantiated by evidence in the report, it links with the assertions that the requirement relates to the regional mapping of salt stores and that EM is the only technology that can provide such information.

The promotion of EM becomes extreme with it being identified a both a direct and indirect measure of salinity. The authors have not provided an explanation as to how this can arise hence a report released under the auspices of the Academies, involving extensive review by personnel in public organisations, and promoted with the phrase 'no magic bullet, just good science', contains a major logical error. The LWA salinity report contains many errors of fact and logic⁶.

The negative treatment of radiometrics was as extreme as the positive treatment of EM. Key conclusions on soil property mapping using radiometrics in the LWA salinity report are:

1. Any soil mapping results using radiometrics only have local validity (the technology is not applicable to regional mapping).
2. Airborne radiometrics cannot be used to map salinity.

⁴ The NDSP was then part of LWA but was disbanded. LWA was subsequently also disbanded.

⁵ Tunstall, BR (2004) Comparison of EM and Radiometrics for Dryland Salinity Mapping. On www.eric.com.au.

⁶ General & Technical Comments of the Initial Release: Technical Report on Salinity Mapping Methods in the Australian Context by Brian Spies and Peter Woodgate (2004) & Comments on the 2005 version of: Technical Report on Salinity Mapping Methods in the Australian Context by Brian Spies and Peter Woodgate (2005). On www.eric.com.au.

3. Claims made by some vendors (me) as to the capability of radiometrics for salinity mapping have no basis in science.

These points are contrary to abundant publicly available results and are largely based on a review of technology described in a patent application (termed SalinityMap). The review was funded by the NSW Department of Infrastructure Planning and Natural Resources (DIPNR) and attributed to Geoscience Australia. Referred to here as the DIPNR review, the report is not publicly available but was used by those preparing the LWA salinity report. The LWA salinity report contains strong negative conclusions that are based on a report that no one can access. Conclusions based on the highly selective use of information have been presented as facts and everyone is apparently expected to accept them because of the status of the government organisations funding those that made them.

A response to the main points in the DIPNR review is given in Appendix 1, and with SalinityMap results on the ERIC web site⁷. These show that the conclusions drawn from the DIPNR review for use in the LWA salinity report represent simplistic application of theoretical modeling (technology) and would not arise with application of the scientific method. Indeed, they would not arise given sound knowledge of numerical techniques for analysing multi band digital image data.

To date all of the main parties in the development of the LWA salinity report and the presentation of the derogatory comments on the use of radiometrics in mapping salinity and soils have rejected all requests for a right of reply. The positions of the parties are best evaluated against legal requirements for the provision of evidence in court, which has the purpose of establishing fact. All evidence has to be freely available to all parties, and those providing it have to be available for cross examination. The use of the DIPNR review in the LWA salinity report breaches fundamental requirements that apply in law as well as science.

The selective use of information is further illustrated by the personal communication by Baden Williams in the LWA salinity report that the EM signal accounts for between 70 and 90% of the soil salinity. Given the significance assigned to EM in the LWA salinity report, and the amount of work undertaken using the technology, the need to use a personal communication to justify its value is bemusing. It is highly problematical given the comment attributed to Baden Williams in the House of Representatives Standing Committee's report⁸ on salinity that no airborne EM has ever provided benefit to land care groups. Baden Williams strongly distinguishes between the value of ground and airborne EM in addressing dryland salinity but this does not occur in the LWA salinity report.

Summary and conclusions

Those developing the LWA salinity report identify the production process as being designed to make the report independent of the organisation that funded it. They further suggest that the process was also designed to provide free and open participation and to be scientifically sound. Methods used to achieve these ends include:

1. Presenting the report as belonging to the Natural Resource Management Ministerial Council.

⁷Tunstall, BR (2004) Comparison of EM and Radiometrics for Dryland Salinity Mapping. On www.eric.com.au.

⁸ Science overcoming salinity: Coordinating and extending the science to address the nation's salinity problem (available on <http://www.apn.gov.au/house/committee/scin/salinity/report.htm>). This was published prior to the LWA salinity report.

2. Presenting the report under the aegis of the Academies.
3. Preparing the report through committees.
4. Openly advertising for contributions.
5. Holding a public forum.
6. Having the report reviewed by a committee.

The situation with each is:

1. The role of the Natural Resource Management Ministerial Council is obscure as the report was funded by LWA and is the property of DAFF.
2. The involvement of the Academies was restricted to the provision of facilities and letters of support. The Academies can only provide a façade of scientific respectability, particularly given the errors of fact and logic in the report.
3. The committees comprised personnel involved in activities that benefit through continuation of the existing situation. The committees were strongly dominated by representatives from public organisations.
4. The form of submission was dictated by Spies and Woodgate and the use of material from submissions was highly selective. The ERIC submission was rejected through not being supported by published peer reviewed papers when an extensive list of publications presented previously included reports published by CSIRO.
5. While there was provision for public comment there is no indication that any of the comments were taken into account, and there are indications that they were not. Moreover, industry was excluded from presenting as an explicit request was rejected on the basis that the format of the public meeting had been determined.
6. If the committee had served its purpose the report would not contain obvious significant errors.

Production of the LWA salinity review involved personnel from organisations that benefit from a continuation of the existing situation. It was prepared by a loosely knit group of individuals with similar administrative backgrounds and scientific interests that were prepared to unite against a common threat to their funding. That threat was industry involvement in environmental activities, particularly research. Personnel in public agencies are prepared to work with companies that provide products they can use to enhance their position but attempt to exclude companies that provide competing services.

The effect of the LWA salinity report is to continue the exclusion of industry from addressing land environmental issues as it denigrates technologies and services from industry and promotes those provided by public organisations. The monetary and environmental costs to the community are very high, as illustrated by their promotion of airborne EM. The ERIC technique they denigrate to justify the statement EM provides the only method for regional mapping of salinity costs around 1% of the EM, and it provides much more relevant and useful information. The cost of airborne EM would always be prohibitive for widespread application but the associated denigration of a competing but more applicable technology means that results needed to improve salinity outcomes are unlikely to be produced in the foreseeable future.

This exclusion of industry has deficiencies additional to decreased benefits and increased costs as it perpetuates the need for high levels of public expenditure on the environment. It locks government into a recurring cycle of public funding which, according to some, involves many

billions of dollars that society cannot afford. It promotes an approach to addressing the environment that is not sustainable.

2005 Report

The LWA salinity report was eventually published under the auspices of DEH as well DAFF but no reason is given for the involvement of DEH. It may be 'justified' on the use of DEH publishing facilities, or the joint involvement of DEH with DAFF in dispersing environmental funds, but DEH had no involvement with the project.

The 2005 version of the LWA salinity report provides information on the background of the authors of the report, but this does not identify that they have any expertise in either irrigated or dryland salinity. They don't. Moreover, there is still no indication of the organisation contracted to develop the report.

Applicability of Existing Land Environmental Information

Historically environmental information has been developed to address land use planning as this has been the prime responsibility of the governments providing the funds. The CSIRO Land System method for example, was designed to evaluate agricultural potential and was used to determine appropriate land uses and farm sizes. The focus on planning continues with the activities of Australian Government organisations such as the Australian Greenhouse Office, the Murray Darling Basin Commission, and the National Land and Water Audit.

The general situation with the jurisdiction of government agencies was that their responsibility to provide environmental information stopped at the farm gate. Expenditures on the environment have been primarily designed to provide information for decision makers in government rather than information useful for landholders in managing the land

Despite this focus on planning those developing the information almost invariably claim that it is applicable in management. While some information is usually better than none the traditional forms of information have proven deficient for management because of their generalised nature. Management depends on site specific information whereas the information used in planning must be generalised. Land Systems contain various mixtures of Land Units where the Land Unit is relevant to management but is rarely mapped. Similarly, Soil Landscapes do not map the distribution of soils but map polygons that contain a diverse mixture of soil types. Such probabilistic information is exceedingly difficult to apply in management even with expert knowledge of the mapping methods and the taxonomy of soils.

Agencies are gradually realising there is a need for more detailed information to address issues such as dryland salinity and vegetation. However, the response is constrained by their history, and they almost invariably attempt to adapt old technologies that were not designed for the purpose. New technologies that best address the requirement are rejected because of a lack of in-house expertise. A recent example is the aborted vegetation mapping for NSW based on traditional air photo interpretation (API). Its subjective nature produces inconsistent results and, as the spatial accuracy is poor, it cannot be used as a reference for monitoring change. The high labour requirement makes it cost prohibitive.

Satellite imagery currently provides the only means of achieving the desired objectives with vegetation mapping, and it is highly cost effective. However, effective application requires high levels of knowledge and skill in vegetation as well as image analysis. Its rejection means that, despite large expenditures, there is still no reference vegetation map suitable for implementation of regulations relating to conservation and land clearing in NSW.

A similar situation exists with soils where existing Soil Landscape maps are effectively useless in addressing dryland salinity. The response has been to resort to subjective interpretative mapping of salinity by way of ground water flow systems rather than the production of reliable soils information that can be used to promote remediation as well as identify hazards.

There now is a need for agencies to have detailed site specific information to develop effective regulations and enforce them, but such information does not exist. Their responsibility to provide information no longer stops at the farm gate. Their pragmatic response has been to separately investigate local situations, however, this has created great uncertainty in the minds of landholders as there is no way of knowing what the outcome of an assessment might be. Typically anything native is assigned high priority, particularly if woody, simply because the information needed for a realistic assessment of status and value does not exist. Landholders are typically subject to the worst possible outcome for them without any substantive evidence of conservation or environmental benefits. This lack of substantive basis is the reason for agencies attempting to deny landholders any right of redress.

Conclusions

Society is concerned about the environment, and has a justifiable expectation that those addressing it on their behalf will take all opportunities to cost effectively deliver the desired outcomes. However, many on the land have become disillusioned with government efforts that seek to address environmental issues by suppressing their rights, particularly when those efforts are based on incorrect information. Science has been central to this suppression in being used to claim validity for false information. The justification of false information has usually employed suppression of contrary information.

Some of this suppression can be seen as being a normal response whereby people continue to work with what they know and find reasons to reject alternatives. However, while natural, this is not acceptable as it degrades environmental outcomes and increases costs. Its escalation to the presentation of misleading information and denigration of alternatives is contrary to basic administrative, scientific and legal requirements. Most of this has been directed at exercising control over landholders but much as been directed at excluding participation by industry.

Reasons given for excluding industry from environmental activities usually relate to the expenditure of public funds and industry having to make a profit. However, the funds used to address the environment have to derive from industry so that without industry there would be no environmental activities. Moreover, profit is an essential component of sustainability. The reasons for involving industry mainly relate to reducing conflict of interest and achieving sustainability, where cost effectiveness is a component of the latter.

Industry is well placed to fulfill the environmental service requirement, particularly since the service largely addresses commercial use of the land. Industry can thereby support government in developing the detailed information now needed for planning and regulation. This then allows agencies to focus on their core activities.

From a scientific perspective the suppression of information is untenable. The questions arise as to why the standards of some public scientists have become so low for it to occur, and what will be done to remedy this ultimate of deficiencies. From a governance perspective the issue arises as to why Australian Government industry policy has not been taken into account in the expenditure of funds on the environment. The initial question of why is addressed by this paper. The subsequent question is; what will be done to remedy this highly adverse situation?

APPENDIX 1: BRIEF RESPONSE TO THE DIPNR REVIEW OF THE SALINITYMAP TECHNOLOGY⁹

This was compiled from 1.5 pages of notes produced following a brief evaluation of the review when it was first available and without current access to the report.

Of the three individuals contributing to the review specific comments can be attributed to two. One reviewer acknowledged the possibility of using a characteristic signature to map a particular attribute. There is no definitive reason that what has been claimed cannot be achieved. However, he concluded that it had not been done. Erroneous understanding that could lead to this conclusion includes:

- His suggestion that the abundances of K and Th should be negatively correlated.
- His suggestion that high values of K and Th are frequently associated with areas of salinity.
- His regarding that the spectral and spatial elements of the analysis are independent.

The association between K and Th levels needs to be positive, which it is, but there is no need for their levels to be high. The identified signatures have moderate levels of K and Th. The requirement is for the existence of a characteristic signature which, given the underpinning physics, involves a positive correlation between K and Th.

This reviewer assumed that the spatial statistics used in the analysis are the same for different areas. For this to arise the spectral and spatial analyses must be independent when they are not. Indeed, it is the interaction between the spectral and spatial statistics that produces the resolution needed to discriminate the salinity signature. The iterative method used to identify classes allows the transfer of signatures across areas but with the spatial and spectral statistical analyses being specific to each area.

Another reviewer assumed that the resolution depends solely on the spectral statistic. He used theoretical analysis to compare the level of a theoretically possible ²⁴Na signal with the signal noise and, as the presumed signal level is much lower than the noise, he concluded that the ²⁴Na signal cannot be resolved. However, signals are routinely detected when they are below the level of noise, as with CDMA phones and in end member analysis with digital imagery, hence this condition alone does not identify that resolution of the salinity signature is technically impossible.

The assumption that the resolution derives solely from the analysis of spectral values is incorrect and this invalidates all considerations in the review of the sensitivity of the analysis. However, even without the benefit of the spatial component of the analysis, the resolution achieved in multi-spectral analysis is much higher than indicated by the signal to noise ratio for individual bands. The enhanced resolution is achieved by identifying a consistent pattern across bands. The theoretical evaluation ignores basic aspects of statistical analysis that are fundamental in achieving high levels of discrimination using multi band digital imagery.

The second reviewer refers only to the K, U and Th bands and routinely asserts that the only signals resolvable are those deriving from parent material. That is, the radiometric patterns can only relate to geology via differences in parent material, and that all of the information is contained in the K, U and Th bands. However, the radiometric signature for the distinct salinity class is completely independent of geology when the signatures for all other classes are

⁹ This is based on notes prepared in September 2003 and without current access to the DIPNR review.

not. There is a salinity class(s) with a distinct spectral signature that is independent of geology.

The review suggests that the SalinityMap results derive from a fortuitous correlation between a salinity class and the intensities for K, U, and Th rather than the detection of a distinct spectral signature associated with salinity. The key inevitable consequence of results deriving from such an empirical correlation is that they cannot be extrapolated across surveys. The results demonstrate that SalinityMap classes can be transferred across surveys with a high level of reliability when the results for other classes cannot. One or two classes have a distinct spectral signature but the others do not. This ability to transfer the salinity class negates the conclusion in the review that the NRI results arise through a fortuitous correlation between K, U, and Th and salinity.

The conclusion that the results arise through a fortuitous correlation (by chance) is additionally problematical because no explanation has been given as to how this can arise. The detection of a consistent signature across a wide range of geologies that have very different signals for K, U and Th negates this claim.

The claim that only K, U and Th deriving from parent material can be detected in airborne radiometric inferences that the TC band does not provide any additional information. This suggestion is simply addressed by a variance/covariance analysis of the information in the bands. The TC band has by far the highest information content and contains information that is not in the other bands. The higher the quality of the data the greater the amount of information in the TC band relative to the K, U and Th bands.

Rationally the issue is not whether a distinct salinity signature exists but how it comes about. The most plausible explanation (hypothesis) is that it derives from cosmogenic ^{24}Na because this radionuclide has two of its coupled multiple emission peaks located in the bands used for K and Th in airborne surveys. The difficulty, as illustrated by the modeling, relates to the expected very low level of any such signal. There is no proof positive either way but the form of analysis used to produce the salinity results technically has the potential to resolve distinct signatures well below the threshold of signal to noise ratio of individual bands. The theoretical modeling does not disprove the hypothesis because of the inapplicability of assumptions invoked in the modeling.

Conclusions

The observation of a distinct radiometric class that is independent of geology cannot be refuted. The observation that this class relates to salinity has observational support and has not been refuted. The hypothesis that the signature derives from ^{24}Na has yet to be tested but has not been refuted by the modeling conducted in the review. The assertions that detection of a salinity signature is technically impossible derive from an extrapolation of the technical analytical capabilities of those conducting the review. The analyses do not approach the level of resolution achievable with other methods and so do not identify what is technically achievable. They do not even take into account of the results that can be routinely obtained with numerical analysis of multi band imagery. The conclusions are based on extrapolation of simple technology rather than scientific analysis.

Overall, theory cannot be used to disprove observations as in science observations are used to test theories. The observations made with SalinityMap negate the theories of the reviewers rather than vice versa.

