THE SOILMAP SAGA

Brian Tunstall

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Summary

Provides the context and history for the development and commercialisation of radiometrics in soil mapping.[1]

Introduction

City dwellers occasionally walk on soils but generally prefer them to be covered by bitumen or concrete. Country folk have a more intimate relationship cursing them when buried in dust storms and when they are too wet or dry to be ploughed.

Best farming practice now has soils as mechanical props storing water and nutrients for use by crops. They are kept naked less some miscreant weed use water they are attempting to accumulate in the soil profile. Nutrients are added using chemical fertilisers when profitable.

In what appears to be the distant past soils were selected for their suitability for crops. Maintaining the fertility of the soil was essential to effective farming, and selection of suitable soils was integral to the development of farming.

The distant past commenced many thousands of years ago and extended to be within my perception. Remnants remain, but modern science and technology combined with religious beliefs to have mankind conquer the land. There was no longer a need to be bound by the shackles imposed by natural constraints as intelligent man could take control.

World War 2 (WW2) was the catalyst for most change. The improvements in mechanisation allowed man[2] to clear everything before him, and conversion from explosives to fertilisers allowed large companies to continue to reap great profits.

Throughout this transition the soil scientists have largely become buried in the commerciality. Their role was to provide information to support the established interests, and even that became minor compared to issues such as weed control. Bigger machines and an explosion in fertilisers and herbicides addressed the future of farming.

The modern approach to achieving best practice can be illustrated by the linking of GPS with spatial measures of crop yield and soil fertility. Patterns of crop yield determined from harvesters are related to basic measures of soil fertility allowing fertiliser applications to be adjusted to be most profitable. All wonderful high tech that increases sales by manufacturers by promising increased returns for farmers. Profit is for now, the future is someone else's problem.

SoilMap had historic roots in addressing the distribution and characteristics of soils to provide information to improve land use and management. Commercially it was meant to allow farmers to select the best sites for crops such as grapes, and allow the development of suitable management practices for the different soils. The problem was its genesis in a period when soil scientists had linked with commercial interests to promote a simple mechanistic approach to land management. The following identifies the consequences.

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[1] Tunstall has full responsibility for this presentation.

[2] My apologies to feminists but the sentiments sit best with the attitudes of the male of the species.

The Genesis

The main vegetation patterns around my brigalow PhD site related to soils. That was expected as soils have been traditionally mapped from vegetation patterns identified in aerial photos. However, Ray Isbell in his Soils of the Brigalow Region identified that occurrences of brigalow were not related to soils. I rate Isbell as the best of the Australian soil surveyors so the comment was not to be taken lightly.

Moving to Canberra gave exposure to Henry Nix and his Bioclim, a development of work by Eugene Fitzpatrick, again one of my select scientists. Bioclim used climate information to predict the suitability of regions for different crops. The main limitation was not the climatic predictions but the lack of soils information that could used to identify specific sites suitable for different crops.

Nix employed an immediate post PhD scientist to address the issue without success. He later had CSIRO sponsor a PhD studentship to again tackle the issue. While that did not provide a means of obtaining the requisite soils information the student involved, Neil Mackenzie, was to figure in the SoilMap saga.

I first seriously considered the issue when located in Rockhampton working in the Shoalwater Bay Training Area (SWBTA). There were two earlier surveys for reference, Land Systems and PUCE (Pattern Unit Component Evaluation). Each provided descriptions of soils and vegetation for fine units within coarse mapped patterns. Discrimination of units within the mapped patterns is essentially based on catenary position[3], as with Soil Landscape mapping used in soil survey.

I numerically analysed Landsat satellite imagery to obtain a detailed vegetation map due to the limited resolution and usefulness of the existing surveys. Combined with comprehensive observations possible through being located in the area I was able to identify broad vegetation patterns related to rainfall but with local variations I attributed to soil fertility. There were patterns within pattern with the local patterns being related to parent material (geology). However, the geology was mapped as formations and the available information was much too coarse for addressing detailed distribution of soils.

My transfer to Rockhampton was based on the establishment of experimental catchments. On returning to Canberra none of the data from the catchments had been analysed. The person employed to undertake the task was Alan Marks, a geophysicist. Describing the problem to Alan his comment was ‘why not use radiometrics?’ My response, ‘why not but what are they?’

The radiometrics are airborne measures of natural radioactive emissions from the soil that relate strongly to parent material. It took one week to acquire the data for SWBTA and produce a map that identified my nutrient related patterns were associated with parent material. The rapid production arose because the analytical methods were the same as I had developed for satellite imagery. Once I knew the characteristics of the radiometric data the rest was routine.

[3] Position in the landscape along a catena (topographic sequence).

The Development

The background is Australian soil scientists being adamant that soils were related to climate but not parent material. The primary soil classification system then used was Great Soil Groups, derived from the USA which was derived from the Russian. The main soil groups are characteristically associated with different climates.

The relevant comment by Bob Gunn, a pedologist in my CSIRO Division that had addressed soils in the SWBTA Land Systems survey, was that one looks at the geology map and then throws it in the corner. Gunn was then editing and contributing to the key book addressing the mapping of Australian soils.

Another issue arose with my addressing soils when located in the Division of Water Resources. The Soils Division was located across the road and their expectation was that all soil research would be undertaken by them. Such partitioning was usually enforced by Head Office[4].

My cover arose through undertaking research on training areas for Defence. No one within CSIRO provided review as funds were otherwise justified. The key development centered on the Singleton Training Area (STA) in association with Rob Gourlay undertaking a Masters Thesis with me as joint supervisor.

The STA work was funded by Defence with Gourlay to produce a management plan. My involvement ensured the development of appropriate resource information with the soils being mapped using radiometrics and vegetation from satellite imagery.

Radiometric data covering the 132km^2 STA were around 10 years old but had never been gridded to provide an image suitable for analysis. The analysis had therefore to start from scratch. However, the main concern was the small size of the STA given the coarseness of the radiometric data. The analysis incorporated segments from only 12 flight lines. Looking at the raw data it was difficult to conceive that anything useful could be obtained.

Given the political constraints the first soil sampling at STA was conducted by Gourlay and me. However, Gourlay was recovering from a very serious vehicle accident and could only record. It was me on the soil auger under hot and very dry conditions when soils were rock hard. That was compounded by my attempting to use an auger borrowed from Bob Gunn's technician. The samples were obtained by buying an auger from a local hire company, reshaping it using the vehicle tow bar, and purchasing an angle grinder for sharpening. I had vowed never again to auger a soil hole in the late 1970s hence the lack of such equipment.

The first soils paper for STA provided a very detailed Soil Landscape analysis where the soil units were mapped from terrain and soils information using GIS. For then very high tech. The second involved further soil sampling to demonstrate that the Soil Landscape approach did not map the main patterns of soils. It negated the Soil Landscape method. The third involved further soil sampling based on the radiometric patterns and mapped statistically significant soil patterns. That map is the first I am aware of that provides statistically significant patterns of soils for an area of that size.

[4] The Division of Water Resources still contained remnants from the multi disciplinary Division of Land Research. Agriculturalists had been annexed early and only two with botanical backgrounds remained in the Canberra laboratory.

Success at STA arose through use of soil properties to describe soils as well as the radiometrics. An attempt to use radiometrics to maps soils in the USA in the 1960s failed because soils were categorised by way of soil types as was standard for soil survey.

Soil Types

This is a wonderful topic for those with no other interests in their life. It links with the wonderful term pedologist, one who is concerned with pedogenesis (how soils develop). It is actually interesting but for the uninitiated it is like reading tea leaves in a teacup.

Pedologists give characteristic soils an unpronounceable name and define their world by way of these reference soils. They follow the same approach as with recognising distinct types of vegetation. The problem with vegetation is that all sorts of integrades occur, and that also applies with soils.

The goal with a pedogenic approach is to differentiate between the reference soils by way of their mode of development. The recognition of soils then depends strongly on an interpretation of how they are formed. Two essentially identical soils can be named differently because they are considered to arise by different means. In the SWBTA Land Systems survey soils were incorrectly named because of an incorrect interpretation of how they were formed.

Knowledge of species provides useful information to the initiated in analysing vegetation but does not allow for rigorous analysis. In particular, it provides very little information on function. The same applies with soil types. The solution with vegetation is to describe the vegetation by way of physical properties such as leaf area. The solution with soils is to describe them by way of their physical and chemical properties.

To increase resolution analyses of vegetation are typically vertically stratified, as with upper, mid and lower strata. The same applies with soils, with the key disjunct occurring between the surface (A horizon) and subsurface (B horizon).

The STA study incorporated key developments in describing soils. Categorical data, such as field measures of soil texture[5], were formed into a pseudo continuous variable to allow analysis with continuous variables such as pH and salinity. Catenary position was similarly ranked in sequence to allow analysis as a variable rather than category where that fudge improves the validity of the statistics as well as their resolution.

The politics here related to my suggestions concerning the inapplicability of soil types when providing information on soils to address land use. Neil Mackenzie had focused his attention on establishing statistical relationships between soil types and soil properties (in the jargon, establishing pedotransfer functions). The fact that the derived statistics represent a laboratory artifact that gives no information on the reliability of soil maps derived using the functions is evidently of no concern[6]. The statistical relationships are between soil types and soil properties but the maps are for Soil Landscapes.

The bottom line is that soil property information is needed to address land use and management, and the measurements must relate directly to the mapped patterns of soils. That occurs with SoilMap. It does not occur with attempts to map soil property information from

[5] Texture categories are assigned names such as sand and silt. These categories can be assigned numbers that identify their position in a continuum from coarse sands to very fine clays. The number sequence is continuous . The pseudo identifies the variable is composed of discrete categories.

[6] Mackenzie was the subject of a complaint to CSIRO Head office by Rob Gourlay re public comments on SoilMap and later became Chief of CSIRO Land and Water.

soil types. The errors are greatly compounded when the reference maps are for Soil Landscapes rather than Soil Units as is essentially inevitable in Australia.

Role of radiometrics

The geology map for STA was more detailed and reliable than usual due to the coal mining potential of the area, however, it still mapped geological formations. Formations represent periods of development and the sedimentary formations all contained layering: Different materials were deposited at different times during development of the formations. The different materials differed widely in their mineralogy and hence gave rise to soils with different physical and chemical properties. The radiometrics mapped patterns of parent material at depths applicable to soils.

THE Australian Soil Classification

This is somewhat an aside but identifies the attitudes and standards of the Australian Soil Science fraternity.

In the 1990s the Great Soil Groups and Northcote's Synthetic Key were replaced in providing names for Australian soil types by THE Australian Soil Classification. The soil types are organised in a hierarchy meant to reflect affinities in development similarly to the families, orders, genera and species in biota. The development of the classification by Isbell incorporated widespread consultation such that it effectively represents a concoction by a large committee.

The dogmatic and doctrinal mind set of the soil scientists is illustrated by their mandating the use of THE Australian Soil Classification for publications on soils. There was no concern about the validity of the classification, or the implications of the constraints they imposed. They are the guardians of all things soils and consider it their right and duty to tell others what they must do.

I refused to use THE Classification for several reasons and remained with Great Soil Groups. That is really of little consequence as the upper levels of THE Australian Soil Classification are based on Great Soil Groups. At a basic level my stance was against the promotion of dogma, but there are scientific issues related to their attempt to mimic a biological classification.

Biological classifications reflect evolutionary sequences that are an inevitable consequence of genetic inheritance. Soils have no such constraints with most deriving from mixtures of parent materials (many soils really are bastards). In giving the impression of an evolutionary/development hierarchy THE Australian Soil Classification is misleading.

THE Australian Soil Classification has no theoretical value beyond that of Great Soil Groups. Moreover, the lower levels have no value for addressing land use and management as they do not provide the requisite information[7]. The Classification is counterproductive to science and to applications involving soils, and serves only to allow some soil scientists to dictate.

[7] Most soil names end with sol thereby constantly reminding themselves as well as users that the classification addresses soils. To my great disappointment they do not identify an arsol.

The Establishment Response

My coming out occurred around 3 years after initiating the soil mapping work and involved presenting a seminar on STA to a packed theatre. As it happened the Chief was present. The first question was, why was this work not done in the Division of Soils (he was ex Soils Division). Answers to that, and to a comment by the OIC of the Canberra Soils Laboratory (John Williams), are in my memoirs.

I asked John Williams to organise a review of the compiled papers on STA knowing that publication in an Australian soils journal meant getting it approved by the soils establishment. The responses were all strongly negative without any positives. On that basis I made no attempt to publish them other than as a Divisional report to Defence.

A favourite comment related to inadequate sampling (Graham Mertha, linked with Isbell in CSIRO Soils Townsville but then in Canberra). A figure of 2,000 samples was given as needed for a map sheet and my sampling density was much lower. I have yet to determine any factual basis for the 2,000 figure, which is published and evidently regarded as absolute fact, other than it represents a personal view based on experience in Soil Landscape mapping. It may apply with Soil Landscape mapping but can have no applicability when other mapping methods are used. Moreover, it has no statistical basis when my results are statically significant. Never mind the quality, feel the width.

Williams became the Assistant Chief of my 'new' Division just before I left CSIRO, and was later Chief. The new Division of Land and Water represented an amalgamation of the Divisions of Water Resources, Soils, and Environmental Mechanics. My officially becoming linked with soils made no difference other than to allow them to directly suppress me.

My sending copies of the papers to Henry Nix received no response.

The soil science fraternity

To join the foresters association in Australia requires a forestry degree. In union terms foresters run a closed shop.

I have not looked at joining a soil society and so can't technically say I have been rejected. However, it is abundantly clear that in Australia I am not accepted as being a soil scientist.

From the beginning my knowledge of soils was more than pedestrian. Almost half my PhD was on soils and I attended soils lectures. My initial work in CSIRO focused on soils, and transferring to Defence work meant use and production of soil survey information. At that time contact with soil scientists could have been greater than with botanists.

One of the issues related to a paper from my PhD on soil salinity but that has never been expressed to me. Effectively the sole comment by a journal reviewer, now surreptitiously known and then in the Canberra CSIRO Soils laboratory, was that he thought science had progressed past that point. Only with publication of my work of Soil Heat of Hydration is the result unquestionable and therefore accepted. Previously it appears that no one was able to follow the logic and concluded I must be wrong as my results were contrary to their accepted theory. Their theory was wrong as my observations were always right and the analysis logically correct.

There are obviously good soil scientists but given the capabilities and attitudes of those regarding themselves as the movers and shakers I would not wish to join an Australian soils society. However, I request the recidivists compare my achievements on soils with those of their acclaimed soil scientists to derive an objective assessment of my status.

Commercialisation

My link with Rob Gourlay arose through his role in the Army Reserve and interests in things natural. By day a planner in the Australian Government public service he obtained a biology degree. When possible he became the liaison officer between Army (later Defence generally) and CSIRO in addressing the Memorandum of Understanding through which I obtained funds.

Recollections of timings are fuzzy but Rob asked me if I was interested in forming a company to address the provision of environmental information to address land use and management. I agreed having realised there was no chance of my developments seeing the light of day through CSIRO. For example, I gave a paper on my classification method to the OIC of the laboratory, Neil Body, for review prior to submission for publication. The response was 'not another paper on classification, who would be interested in that'. It was discretely placed in a drawer where it remains. That classification procedure effectively provides an end member classification without knowledge of end members and is central to the effectives of the radiometric mapping.

That rejection rubbed salt into the wound of not being able to publish comprehensive results from satellite image analysis for SWBTA. Given the classification method the results were particularly good but the Division could not decide on the expenditure needed to reproduce the maps. While maps were then expensive to produce the laboratory still retained the mapping capability developed in Land Research for producing Land Systems maps.

I have been a shareholder of the company Environmental Research and Information Consortium Pty Ltd (ERIC) since its inception but could not be a director while employed by CSIRO. I was advised of the restriction on directorships when advising Body of my intent. While there was no need to advise CSIRO of a shareholding I prefer to have things in the open.

Rob Gourlay's vehicle accident occurred shortly after ERIC was formed and so greatly affected his livelihood as well as almost taking his life. The money obtained from Defence over the two years of his Masters made things a little easier.

In a masterstroke Gourlay persuaded Body that the resource information for STA be presented as a joint CSIRO ERIC report. ERIC then had rights to use the method without payment of royalties.

The name SoilMap was devised by Gourlay and trademarked by ERIC. The trademark has likely lapsed having transferred with the sale of the company's assets and operations. It was last used by Natural Resource Intelligence Pty Ltd but transferred to the parent company when NRI was closed down. That led to my use of SoilSelect as an alternate name when attempting to resume operations after the closure of NRI.

The SoilMap methodology is most cost effective when applied across a 1:100,000 map sheet. While ERIC conducted numerous studies for individual landholders it was largely unable to obtain ongoing funding for regional studies. Two early regional studies addressed the Gemalony-Wyldes Plains and the Cootamundra Shire in NSW. The subsequent regional studies were in Victoria. The soil mapping in one was part of a comprehensive land use study that was won by another small company. With the other ERIC managed to win against the Victorian State soils agency that had written the specification so as to guarantee their selection[8]. I suspect my prior work in the region helped.

[8] ERIC produced a Soil Landscape map from radiometrics thus technically SoilMap was not involved.

The situation is illustrated by attempts at obtaining funding for application of SoilMap in the Harden region near Canberra. After great persistence by local farmers, and good relations between ERIC and NSW Geology, the area was flown for radiometrics. The only soil map from the data I am aware of was produced by the Bureau of Rural Sciences (BRS) for a small test site. BRS is part of an Australian Government Department that attempts research but does not have the capability to map soils from radiometrics. Their failure resulted in the closing off funds for ERIC rather than their funding ERIC to show what could be done. Their parent department controlled the disbursement of applicable Government funds.

Non-ERIC applications

While ERIC obtained work involving application of radiometrics most large studies were conducted by me for Defence while in CSIRO. In sequence they involved a detailed survey of the new 1,000 km^2 Mt Bundey training area in the Northern Territory (NT), a broad survey of the 9,000km^2 Yampi Sound Training Area in the Kimberly, almost half of the new 6,000 km^2 Bradshaw Training in the NT, and completion of a detailed soil map incorporating radiometric information for the 3,000 km^2 SWBTA.

I am unaware of any response to the Mt Bundy study other than associated with my identifying that the Wildman Formation, which there is mapped as being everywhere, was composed of two distinct rock types that supported very different vegetations. That situation likely arises because I was involved in its use in preparing the Land Management Plan (LMP) and so I applied the information.

The soils information for Yampi was meant to be used by Dames and Moore in preparing some form of LMP. I was told they had to effectively disregard it and devise their version of a Soil Landscape map that identified soils by way of types rather than properties. My map has evidently been useful to Army engineers just in addressing the sole access road.

My Bradshaw study was critical for Defence in ensuring they met procedural requirements with the land acquisition. That contribution led to my writing the specification for the Environmental Impact Statement. Details are given in my autobiography but the outcome was consultants reverting to traditional Soil Landscape mapping that their experts could implement. I don't have definitive information but have reason to suspect that engineers find the Soil Landscape information incomprehensible and use my soil map established with two days field work.

The SWBTA mapping was a hybrid affair due to the coarseness of the radiometrics. In effect I implemented an ultra detailed Soil Landscape map that mapped soils at unit level by combining information from the radiometrics with vegetation patterns derived from satellite imagery. While I obtained considerably more soil samples to determine soil properties there was abundant general information from prior surveys and my knowledge of the area.

The SWBTA soil map was an exercise in determining the level of detail I could achieve with the available mapped information. It is much too detailed for general use. At the request of Defence Alan Marks produced a simplified version that evidently has been useful.

Testing

In all applications bar STA the final map has been produced using results from an initial field sampling. A second field sampling to establish final statistical significance is not conducted as it is not cost effective. The initial results are much more detailed and reliable than ever provided before and little if any useful information is provided by further sampling. A second sampling is generally an academic nicety.

The SoilMap results are statistically tested each time the method is applied. There have been glitches but they are rare provided the methodology is followed with the involvement of locals being integral. The one of most consequence arose early with the Gemalong-Wyldes Plains study with difficulties arising through NSW Agriculture becoming involved and thwarting implementation of the full methodology.

The issue at Gemalong-Wyldes Plains involved incorrect mapping of patches of clays as being coarse textured soils. My inspection shortly after joining ERIC quickly established that the result arose because paddocks were subject to flood irrigation. Irrigation shortly before acquisition of the radiometrics greatly reduces the signal making clays appear similar to sands or loams.

The involvement of NSW Agriculture may have arisen through interest but their ignorance did considerable damage. The interest was self interest with their ignorance extending to an officer greatly modifying ERIC results and then presenting them as an ERIC map. Their objective was to obtain knowledge of the technology so they could provide such services. Later they advertised a site selection service for crops to compete with the ERIC services. I have yet to see evidence of their having such capabilities although a rudimentary level is possible.

The most detailed independent evaluation was conducted by Earth Tech, then a subsidiary of the TYCO corporation. That involved detailed mapping of a vineyard prior to further development where the soils had previously been mapped to unit level using traditional methods. The traditional map contained the covenant that further field sampling would be needed prior to further development. The ERIC SoilMap was very different and provided the requisite information. Evaluation was by the property owner and the local Earth Tech representative.

During the test the property was visited by the Victorian soils agency with the officer claiming they could produce the same results as ERIC. That claim has never been justified.

Salinity Map

Routine implementation of SoilMap provides results for salinity and can therefore be used to address issues such as dryland salinity. However, it was found the analysis could identify specific salinity classes that could be reliably transferred across radiometric surveys. As usual the ERIC results were mainly evaluated by others, primarily the Cootamundra Shire Council but also John Angus from CSIRO Plant Industry.

It took some time for me to convince myself that we were doing what we appeared to be doing. The convincing arose when seeking an explanation and finding that cosmogenic sodium has two linked emissions in bands discriminated by the airborne radiometrics. That allows resolution of the signal at well below the signal to noise ratio given appropriate analysis. End member analysis is appropriate, and the ERIC classification procedure allows identification of the classes without having knowledge of the end members.

The form of analysis has its origins in encryption developed during WW2 but now has several applications. A key one is in mobile phones.

The response by CSIRO Exploration and Mining to ERIC use of radiometrics had been cold at best. The response to the suggested identification of cosmogenic sodium was reactionary, and modelling was used to demonstrate that any such signal was well below the detection

level of airborne sensors. The signal to noise ratio was identified as being grossly inadequate. This led to the comment in the draft Australian Government report on Salinity Mapping Methods that 'claims by some vendors have no basis in science'.

A relevant comment from CSIRO mining (Dixon) was there is only one way to analyse radiometrics. While the comment identifies a complete lack of understanding of science it specifically identifies a lack of knowledge of end member analysis where the achievable resolution can be much greater than identified by the signal to noise ratio. As the use of multi channel digital imagery, and particularly hyper-spectral imagery, is based on such capabilities those supporting such comments have no knowledge of the capabilities or potential use of such imagery. They are not fit to undertake research other than in a supporting technical capacity.

A positive response to SalinityMap was initially obtained from the NSW Department of Land and Water Conservation. The arrangement was they would obtain an independent review prior to considering its use. My requirements were that the reviewers include a physicist and no soil scientist, and that I have the opportunity to respond. The chaos following receipt of the review precluded my responding and included forced sale of NRI. In consequence SalinityMap has never been applied commercially.

Within the chaos the operational head of NRI, James Moody, fell on his sword. In a parting gesture he surreptitiously circulated a letter to ERIC SoilMap clients advising them of concerns with the SoilMap results they had received. Such action was definitely against the interests of his then employer and should not have arisen. Moreover, his comments were based on the review of SalinityMap which had no relevance to SoilMap.

It appears Moody was unaware that when ERIC was sold the ownership of all prior work remained with ERIC thereby preventing the transfer of unknown liabilities. That is 'situation normal' and meant that Moody had no official status in making such comment. His actions were illegal making him liable for consequential damage to ERIC.

After leaving NRI James Moody was next employed by CSIRO Division of Land and Water, and from marketing eventually headed Research Development in CSIRO Head Office.

A provisional patent application was lodged for SalinityMap. Apart from getting publicly funded scientists knickers in a twist, the patent was of little value without conduct of the research to evaluate just what was being detected. At a roughly estimated million dollars the research was not commercially viable and had to be funded by Government. However, the amount was a very small part of that expended addressing dryland salinity and the information would have saved more than the cost of research.

The DLWC sponsored report on SalinityMap is not publicly available but was used to denigrate ERIC methods in the Australian Government report on salinity mapping methods. Given the content of the reports there was no chance of receiving Government funding for developing SalinityMap.

The required research still intrigues me because of the nature of the signal. A point observation is useless essentially regardless of its resolution. The requirement is for an array of data and that is best provided as a spatial array. Issues include just how big a block of data is required. However, the method can still be used without such knowledge and has the potential to greatly increase knowledge of surficial drainage in landscapes.

Deceit, charlentry and abuse of position

In the mid 1970s the Australian Government decreed water was out and salinity was in. There was no money for research on water despite changes in salinity arising from the movement of water.

The rising groundwater model had previously been identified as applying to dryland salinity, and soil scientists applied this model to all occurrences of dryland salinity. It appeared simple and they thought they understood it. They were joined by a few geologists, particularly those in AGSO (Australian Geological Survey Organisation), as it allowed them to claim relevance and hence justify receipt of funds to address dryland salinity.

The ready availability of funds produced a great diversity in those joining the rising groundwater bandwagon for dryland salinity. Engineers became prominent, and new species of scientist emerged such as hydro ecologist. One individual promoting himself as a hydro ecologist had no knowledge of either salt or water. John Passioura did a service to science in identifying the charlentry associated with the addressing of dryland salinity in Australia[9].

The salinity funds derived from the Australian Government and bureaucrats maintained control. Considerable funding was inappropriately directed to Government organisations such as BRS as their parent Department jointly controlled disbursements. State departments breached procedures to ensure that funds flowed to them without competition. Overall, one had to accept the rising groundwater model as being applicable as the entire establishment depended upon it.

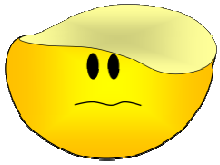
Identifying that the rising groundwater model was almost invariably inapplicable to dryland salinity should have resulted in considerable work for ERIC, particularly when a Shire Council identified the ERIC results as being particularly useful. However, the establishment became highly reactionary and that culminated in use of the Australian Government report on salinity mapping methods to bag the ERIC technology. State soil agencies had strong involvement in the report.

Laws exist that are meant to prevent what occurred with ERIC and dryland salinity. The Government salinity mapping report promoted methods offered commercially by government agencies while knocking commercial companies. Such abuse of position is against the law but the ACCC[10] considered the case too difficult due to arguments depending on assessments of the validity of science.

Conclusions in the salinity mapping report are demonstrably wrong making it unfit for purpose. It does not meet the requirements of consumer legislation. The response by a Deputy Secretary of the responsible Australian Government Department was to present the report such that responsibilities are difficult to identify. My response remains that it should be withdrawn through being unfit for purpose.

[9] Epitomised by their production of a map of the salinity situation in Queensland in 50 years time when they were unable to map the existing situation.
[10] Australian Competition & Consumer Commission

Current Establishment Position



As an involuntary recluse I only occasionally glimpse the outside world. A noteworthy glimpse was a scientist from Britain presenting a seminar on radiometrics for soil mapping in the theater where I came out. He addressed improved statistical analysis of results where radiometrics have been used to maps soils.

The Australian establishment position is illustrated by their release of SoilMapp, an IPod application for the delivery of soil maps for application by farmers and the like. The SoilMapp maps are said to be derived from the best available information.

SoilMapp results would almost invariably be obtained by applying pedotransfer functions to Soil Landscape maps. The suppliers have no specific knowledge of their reliability but when evaluated for application in land use and management they would be garbage.

The SoilMapp development links with a press release by CSIRO that Australian soil scientists are linking with counterparts in the USA to improve the reliability of pedotransfer functions. This introduces new considerations, such as the level of detail of Soil Landscape mapping being much greater in the USA than Australia. Agricultural areas there are mapped at the Soil Unit level when Australia essentially has no coverage of unit level maps and extensive agricultural areas have not even been mapped at the Soil Landscape level. However, the fundamental issue remains that the approach does not address the reliability of mapping.

SoilMap represents a methodology for developing mapped soils information suitable for use in land use and management that can be cost effectively applied across large regions. While most efficient and effective when using radiometrics for mapping the method can be applied without such data. A key output is a map, but SoilMap is much more than a map. SoilMapp is simply a map of unknown but inevitably low reliability.

For me the situation is charlentry confirmed as an approach is being promoted as providing results that it logically can't. Moreover, they are attempting to trade on the SoilMap reputation to gain respectability for their SoilMapp product. Given their efforts at denigrating the SoilMap method their actions are despicable as well as corrupt. Even without SoilMap being trademarked there is a good case for their using deceit to promote their SoilMapp product (deceptive advertising).

Implications

The answer to the Isbell paradox is the distribution of brigalow depends on the interaction between soils and climate. Brigalow preferentially occurs on different soils depending on climate, as has been demonstrated statistically for poplar box. The implications are that, while there can be distinct relationships between vegetation and soils locally, the relationships can vary with region. The difficulty in determining the associations arises because the relationships are probabilistic rather than absolute and changes are often gradational.

The implications of the SoilMap saga for ERIC have been commercial failure due to attacks by publicly funded scientists that consider they have sole rights to address particular issues. They consider they are the only ones working in the public interest when a successful ERIC would have provided much greater benefit to the public. Not only was the information

provided greatly improved compared to theirs, it was delivered to promote its use by landholders.

As a commercial company ERIC almost contributed funds to government and was not solely a drain. The drain came from receipt of Australian Government funds to promote commercialisation.

Commercial considerations aside, the implications of the SoilMap saga for me are a great wastage of time in addressing miserable science.

The broader implications extend to climate change. The mechanistic approach to agriculture supported by soil scientists has contributed to climate change, greatly building upon the impact of poorly controlled grazing. The information on soils developed by ERIC is basic to developing cost effective means to redress the impacts.