WATER MANAGEMENT: WHAT'S IN A NAME?

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Abstract
The establishment of broad-acre agriculture in southwestern Australia has brought about major changes in hydrology, resulting in an apparent excess of water in a semi-arid environment. Surface water management is generally regarded as being true, tried and accepted best management practice; but its effectiveness has rarely been questioned. Initial approaches to water management in the dryland agricultural districts of Western Australia were to adopt soil conservation techniques established in the late 1950s to late 1970s.

In the 1980s waterlogging and inundation were viewed as the biggest issue and interceptor drains and level banks were widely adopted. In the 1990s, fuelled by the decade of Landcare and the 'salinity crisis', tree planting and revegetation were promoted as the panacea. Recently drainage, saltland agronomy and perennial farming systems have also become prominent. In almost all cases the object of the method employed was to manage water more effectively, as either surface runoff or groundwater recharge. Most practices were evaluated and implemented as plot trials or at the farm scale, with only limited applications at catchment scales. This paper explores the application of water management techniques and assesses how effectively they have been implemented in southwestern Australia.

Additional Keywords: engineering, salinity, planning, earthworks

Introduction
This paper highlights some of the approaches used in surface water management during the last 50 years when the majority of land cleared for agriculture was completed in the dryland agricultural areas of Western Australia. The ideas introduced may not be new but provide at least one perspective on the National and State approach to achieving improved land and water management. The water management methods, their application and success are presented to stimulate future discussion on water management. A simple ideology is outlined as one approach investigated by the authors.

Why Water Management?
The last great land clearing program, 'a million acres a year' started in the 1960s and completed in the 70s, was followed by a period of relative quiescence, with only minor clearing (by comparison) during the 1980s. In all, about 15.7 million hectares of land was cleared removing an estimated 15 billion trees and vast areas of mallee scrub and heath. This clearing paved the way, and created the right conditions, to develop one of the worst examples of dryland salinity in the world (Beresford *et al.,* 2001).

The problems associated with land clearing and salinity in Western Australia are well documented (Wood, 1924; Teakle and Burvell, 1945; Bettenay *et al.,* 1964; George and Coleman, 2001; Hatton *et al.,* 2003) and other land degradation issues, such as waterlogging, water erosion and flooding occur as a direct or indirect result of excess water in the landscape (Nulsen, 1993). The inability of landholders to effectively manage this excess water at farm and catchment scales has continued to reduce the potential productivity of agricultural lands. The areas affected by salinity (1.3 Mha) and waterlogging (0.5 Mha during an average year) highlight the extent of the problem. Upon reflection of the last 50 years of land management, it seems blindingly obvious that rain falling on cleared and unmanaged landscapes has caused the water induced degradation that is apparent today.

The Problem Identified
Farmers and scientists were quick to recognise the problem with successive reports by Burvill (1956), Henschke, (1980) and George (1990) outlining the increasing extent of dryland salinity and other forms of land degradation. The recent Land and Water Audit suggested the area currently affected in Western Australia could be in the order of 1.8 M ha and had the potential (based on limited data) to expand to 4.5 Mha (Short and McConnell 2001). The publication of regional-scale maps has provided landholders with the long-term predicted extent of salinity.

So what went wrong? The evidence for changed hydrological processes and catchment water balance, leading to salinity was reported by Wood in 1924, yet clearing without consideration of the long-term consequences continued to gather pace throughout the first half of the 20th century. The government of the day was only interested in expansion of exports of wheat and wool and continued to expand and profit until the wool price crash and drought in 1969. Current popular opinion is that the government had been overzealous with its land release programs and that too much of the native vegetation had been cleared (Jenkins, 1997). Indeed by the end of the 1980s only 11 % of native vegetation remained in fragmented and isolated pockets in the wheatbelt.

The Problem Addressed?

Government and farmers, recognising the threat to productivity, took action over the next four decades in a bid to arrest the spread of salinity. After the wet years of the early 1960s, and the drought in 1969 the impacts of salinity became more obvious and therefore a more politically sensitive issue (Beresford *et al.*, 2001). Some farmers pressed for widespread drainage schemes and government intervention to counter the problems arising from excess water in valley floors. Soil conservation and flood management were topical and land conservation officers were employed by the Department of Agriculture to assist farmers improve their surface water management

But not all farmers were quick to react or saw there was a need and despite widespread promotion, soil conservation was limited to works carried out in direct response to a local problem or production benefit over a small area (Farmer *et al.*, 2004). Productivity gains in the wheat industry continued to underpin high returns to farmers, and investment in risk management based on the inferred long-term threats from salinity did not encourage the required level of investment (Beresford *et al.*, 2001). Rainfall, once intercepted and utilised by the native vegetation, continued to runoff onto valley floors, promoting groundwater recharge and the development of perched aquifers and secondary salinity.

During the 1970s and 1980s the problems associated with water management and salinity continued to expand in the majority of the wheatbelt. Areas where excessive land clearing did not take place or where sufficient water management strategies were employed did not exhibit same rapid expansion. Henschke (1983) noted that during the late 1970s, credence was given to the theory that one of the main causes of salinity is the movement of water downslope via shallow surface soils. A local farmer, Harry Whittington promoted the treatment of shallow saturated soils by the construction of interceptor drains or banks that would capture and store drainage water from the soil profile and thus prevent salinity developing. The WISALTS (Whittington Interceptor Salt Affected Land Treatment Society) organisation was formed and many farmers tried the banks, with thousands of kilometres being constructed (Henschke, 1983). Concern was raised by the Department of Agriculture that the banks were unlikely to work in all landscapes and soil types and in some cases may promote the development of salinity.

The ensuing debate largely discredited WISALT banks but offered no viable alternative. The polarisation of the community in some areas also engulfed the use of surface water management techniques as a method for controlling salinity and these techniques were lumped in with WISALTS and were considered ineffective. However, the problems associated with water management continued to raise questions as to what was the most effective approach. McFarlane and Barrett-Lennard (1986) reported that waterlogging, water erosion, inundation and flooding were still considered major problems and the design of management structures and placement in the landscape required improved definition. Further work was completed on drains and banks and it was considered by some that surface water management was largely common sense and would be adopted by landmanagers at as a matter of course.

Although soil conservation structures did manage erosion problems, they did not deal with groundwater recharge in the upper landscape, or along the valley floors where most of the redirected water (not stored in dams) was discharged from soil conservation structures. Adequate surface water management and large scale water harvesting for recharge control was never adopted. As a consequence, inundation in the lower catchment and valley floors occurs far more frequently than was the case prior to clearing. Cambell (1994) noted that although there were some successes, the impact of the soil conservation strategies on salinity management has generally failed. The soil conservation programs, essentially directed by government, were considered to have a narrow focus and avoided tackling the broader land and water management issues (Nabben, 1999).

The decade of Landcare during the 1990's was heralded as a turning point in the change of focus from strictly productivity, to issues of environmental protection and resource management on-farm. Landcare stressed the importance of protecting remnant vegetation, re-vegetation and improved farm planning and soil management. The program, was coordinated under the National Landcare Program (NLP) and National Heritage Trust (NHT) fund, and placed a greater emphasis on community-based involvement and provided incentive packages for on-ground works (Nabben, 1999). The incentive scheme provided an opportunity for the community to co-invest with the landholders in managing a problem of national significance, affecting productivity and bio-diversity values. The program promoted the integration of farming systems with remnant native vegetation protection and revegetation. Alley farming was trialled as were alternative cropping system. However the scale and level of adoption across the wheatbelt was disappointing, and is relatively insignificant compared to that required to redress the salinity problem. A survey conducted by Jenkins (1996) indicated that after 10 years of dedicated investment in these strategies the increase in re-vegetated areas on the farms surveyed, varied between 0.5 and 1.5 percent. During the same period (1986-1996) the area of native vegetation within the surveyed Shires declined by an average of 3 percent due to clearing. At the end of the decade of Landcare, most farmers concluded that tree planting was unlikely to deal with the problem of water management and salinity unless vast areas were planted and planted strategically. Hatton and Wu (1995) and Smith *et al*., (1998) drew similar conclusions.

In addition to soil conservation earthworks, research was also being conducted into minimum tillage, tram-lining, working the contour, perennial crops, and the productive use of saline land through alternative salt tolerant crops. Researchers also strived to improve water use efficiency for annual crops in an effort to reduce leakage below the root zone. These systems were the first attempt to mimic the water use capacities of the native vegetation in an effort to address the hydrological imbalance.

How Have We Fared?

Since the introduction of the Western Australian Salinity Action Plan (Anon, 1996) which promoted the range of management options described above, the only intervention method that has been widely adopted is deep drainage using a single drain on the valley floor to enhance discharge. This approach was similar to that advocated by farmers in the 1960s, demonstrating that we have now come full circle and are still struggling to find a practical and effective water management strategy that is widely applied and is likely to impact on the salinity problem. Having rolled the dice and opted for increased agricultural production, soil conservation, surface water management, strategic revegetation and direct engineering intervention, the limits of these approaches have been exposed. In each of the techniques trialled, the eventual outcome of adoption was to manage water more effectively to reduce the extent and impact of salinity. Most practices were evaluated and implemented as plot trials or at the farm scale, with only limited applications at catchment scales. The limitations of the techniques lay not in the effectiveness of the treatment, but rather in the extent of adoption and integration.

The systems developed and promoted over the last 40 years have generally been implemented as a single strategy, evaluated as not effective, discarded and we progressed onto the next strategy. In almost all cases, as one “silver bullet” goes out the window, another is adopted. Without the widespread and integrated approach to water management it is unlikely that the extent and impact of salinity and its associated problems will be ameliorated in the long term. Feedback from exponents of the Landcare-landscape approach to water management is enlightening. Miller (2001) wrote "I realised I had to have a whole farm approach to integrate all the features and issues of the farm. They all revolved around soil and water." Through the adoption of this approach Miller was able to increase the profitability of previously degraded farmland approximately 6 fold, providing strong support for an integrated approach to land and water management.

Thus the main objective for any landholder should be to develop a water management strategy that includes water harvesting and runoff interception, improved drainage, changes to farm land management practices and revegetation (Coles and Ali, 2000). Barrett-Lennard *et al.* (2004) suggested that the management of salinity risk requires combinations of: (a) engineering strategies that decrease run-on to valleys and increase runoff from valleys, and (b) plant-based strategies in the valleys that decrease recharge and increase use of the shallow groundwater. These sentiments are echoed by Farmer *et al.* (2002) and Cattlin *et al.* (2002) who have argued that the management of runoff from shedding landscapes in the upper slopes of catchments will reap the benefits of reduced inundation and water logging on valley floors. They also state that by removing impediments to flow continuity on valley floors, then the duration and extent of waterlogging can be reduced. If this can be achieved then the potential exists to mange rising watertables in wheatbelt valleys that occurs as a direct result of upslope runoff.

Conclusions

An examination of a number of approaches to water management over the last 50 years has highlighted the single step adoption strategy. Landholders and government agencies have all proclaimed that they have applied water management techniques and found them wanting, however the implementation has generally occurred in an ad hoc manner with little integration of on-ground works targeted to achieve whole of catchment outcomes. Water management problems have been tackled, as one-off symptoms, and the implications of unmanaged rainfall in cleared catchments appears to have largely gone unnoticed. While the symptoms have been highly publicised (i.e. salinity) the direct cause has quietly continued to contribute to the problem. Unless the level of intervention by government and landholders is adopted with similar enthusiasm to that which resulted in the 'million hectares a year' clearing program, it is considered that the scale of the problem is likely to continue to increase. If that level of investment is considered unacceptable, then future techniques for land and water management need to be examined carefully, and a practical approach to managing saturated and saline landscapes is required. Funds should be transferred into programs that will develop farming and land management systems which assume that the long-term degradation that is now apparent will continue into the future, as it has for the last 100 years.

The authors believe that targeted investment and incentives within "whole of catchment" management approaches can be successful, if the approach assesses the hydrological processes at landscape scales, develops a conceptual management strategy at catchment scales and promotes localised adoption at farm scales. The major benefit of using the landscape approach to whole of catchment planning is that it yields management options tailored to specific problems rather than a host of recommendations based upon prescriptive treatments. From a water management perspective, the process provides a relatively simple means of communicating cause and effect. However, the lack of widespread co-operative integrated adoption remains the single most significant barrier to effective water management.

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