Water wars and farming systems: implications for advisory practice and policy making

Ruth Nettle, Mark Paine

University of Melbourne, Faculty of Land and Food Resources, Victoria, Australia - ranettle@unimelb.edu.au

Abstract: *Water issues appear as newspaper headlines in Australia and are a feature of current political and public debate at National, State and regional levels. The increasing privatisation of water, changes to water allocation systems, as well as the increased influence of the market on water use, are part of a broader environment of change. Amid this milieu, often referred to as water "wars" (de Villiers, 1999; Shiva, 2002), is the Australian dairy industry which uses 25% of the surface irrigation water in Australia and has 57% of it's 8,000 dairy farms fully or partly dependent on irrigation (Dairy Australia, 2006). Reliable and affordable irrigation water remains a central platform to farm viability and profitability but recent low water allocations, climate change concerns and high water prices have meant a re-think for farmers about the place of water in their business – and the very future of their business and irrigated dairy farming. How does a rural industry, like dairying, negotiate a future? What is the role of mediating or broker professions (i.e. extension and advisory practice) in supporting learning and change in this context?*

This paper reports on research into water security issues from the perspective of dairy farm businesses and the advisory profession. Three critical issues for a rural industry negotiating a future in relation to water use provide the focus for the paper. These are: farm-level adaptation through changing water allocations and new water policy; negotiating new technologies for achieving water use efficiency; and, balancing environmental and productive water-use. Two case studies of farm decision making and advisory practice in relation to these issues are described. An across-case analysis suggests that managing complexity in water issues and negotiating a future for an industry requires learning processes at 3 levels: Farmer-advisor; Advisors-policy; Advisors-other disciplines-policy. Currently, useful frameworks for acting across the critical issues and learning levels are missing, resulting in a focus on technical solutions over social and ethical processes. The paper concludes with elements of a framework for an ethical response to bring the farm adaptation and advisory voice to water policy formation and implementation.

Keywords*: Water policy, dairy farming systems, extension role, learning processes*

Introduction

In Australia, water use for human consumption, irrigation and industry is being restricted due to prolonged drought and debates over priorities for water use are on-going. Can water be 'stretched' to meet the needs of irrigation, industries, cities, towns, households, communities, rivers and landscapes? Water for irrigated agriculture is increasingly contested and policy approaches are increasingly turning to water markets and new technologies. In this context, how do rural industries negotiate their future? Do extension and advisory professions have a role to play in supporting learning and change in this context? In order to address these questions research was conducted to explore farm decision making in relation to water security on Australian dairy farms and the role of the advisory profession in supporting change. In order to appreciate the context in which dairy farms operate and adapt their system, a background to water policy, water allocation and water use in dairy farming systems in Australia is provided, along with a background to extension services in the water domain.

Australian Water policy

The Australian Government's strategy with respect to water use is contained in its "National Water Initiative" (NWI). This policy is based on an imperative to *'increase the productivity and efficiency of water use and the health of river and groundwater systems in Australia'* (NWI, 2005). The NWI seeks

to; a) expand the role of market forces to allocate water to its most profitable uses; b) give greater security to entitlements to water under State laws; c) address over-allocation in some irrigation systems, and; d) achieve integrated planning between water distribution systems and agricultural and environmental uses (NWI, 2005). The initiative is managed at the highest level by the Department of Prime Minister and Cabinet and, until November 2007, was the Federal Liberal Government's policy response to disputes over water use and priorities for 'economic, social and environmental wellbeing'. Water policy at a national level is currently in a "holding pattern" – with a change of government in November, 2007 (to a federal Labour government) signalling a new era for water policy.

Australia's system of irrigation water distribution, licensing and allocation varies from State to State, but predominantly consists of a licence or water "right" that establishes the amount of water able to be extracted from a river, irrigation system or groundwater water source in a given year. At the state level, rural water authorities are responsible for the management and delivery of water within Water Resource Management Acts that provide strategic guidelines for the use and governance of water resources.

Water use and Australian Dairying – realities and dilemmas

Dairying is one of Australia's' top 3 rural industries. With a farm gate production value of AUD$3.2billion, it ranks third behind beef and wheat. It is also the fifth most important in agricultural exports – valued at AUD$2.5 billion. There are 8000 Australian Dairy farms with 1.8 million milking cows producing 9.6billion L each year. Australian dairy farmers operate in a deregulated and open market environment where international milk prices are the major factor determining the price received by farmers. Therefore, milk production remains predominantly (75%) pasture based with a focus on efficient, low-cost, high quality milk production. Around half of Australia's milk production is exported. Average Herd size is 225 cows and owner-operated farms dominate (Dairy Australia, 2006). The Australian dairy industry uses 25% of the surface irrigation water in Australia and has 57% of its farms fully or partly dependent on irrigation to maintain the productivity of their farms (Dairying for Tomorrow, 2006). The significant drought in Australia has also seen pressure mount on stock water for dairy herds.

Increasing the productivity and efficiency of water use has become a significant policy imperative, yet its meaning and strategies for its improvement vary between and among farmers, water resource managers, natural resource managers, water specialists and policy makers (Keeble and Johnson, 2002). From a dairy farmer's perspective, water use efficiency (WUE) concerns production efficiency (i.e. growing more grass/producing more milk solids with the same amount of water – or using less water for the same production). For managers of water storage and delivery systems, WUE is a measure of water losses prior to delivery to the 'farm-gate'. For managers of natural resources and landscapes, WUE can vary depending on the scale involved: that of individual plants or pasture water requirements to reducing the impacts of salinity across an entire catchment. Further, at the farm level, a wide range of water use efficiencies occur across irrigated dairy farms (e.g. between 35 and 94 kilograms of milk solids produced per megalitre of water (kgMS/ML) (Armstrong, et al, 1998) with no simple, direct association between water use efficiency and farm profitability (Armstrong, 2004).

Uncertainty is a major reality for dairy farmers, policy makers and water organisations. Uncertainty exists over appropriate definitions of WUE, over the extent to which WUE gains will actually save water for the environment, over how to best establish performance indicators for reporting changes in WUE and over how to best make decisions on-farm to enhance farm profitability, labour-use and WUE. Such uncertainty sets a complex context for both farm and policy decision-making regarding water security, and together with the uncertainty over the likely market valuation of water, changes to water allocation laws and pricing, irrigated dairy farmers are reported as being in a 'holding pattern' waiting to make further capital investments in water use efficiency gains until the implications of these changes become apparent. (Dairy Australia, 2005).

Understanding water access and allocation arrangements

Water access and allocation arrangements differ between states and regions in Australia. In general, in areas serviced by irrigation systems, owners of water rights pay an annual tariff for each megalitre of water they "own" (this includes fees for entitlement storage, infrastructure access, and infrastructure use), an annual service fee, and fees for each service point on delivery channels connected to their

farm. Prices for these fees vary between each irrigation area. By way of example, the water access and allocation arrangements in two regions are provided to reveal the context for farm decision making.

Northern Victoria

The water authority supplies irrigators with water through a number of allocation and delivery systems. Irrigators hold permanent entitlements to water right allocations and can receive additional sales water depending on water storage levels (Goulburn-Murray Water, 2004). The volume of water irrigators can access each annual irrigation season is determined by the amount of water right owned by them, measured in megalitres, and the water right allocations made available by Goulburn Murray Water for that season. Each two weeks across the irrigation season media statements announce the probabilities of irrigators receiving 100% of their water right plus any sales water. As the irrigation season progresses new probability statements for water right and sales water allocations are made taking into consideration additional inflows into the water storages (Goulburn-Murray Water, 2005). Under new allocation rules, entitlements to water right and any sales water is now separated into a) "high-reliability" and "lower-reliability" water shares, b) a delivery share that entitles owners of water shares to have water delivered to a property, and c) a water use licence.

The introduction of water ownership by non-landowners and the flexibility to own a varying mix of high and lower-reliability water shares is expected to lead to increasingly complex market arrangements, as horticulturalists, dairy farmers and croppers seek differing levels of water security to suit the varying production needs of their farming systems.

Macalister irrigation district (MID)

Water for the MID is primarily diverted from the local river and stored in Lake Glenmaggie which receives annual inflows of over 500 000 ML, well above its storage capacity of 190 000 ML. This storage therefore operates as a 'spill-and-fill' dam that gives irrigators in the MID a highly reliable supply of water. In the legally gazetted boundary of the MID irrigators, including approximately 500 dairy farmers, hold an entitlement to water right (or a 15 year licensed volume) for a certain amount of water, measured in megalitres.

The spill and fill storages of Lake Glenmaggie enable a policy of water right allocation that is unique. Under this system, water that irrigators take from the start of the irrigation season in August, while the lake is filling, draws down their water right allocations. Once the lake fills and then spills over – typically around mid-September – the water irrigators have already taken becomes 'off-quota' or 'spill entitlements' and is no longer counted against their water right allocation. This off-quota water is charged to farmers on a per megalitre basis, at the same price as water right for that year.

These two vastly different water allocation systems accompanied by the complexity of water governance arrangements provide the background to irrigated dairy farms decision making for profitable and sustainable businesses. Within this context, an overview of the provision of public extension services is provided next.

Advisory/extension services and water resource management

Since the early 1990s public extension programs have sought to influence and intervene in how irrigated dairy farmers manage water on their farms. Extension programs have sought to support improved irrigation design and irrigation practices and has accompanied financial incentives (particularly rebates) to encourage the development of Whole Farm Plans, water use efficiency measures (e.g. installation of automatic irrigation, re-use systems, conversion to spray irrigation on lighter soil types), salinity and nutrient run-off reduction incentives. With recent changes to water allocation rules, information and education programs have been provided by public extension agents receiving funding from the policy arm of government. This has extended to education for technical advisors to ensure advisors, who deliver the bulk of the farm planning advice understanding the technical changes needed to achieve the goals of the program.

While the financial incentives provides money to assist farmers to cover the costs of physical work and farm planning consultants, the advisory support given to farmers tries to ensure any changes fit with farmers' goals and ongoing farm management. Success in this requires the extension support to be a

brokering practice between the public environmental interests of the program and farmers' needs for productivity and profit.

At a regional level new technologies are being implemented to try and increase water use efficiency at an irrigation system scale through channel automation.

Finally, the dairy industry itself invests in research into water efficient plants and forage systems as well as co-investment in water reform education, however, input into policy making remains in the hands of agri-political representation (rather than research and development).

Research questions and theoretical framework

The preceding outline raises key issues for farmers, rural industries, advisors and policy makers with respect to water management challenges and farming systems:

- How are farmers adapting to changes in water allocation rules and long-running conditions of drought?
- What is the role of the advisory/extension profession in the changed water policy environment and in the context of farm adaptation?
- Are current approaches to water policy and interventions at the farm level sufficient for the challenges that an altered water environment bring?

These issues have to do with the practices of, and interactions between, key actors in water resource management: farmers, advisors and policy-makers. In practice, a predominant paradigm governing interactions between these groups in Australia is that policy is formed through consultation with such groups and then implemented using a combination of financial incentives and public extension services to support desirable land management change. Further, research contributions with respect to learning and change in water resource management issues have tended to focus on farmer decision-making and learning (e.g. McCown, 2002) or on multi-stakeholder processes of negotiation and/or collective action (e.g. Barbier and Chia, 2001; SLIM, 2004; Pahl-Wostl et al, 2007; Ison and Watson, 2007). What appears to be missing in practice and research is a framework that specifically brings adaptive farm management and advisory practice to bear on policy formation and implementation in a meaningful way. In essence, we contend that this is vital for *ethical* collective action. In this context, *ethical* frameworks (i.e. principles that guide action based on respect, mutual obligation and responsibility and fairness) would need to consider not only who is involved – but how "practice" is best represented and utilised. Falkenmark and Folke (2002) labelled such frameworks as being about doing the right things – not just doing things right. Although issues of power are recognised as playing an important role in outcomes from social learning approaches in water resource management (Ison and Watson, 2007) – changes to power relations alone would not necessarily ensure farmer adaptation and advisory practices are represented, utilised and valued. In this context what elements would characterise ethical collective action and what is lost by not having adaptive farm management and advisory practice represented?

To explore these issues it is suggested that the current practices of rural actors, in particular farming and advisory practice, is a useful starting point. We contend that in order to understand water management challenges and farming systems it is necessary to understand how farmers make sense of water in their business. The information being sought, the meaning ascribed and the action taken by farmers concerning water become the entry point for understanding how they cope with interruptions (Weick, 1995) and provides the context for advisory practice. This entry point locates the reality of farm adaptation (i.e. practices and action) rather than cognitive processes (i.e. what farmers think and believe) as central to understanding change.

Research method

Twelve case study farms from two different irrigation regions of the southern Australian state of Victoria were chosen to explore farming and advisory practice with respect to water management. . The research team included two extension officers (one a dairy specialist and one an irrigation specialist) and the main author (a rural social researcher). The regions chosen included the Northern Irrigation region and Macalister irrigation district. Case study farms were chosen using region-specific criteria including variation in a farm's: current capacity to improve water resource management and

manage through changes in water allocation rules and policy; on-farm roles and responsibilities; the particular water issue for the farm and the availability and use of information and advisory services in the region. Semi-structured interviews with the case study farmers were conducted in July and August, 2005 and explored what they were doing in relation to water management on their farm and why, how they went about implementing changes on their farm regarding water use, how they learnt about and managed water on their farm and how they sought and used information and advice regarding water management in their business. Transcripts of these interviews provided the data for an action research process with the different extension agents in the regions to reflect and theorise about current approaches to water resource intervention and the planning and testing of new approaches as "reflective practitioners" (after Schon, 1983). The findings generated focused on answering the key questions of a) understanding farm decision making with respect to water; b) positioning the role of extension; and c) developing new practices for extension in water resource management. Implications of this work for policy and future interventions were also considered.

Results

For the purposes of this paper, 2 of the 12 case studies (Nettle, et al, 2007) have been chosen to highlight key dimensions of the advisory role in farm systems in water challenged environments. That is, farm-level adaptation through changing water allocations and new water policy (Case study 1-Adam) and negotiating new technologies for achieving water use efficiency (Case study 2 - Peter). Each case study is analysed with respect to the extension role and policy implications in water resource management and resilience and sustainability of their farming systems.

Case study 1 - Adam: Farm adaptation – can advisors facilitate alignment between farming practice and policy goals?

Introduction

Adam is an owner-operator of the Northern Victorian farm he purchased in the late 1990's. He is married with young children. In the last 5 years he has made significant water-related farm management changes including: Selling permanent water, buying temporary water, Changing to a fully flexible production system (adjust herd size and production based on milk, water and feed prices in a given year) and changing the pasture base of the farm to annuals (rather than perennials)

Managing water in the business

Adam has his mind set on farm profitability and enough flexibility in the production system to make the most of any opportunity – which sometimes involves "closing down" farm production if things are tight. It was the low water allocations and high water prices through the 2002 drought that was a trigger for Adam to change his farm forage base and reconfigure his debt though selling permanent water right.

In June 2002 Adam calculated that the more cows he milked the less money he would make. In response Adam 'parked' his spring calving cows off the farm and milked the autumn calving cows through to Christmas, before selling them for what he considered a reasonable price. With no cows on his farm Adam sold 450 ML of unused water right as a temporary transfer for AUD$500/ML at the peak of the water market in January, and ceased production.

Then, early in 2003 Adam permanently sold 450 ML of his water right entitlements for AUD$1200/ML. After this, Adam had a remaining 250 ML of water right to begin the 2003–04 irrigation season. The money realised from the sale of water right and some land was used to retire some of the AUD$500,000 debt Adam had incurred from laying out the farm and building the dairy, and as a pool of funds, earning interest, to buy temporary water on an annual as-needs basis.

Adam: 'So I guess, while I owed money on that water right, I had to make money every year to pay the interest. Now, I'm buying temporary water; if I want to shut up shop and close the production system right down and slow it right back, I can do it. I'll just get rid of some cows and buy in less water that particular year.'

With his reduced volume of water right Adam worked out that he needed the flexibility of annual pastures and lucerne to cope with greater fluctuations in irrigation scheduling. This decision (to shift away from perennials) was also motivated by the physical constraints of the soils and peak prices for temporary water over summer.

Going into the 2003–04 season, as the milk price and water allocations improved, Adam could see that favourable market conditions for scaling up production were coming into place. In response he quickly rebuilt his herd to 210 cows and bought 900 ML of temporary water, taking his total water use for that year to 1150 ML. With his decision to sell water right and buy temporary water Adam is somewhat concerned he has foregone any eventual capital gains on the water right, but apart from this he is confident of the effectiveness of his changes.

Adam: "I think [the farm] is viable as long as we can still trade temporary, I am watching what they do with all the new rules and that in trading certainly don't hesitate to buy my water right back if I figure it is the right thing to do…"

Managing flexibility and risk

Adam is keen to be rewarded for his dedicated hard work with high financial rewards in the short-to-medium term. To achieve this he is highly engaged in understanding the costs and benefits of different management options for his dairy farming business. By shifting debt from his capital investments in land, water and dairy infrastructure, to his herd (which he can expand and contract as needed), Adam has traded in the security of owning water right for the possibility of higher but more volatile annual returns.

Adam: 'Certainly we owe more money now because we have bought cows, but most of our debt now is mostly on stock, and if I sold all my cows I would wipe off all me debt, I just have to be careful to make sure our debt does not get beyond what our stock is worth.'

Farm system implications

Rather than being about building up a stable production platform Adam manages water on his farm opportunistically and has built his farm system to be responsive to changes in prevailing annual economic conditions and water allocations. Adam views water as a tradeable, functional resource rather than a long-term asset for achieving business goals. Under Adam's farming system 'the herd' is far less important than for most other dairy farmers. The level of detail in seasonal planning to this level requires accurate and timely information. The success of such strategies is also reliant on an ability to be able to source cows cost effectively. Adam's decision to reduce capital (assets) or manage fixed costs in halting production may be considered an unusual approach for business success and not necessarily the "best" decision for the long term. For those supporting farmers in water decision making – what constitutes a good decision? Adam does not suggest that the effective use of infrastructure (the dairy, irrigation system, etc) and their "fixed cost" are part of the consideration in his decisions to "shut down production". Debt management is featuring highly in Adam's decisions about water and the production system. However, his shift in debt profile also has an impact on the markets (e.g. livestock markets). The changes and decisions Adam has made have increased the need for quality market (including livestock) and water information to manage the farm system effectively and have also exposed Adam to increased risk from water market changes and delivery rules.

The extension position and this farm

From the analysis of Adams decisions, the extension officer has identified that Adam is exposed to 3 main sources of risk: a) the potential threat to accessing water onto his farm (water delivery) from his sale of water right. b) the casual water use fee as a factored cost in decision making; and c) the uncertain implications from production and profit sense from the reliance on purchased water. If Adam doesn't continue to get decisions right he risks production loss, loss of wealth and a limited ability to capture opportunities. The extension officer thinks that Adam would benefit from looking at alternative scenario's regarding temporary water purchase (eg. potential to take up more high-reliability) delivery share and gaining regular up-to-date information from water authorities and government.

Adam's very different production system presents a challenge for extension to be able to respond to the unique situations of farmers. Exposure to people like Adam challenges extension to "think outside the square" and represent a learning opportunity for extension program design and delivery – because the different way risk is managed by farmers impacts the way technical options and information are perceived and understood.

Adam's system demands accurate information for sound decision making yet different organisations and expertise are required to contribute to these "good decisions" and the information would need to be "in-tune" with each other. Extension would appear to be in a position to broker the necessary input to farm decision making across these organisations because of their insight into farm decision making.

However more would be required to align the activities of the organisations and sites of expertise in such a way that contributes to farmer capacity to adapt.

Conclusion from this case study

How can extension represent farm system change effectively to industry and policy? This case would suggest that there is a currently an unrecognised and unsupported role for extension to act in organisational alignment concerning water. There appears to be a gap in the capacity of extension to broker the different knowledge and information sources required for farmers to meet the challenges of water and in a way that meets the needs of farmers. Secondly, there appears to be a gap in the capacity of organisations and "sites" of expertise to align their activities to meet the decision making needs of farmers.

Case study 2 - Peter: Finding appropriate technology together – can co-learning relationships meet policy goals?

Peter has developed his family-owned dairy farm into a large and successful farming enterprise. With Peter's sons having recently returned to work on the farm, Peter is working with them on an eventual succession in farm management and ownership. A primary consideration in their succession planning is ensuring they can continue to grow enough pasture to feed their 900 cows and pay for their AUD$750 000 investment in a new rotary dairy. To achieve these goals, Peter and his sons are aiming to produce 6 million litres of milk a year. However, one crucial factor they are struggling with is having enough water to grow the pasture needed to support this level of production.

Seeking options for managing water better

Peter positions water as an essential part of the viability and longevity of the farm business.

Peter: 'We are getting into years when we are running out of water earlier … it's not the cost….that's …the main driver to create efficiency … the threat is that we only get 'water right' one day. And how do we make the most out of that (son)? … All of a sudden if you can't get enough water to grow the grass to milk the cows, you're under stress, the whole enterprise in under stress (Peter).'

The farmers identify a lack of water through inefficient irrigation threatens to restrict the volume of grass they can grow and the profitability of the business. Added to their concerns is the exorbitant amount of labour required to irrigate the farm, which further pushes up the costs of growing grass beyond what they think is reasonable.

Peter and his sons are concerned that if they are ever restricted to water right only allocations because of changes in government policies they will be unprepared for the water efficiencies needed to maintain the farm's productive pasture feedbase. As a way out of their situation they have been attracted to the water savings and production potential held by converting from their current flood irrigation to spray systems. Yet after investigating the options they assessed converting to spray irrigation as an unviable option.

Discovering alternatives for achieving water security

At the first meeting with the irrigation extension officer, problems with spray irrigation for this farm were raised and the extension officer was keen to expose them to an alternative solution – high-flow flood irrigation. High Flow Flood systems increase the rate at which water flows across a bay thereby reducing the volume of water lost to deep-drainage losses, and past the pasture plants' root zone. Trials indicate that by dramatically increasing the flow-rate to bay-size ratio on permeable soils, water use per irrigation and over an irrigation season can be almost halved. To support this shift, the extension officer figured he would first have to get the farmers to fully appreciate the deep-drainage losses of water going through the water table (past the pasture plants' root-zone) that were likely to be occurring because of their farm's permeable soils and current irrigation practices. Based on his calculations the farm could be losing 1000 ML each year to deep-drainage losses. Peter's son said to the extension officer:

'…you frightened the hell out of us …about how much is going through. We're only seeing what comes up above … I reckon I can almost see it.

After explaining how high-flow flood worked in some detail the farmers were keen to investigate this option and so the extension officer sent the group a three-page 'Irrigation Re-development Strategy' that laid out how to do a stock-take recording the farm's various water use rates on different irrigation

bays, its infrastructure, production and labour requirements. Upon his return for a follow up meeting Peter had acted swiftly, contacting the local water authority about the possibilities of getting a larger wheel put on their spur channel so that they could get more water onto their bays faster, and investigated finance options with the bank. However Peter's plan for action was wrong in its assumptions on what was needed to implement high-flow flood irrigation successfully. The extension officer was able to work through this error before work was begun.

Implications for the farm system

Peter and his family demonstrate a long term commitment to dairy farming – one that will see a fourth generation on the farm. Getting water right is central to them achieving the goal of a profitable business. They are not afraid of significant change and are searching for what they need to do to achieve the change they believe is needed. However, water saving options for their farm do not come "off-the-shelf". Their farm presents a learning challenge for irrigation specialists as they seek to effectively support what will ultimately be a tailored solution. Significant water decisions can be seen to involve other organisations (water authorities, banks, irrigation designers) and will also impact the production profile of their business.

The extension position and this farm

Making High Flow Flood (HFF) work on this farm requires more than an understanding of the technology. It requires decision support in irrigation management and a way to learn through and experiment. The irrigation officer finds that working with a person like Peter offers an opportunity to test the robustness of a technology under real conditions and also offers benefit in understanding the strengths and limitations of these irrigation technologies for other farmers. His experience with Peter has given him an understanding of the planning and management challenge for farmers in making a decision and changing a farm to High Flow Flood (e.g. the attention to detail and staged development required). Ultimately it will also require a higher management capability to make the most from the choice. For the extension officer, working alongside the farmers through change is a way to develop this level of capability.

Conclusion from this case study

The irrigation officer sees a high return to his extension goals and policy intentions from continuing to work with Peter by supporting their joint learning and monitoring of the implementation of HFF on the farm. He sees that this knowledge will also benefit other farmers who are considering it as he will have a process that farmers can use to assess its applicability to their own farm and an idea of the "traps and tips". Further, he will develop an idea of the performance of the system (compared with its theoretical potential) to achieve the extent of water savings desired.

For technologies to achieve their policy goals can be seen to require an on-farm capacity to decide, implement and modify the use of technologies to improve business performance as well as an advisory relationship that fosters a learning process between farmers and extension that builds capacity of both. It can be hypothesised that water savings, water use efficiency and transaction costs are all compromised by poorly conceived technology options for farms. The type of knowledge required to improve technology adaptation is that that is built from farmer and irrigation system specialists working together to reduce errors. However, there appears to be a gap between the synergy created from farm-extension interaction being translated to a policy context.

Discussion and Conclusion

The two case studies represent different roles and challenges for the advisory/extension profession in relation to complex and uncertain farm system resource management issues. Fundamentally the challenge is in working more effectively:

1. "with" (farmers) to co-learn in the development of resilient farming systems,
2. "up" (to policy) to better represent farming systems adaptation; and,
3. "between" (industry, other disciplines and organisations) to engage other disciplines and policy in "playing their part" effectively.

Traditionally, advisory and extension professions have closely associated their profession and practice with farming. This often synergistic relationship however has tended to result in extension policy decisions that define such synergy as being of only "private good" (i.e. a relationship that benefits the

farmer alone). However from both case studies it is apparent that the interaction between farming and extension/advisory practice means that extension: a) learns from and contributes to the adaptive management of farmers; b) interprets changes in policy for farm businesses and the range of possibilities, opportunities or risks that may flow from policy implementation across a population of farms and, c) reduces errors from the introduction of new technology for achieving policy objectives. Such outcomes from farm-extension interaction are not currently represented meaningfully to policy. So although social learning approaches often involve farmers and advisers as stakeholders – it is the result of farm-adviser interaction that is missing from this representation.

Extension/advisory professionals working across farm systems often have a generalist technical capacity and an ability to know the limits to their technical knowledge and where and when to seek specialist input or referral. The challenge exposed through the case studies is that the extension professional can often assess the organisational alignment necessary to improve the farming system but does not have the capacity or mandate to lead organisational alignment (e.g. timeliness of water market information). This is a true "brokering" practice that is not just leadership or facilitation – but mediation between the needs of other professions/stakeholders and farming needs. Currently there appears to be little support or recognition of such mediating practice in water resource management frameworks.

The low use of the advisory dimension of farm adaptation and water policy represents significant lost opportunities in water resource management and poorer quality policy – raising the need for an ethical assessment of current interventions. This research would suggest that an ethical collective action would: a) represent the adaptive voice of the farmer through advisory practice at a policy level; b) support the capacity of the brokering professions to align organisational action; and c) increase the transparency of policy making and farmer adaptation to each other. These dimensions of an ethical collective action are represented diagrammatically in Figure 1.

The extension/advisory professions are ideally placed for the mediating role in negotiating ethical frameworks, implementing action plans of industry and government (i.e. not as a "voice" for policy), and align top down policy with bottom up farm and industry perspectives. Advisors/extension can work with policy makers and their staff to create contextual understanding, build linkages over time and educate about new developments. In the current social learning frameworks it would appear that the "leadership and facilitation" dimension (SLIM, 2004) is the area in which the ethical framework and advisory contribution could be negotiated.

In the context of such conclusions it would appear that more research and development is required concerning effective policy approaches in resource management and resilient farm systems – particularly the way advisory and farm adaptation voices may be a greater part of policy design and implementation.

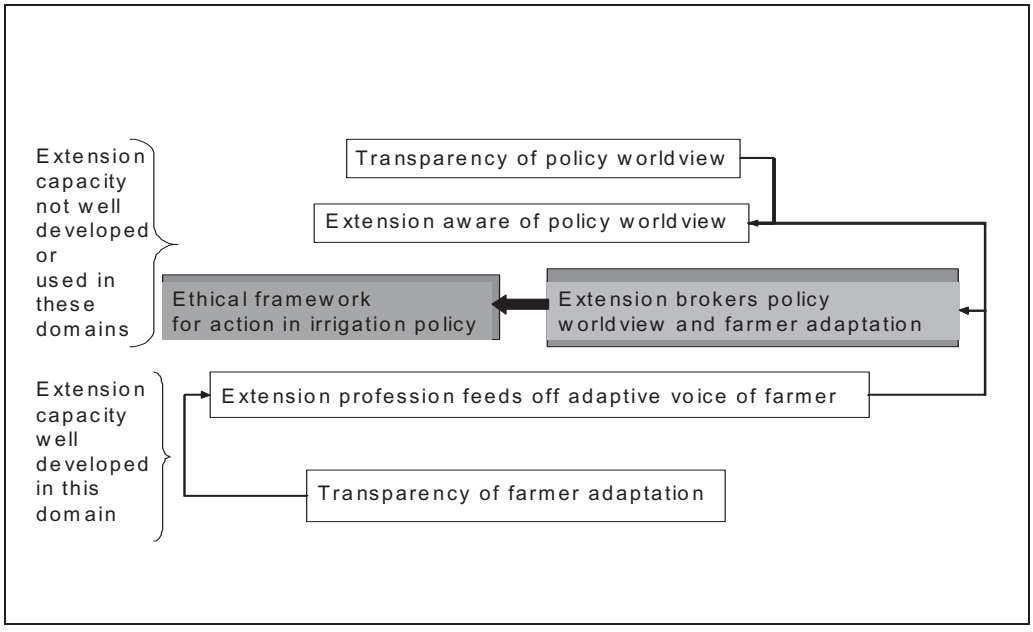

Figure 1. Dimensions of an ethical framework for irrigation policy making (the policy process is represented diagrammatically on the right, the capacity and role of extension on the left)

References

Armstrong, D. P., Knee, J., Doyle, P., Pritchard, K. and Gyles, O., (1998). *Water Use Efficiency and Profitability on Irrigated Dairy Farms in Northern Victoria and Southern New South Wales*. Department of Natural Resources and Environment, Institute of Sustainable Irrigated Agriculture, Kyabram Dairy Centre.

Armstrong, D. P., (2004). Water Use Efficiency and Profitability on an Irrigated Dairy Farm in Northern Victoria: A Case Study. *Australian Journal of Experimental Agriculture 44: 137-44.*

Barbier, M. and E. Chia (2001). Negotiated Agreement on Groundater Quality Management: a Case Study of a Private Contractual Framework for Sustainable Farming Practices. *Agricultural Use of Groundwater, Towards Integration Between Agricultural Policy and Water Resources Management.* C. Dosie. Dordecht/Boston/London, Kluwer Academic Publishers: 302.

Dairy Australia, (2006). *Dairy 2006: Situation and Outlook*. Dairy Australia.

Dairying for Tomorrow, (2006). *Survey of NRM practices on Australian Dairy Farms.* Dairy Australia.

Department of Prime Minister and Cabinet, (2005). National Water Initiative 24 March 2005 [cited 2 February 2006]. Available from http://www.dpmc.gov.au/nwi/index.cfm

de Villiers, M., (1999). *Water Wars: Is the World's Water Running Out?* London, UK., Weidenfeld and Nicolson.

Falkenmark, M and Folke, C. (2002). The ethics of socio-ecohydrological catchment management. *Hydrology and Earth System Sciences* **6**(1), 1-9.

Goulburn-Murray Water, (2005) [cited 11 August 2005]. Available from http://www.g-mwater.com.au/news.asp.

———, (2005). Goulburn-Murray Water Annual Report 2004-05.

Keeble, B., Robertson, D. and Johnson, F., (2004). A Qualitative Approach to Improve the Effectiveness of Products of Research Findings for Users: A Case Study of the Analytical Irrigation Model. *Australian Journal of Experimental Agriculture 44: 207-12.*

Keeble, B. and Johnson, F., (2002). *Study of Stakeholder Outlook on Water Use Efficiency.* Department of Natural Resources and Environment.

Ison, R and Watson, D. (2007) Illuminating the possibilities for social learning in the management of Scotlands water. *Ecology and Society. 12 (1): 21*

National Water Initiative, (2005). Department of Prime Minister and Cabinet, Australia. (24 March 2005 2005 [cited 2 February 2006]); available from http://www.dpmc.gov.au/nwi/index.cfm.

McCown, R.L. (2002) Changing systems for supporting farmer's decisions: problems, paradigms and prospects. *Agricultural Systems 74 (1) 179–220*

Nettle, R.A., Lamb, G., O'Connor, R., Taylor, C. (2006). *Water Security: Dairy farm decision making and the role of extension.* Dairy Australia, Melbourne. pg 1-135.

Pahl-Wostl, C. Craps, M. Dewulf, A. Mostert, E. Tabara, D. & Taillieu, T. (2007). Social Learning and Water Resources Management. Ecology and Society 12(2), 5.

Schon, D., (1983). *The reflective practitioner: How Professionals Think in Action.* Basic Books, Inc. USA.

Shiva, V., (2002). *Water Wars: Privatization, Pollution and Profit*. London, UK., Pluto Press.

SLIM, (2004). *Social Learning as a Policy Approach for Sustainable use of water: A field tested framework for observing, reflecting and enabling.* European Commission DG-Research - 5th Framework (1998-2002). (http://slim.open.ac.uk).

Weick, K., (1990). Technology as equivoque: sense-making in new technologies. *Technology and Organisation*. P. S. Goodman, L.S. Sproull and Associates. San Francisco, Jossey-Bass: 1-44."

Weick, K., (1995). *Sensemaking in Organisations.* Sage publications. USA.