

Congress sub-theme most closely related to the paper - WATER CONSERVATION AND DEMAND MANAGEMENT - The social aspect of water

Classifying, Clustering & Clumping; defining groups of irrigators in Australia's Namoi Valley.

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Introduction

The people of the world rely on irrigated agriculture to produce about 40% of the food that they consume. The expected growth in the Earth's population, together with an increase in levels of nutrition and changing food preferences spurred on by increases in prosperity, will contribute to an increasing demand for food. With food production needing to almost double by 2050 (Falkenmark et al. 2004) irrigated agriculture will be required to contribute to this increase in food supply. Very little of this production increase is likely to be from the development of new sources of water, the bulk of the increase will need to be obtained by using the existing water supply in a more efficient fashion.

In Australia this increase in food production and improved water use efficiency will need to happen in a troubled environment where the rapid growth in irrigated agriculture has already led to tension between competing uses and users of water. This rivalry has been made tangible by the visible effects on the environment from the over extraction of water such as declining groundwater reserves, rising water tables, increasing salinisation, and the like. In an effort to address these problems the Australian Government has been attempting to implement a series of reforms to water resources management since 1994; but only with limited success. This process however gained further momentum with the introduction of the National Water Initiative in 2004 (CoAG 2004) and since the 2006 drought resulted in the lowest recorded inflows into the Murray-Darling River system has now gained added pace. The stressed river with its economic, social, and environmental impacts precipitated the government announcement of a plan to spend ten billion dollars on water reforms, including one and a half billion dollars for improving on-farm water use efficiency and three billion dollars for purchasing irrigators' water entitlements (Commonwealth of Australia 2007c). As an incentive to irrigators any water recovered through efficiency gains is to be shared equally between irrigators and the environment.

Australian farmers have a substantial role in managing the environment; they are responsible for managing 60% of the nation's landscape (Commonwealth of Australia 2007a) and nearly 70% of the extracted water resources (Commonwealth of Australia 2007b). It is clear then, that the successful management of water in Australia is at its core, a people-based activity, but despite this, people are rarely acknowledged as being at

the centre of the process. Furthermore, if they are actually recognised as being part of the process, their motivations are often mistakenly identified as being solely commercially focused, so that too great a reliance has been placed on the use of the financial incentives of market based instruments as a way of achieving water reforms.

This paper explores the non-commercial factors influencing farmers' decision making in the context of the recently implemented Water Sharing Plans (WSP) in the Namoi Valley of New South Wales. In line with the governments water reform goals, the WSP were introduced to rectify an over allocation of groundwater resources. The required amount of entitlement reduction varied across the valley, according to the existing amount of over allocation, and has resulted in some licence holders losing up to 94% of their entitlements. To manage this degree of reduction most licence holders have to make some kind of decision about how to deal with it. This could be by purchasing or selling land or water.

Objective

We contend that irrigator's responses to policy initiatives, such as the reductions in water entitlements announced in the WSP, are not homogenous, but instead that irrigators exhibit a range of behaviours that are strongly influenced by the range of values and attitudes that they hold. Developing a better understanding of these values and attitudes through research such as this will lead to better policy design and implementation.

Using cluster analysis our previous research (Kuehne et al. 2008a) developed a typology with three groups of irrigators. These groups illustrate how the management decision making of farmers is influenced by their values, attitudes and goals towards family, profit, land, water, lifestyle, and community, and the unique and individual ways in which they combine these.

Providers want their family to work in the farm business with them and to continue operating the farm business after they retire. They see family as being important to the same extent that *Investors* see it as being unimportant. They are less motivated by making a profit than the *Investors*. Their values towards land suggest that even when opportunities for sales or purchases of land arise they are not willing traders. For them land is more than just a means to generate an income. This means they are unlikely to sell their land even if it does not generate a reasonable income. The reason for this is that their land is a resource that enables them to achieve their family goals. Improvements they make on their farms are not necessarily for financial gain. They don't believe that water should be traded and if they had any unused water they would use it for further development of their farm (Kuehne et al. 2008a).

Lifestylers' values towards family are much less prominent than *Providers* but still exist. Their value preferences towards commercial activity are similar to those of *Providers* in that they prefer to reinvest profits back into their farm. However, unlike *Providers* they are more willing to admit that financial gain is a motivation for their involvement in farming. However, unlike *Providers* they are more willing to reduce equity in their farm

than sell off farm investments. As with *Investors* they also view the regular trading of land as an acceptable undertaking, and like *Providers* they see their involvement in farming as being of more importance than owning the land. They view their land as just something they use to produce an income and also view any improvements they make to the property as an investment leading to increased property values. They suggest that they are prepared to sell land if it performs poorly as an investment. They are not planning to buy more land for their family members. They are similar to *Providers* in their attitudes towards water, and are not strong advocates of the sale of water, preferring instead to use it to increase the production of their farm (Kuehne et al. 2008a).

Investors do not place value on their family members continued involvement in their farm business. Even though they are more motivated by profit than either of the other clusters they are also likely to be receiving lifestyle benefits from their investment. They have a more dispassionate attitude to land ownership being more prepared to trade under-performing investments in land than either the *Lifestylers* or *Providers*. They suggest that water should be able to be freely traded and see its value being derived from what it can produce (Kuehne et al. 2008a).

This paper reports on research into the relationship between the three groups; *Providers*, *Lifestylers*; *Investors*, and 1) their likelihood for participating in the water reform process, 2) the influences on their decision making, and 3) their preferred method of gathering decision making information.

Methods

An exploratory mail-out survey was conducted with 151 ground water licence holders of Australia's Namoi Valley. Quantitative demographic information as well as personal and property specific data was gathered. Qualitative responses were sought to questions about decision making specific to licence holders farm businesses and their perceptions of the success of water reform in NSW, and Australia in general.

Building on the findings from the mail-out survey a telephone survey was conducted to gather demographic data as well as information on past and intended management actions. It also included a set of value and attitude statements against which the respondents were asked to rate their level of agreement using a one to five Likert-scale. The telephone survey was administered to 121 ground water licence holders. The results of the telephone survey were used to establish the three clusters discussed above. Identifiers were used which enabled the researchers to link the responses to the mail and telephone questionnaires.

The property and business characteristics data from the mail out survey was divided according to the *Investor*, *Lifestyler*, and *Provider* classification. These three groups were compared using descriptive statistics and cross tabulations. Qualitative responses were divided into the same groups and were analysed using a simple cut and sort technique.

Results & Discussion

Using the introduction of the WSP as a pivotal decision making event, the research establishes the perceived impact of the event, and how other threats are perceived. It establishes what types of responses are being made to the WSP and if these differ between cluster groups. It explores the sources of information used for making these decisions, those things that are influencing the decision, and those things that would have made the decision easier to make.

Quantitative analysis

The quantitative analysis of the mail-out survey involved the use of simple descriptive statistics. Mean values were generated for property characteristics and WSP impacts (table 1).

Table 1: Mean values of property characteristics and WSP impacts from mail-out survey.

	^a Investors n=25	Lifestylers n=39	Providers n=39	^b All N=151
Groundwater entitlement ^c	499	780	648	682
Groundwater usage ^c	173	363	256	282
% of entitlement used	34	46	39	41
Total farmed area ^d	570	793	868	873
Cotton area ^d	211	320	378	276
Food crop area ^d	129	112	173	129
Crops for livestock ^d	65	77	90	82
Annual income reduction from WSP ^d	0.28	0.59	0.22	0.8
Investment in response to WSP ^d	0.44	0.73	0.54	0.6

^a Cluster developed from phone survey, ^bNot all mail-out survey respondents could be matched with cluster group categories ^c Megalitres, ^dHectares, ^e Million A\$

The mail survey results show that the clusters do have differing property and business characteristics. *Investors* have less water entitlement and use a smaller percentage of their entitlement over a smaller irrigated area. *Lifestylers* have more entitlement and use a greater percentage of it. They suggest that they will suffer double the financial effects of others from the implementation of the WSP and are expecting to make greater investments to counter its effects. *Providers* have more total farmed area than either of the other groups; they appear to be slightly more productive and are less affected by the WSP than the *Lifestylers* or *Investors*.

The nature of the causal relationship still needs to be explored. It is not clear if irrigators' values have led to their property characteristics, or if the property characteristics have led to the irrigators adopting certain values. It is not clear whether they cause each other or if there is some other variable influencing the relationship.

Kuehne and Bjornlund (2008b) suggest that cluster memberships based on values could change over time. Irrigators could pass through different groups according to their life and business stage. For example a farmer whose goal is to develop a property is initially

likely to be focused on profit (and would therefore belong to the *Investors* group) until such time that their goals are achieved. When the farmers' development goals were achieved they would then move to either the *Lifestyler* or the *Provider* group. They could set up a business for the family and become a *Provider*. But, if this is not a possibility, either because of no children or because of disinterested children, they could continue farming up until the time of retirement and belong to the *Lifestyler* group.

The 151 respondents to the mail out survey appear representative. Their average entitlement was 682.4 ML, while the mean entitlement for all of the licence holders on the contact list provided by the government for this research is 599.8 ML. The mean size of entitlement of the survey respondents is a little larger than that of the government list. Reflecting the difference in entitlement size the respondents also used more water with the mean annual use for all license holders over the twelve years between 1991 and 2003 being 234.0 ML while the respondents to the mail-out survey used 282.9 ML. The fact that mean annual allocations for the respondents are 13.7% larger than for the population, while annual water use is 20.5% larger, is likely to be caused by survey respondents aggregating multiple licences in their responses and that larger irrigators may be more likely to find the survey relevant.

In an effort to achieve greater insight a crosstabulation was performed. Relationships were found between cluster group membership and years farming, average annual groundwater use, and number of employees. These relationships are significant and strongly associated.

			Years Farming			
			up to 20	21 - 35	Over 35	Total
Cluster Group	Investors	Count	10	6	8	24
		Expected Count	7.2	10.3	6.5	24.0
		% within Cluster Group	41.7%	25.0%	33.3%	100.0%
	Lifestylers	Count	12	14	12	38
		Expected Count	11.4	16.3	10.3	38.0
		% within Cluster Group	31.6%	36.8%	31.6%	100.0%
	Providers	Count	8	23	7	38
		Expected Count	11.4	16.3	10.3	38.0
		% within Cluster Group	21.1%	60.5%	18.4%	100.0%
Total	Count	30	43	27	100	
	Expected Count	30.0	43.0	27.0	100.0	
	% within Cluster Group	30.0%	43.0%	27.0%	100.0%	

Table 3: Chi-Square Tests of Years Spent Farming and Cluster Group

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.680(a)	4	.070
Likelihood Ratio	8.804	4	.066
Linear-by-Linear Association	.058	1	.809
N of Valid Cases	100		

0 cells (.0%) have expected count less than 5. The minimum expected count is 6.48.

The cross tabulation (table 2-3) showed that farmers with less than twenty years of experience are more likely to be *Investors*. Farmers with from 20 to 35 years of experience are more likely to be *Providers*. *Investors* and *Lifestylers* are equally dominant in the over 35 years of farming experience category. This adds further support to the idea that cluster group membership can change during the course of a farming career. The lesser numbers of *Providers* in the long-term farmers group can be explained by their need to deal with family succession issues. When *Lifestylers* grow their business it stays under their control until the time that they have to give up living on the farm. *Providers*, however, grow their business with the specific intention of handing it on to their family. The passing on of the ownership and management of the farm business to the next generation usually happens prior to retirement. This results in the Provider appearing to have spent less years farming.

			Average Use			
			No use	Up to 250	250 and over	Total
Cluster Group	Investors	Count	3	15	4	22
		Expected Count	4.4	9.3	8.2	22.0
		% within Cluster Group	13.6%	68.2%	18.2%	100.0%
	Lifestylers	Count	6	15	18	39
		Expected Count	7.9	16.5	14.6	39.0
		% within Cluster Group	15.4%	38.5%	46.2%	100.0%
	Providers	Count	11	12	15	38
		Expected Count	7.7	16.1	14.2	38.0
		% within Cluster Group	28.9%	31.6%	39.5%	100.0%
Total	Count	20	42	37	99	
	Expected Count	20.0	42.0	37.0	99.0	
	% within Cluster Group	20.2%	42.4%	37.4%	100.0%	

Table 5: Chi-Square Tests of Groundwater Usage and Cluster Group

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.012(a)	4	.040
Likelihood Ratio	9.965	4	.041
Linear-by-Linear Association	.002	1	.964
N of Valid Cases	99		
1 cell (11.1%) has expected count less than 5. The minimum expected count is 4.44.			

Regarding groundwater usage (table 4-5), *Providers* are the most likely not to have used their licence at all. They have a larger farmed area so the need to have activated their licence and develop irrigation, may not have been as strong as the *Lifestylers* or *Investors*. *Investors* are strongly represented in the up to 250 MI a year usage category while *Lifestylers* are more likely to be using over 250MI. Groundwater is used for about a third of all irrigation in the Namoi Valley (Kuehne et al. Under Review). It appears that in addition to their use of groundwater *Providers* are also likely to use more surface water than the other groups.

			No. of Employees			
			Zero or One	2.00	3 or More	Total
Cluster Group	Investors	Count	2	11	5	18
		Expected Count	3.8	6.1	8.1	18.0
		% within Cluster Group	11.1%	61.1%	27.8%	100.0%
	Lifestylers	Count	5	11	21	37
		Expected Count	7.9	12.5	16.6	37.0
		% within Cluster Group	13.5%	29.7%	56.8%	100.0%
	Providers	Count	12	8	14	34
		Expected Count	7.3	11.5	15.3	34.0
		% within Cluster Group	35.3%	23.5%	41.2%	100.0%
Total		Count	19	30	40	89
		Expected Count	19.0	30.0	40.0	89.0
		% within Cluster Group	21.3%	33.7%	44.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.710(a)	4	.013
Likelihood Ratio	11.994	4	.017
Linear-by-Linear Association	.756	1	.385
N of Valid Cases	89		
1 cell (11.1%) has expected count less than 5. The minimum expected count is 3.84			

The number of employees (table 6-7) is an approximate indication of the extent of irrigation activity within the business. *Providers* are more likely to have either one or none, *Lifestylers* two and *Investors* three or more. *Investors* are likely to have less direct involvement in the farming business than the other categories and more likely to have other sources as their main income, hence they need to make more use of non-family workforce

Cross tabulations, significance testing and strength of association tests were done with all the data. Influenced by the low sample size, we did not find that relationships could be confirmed between cluster group membership and 1) the size of the farmed area, 2) the size of the groundwater entitlement, 3) the level of schooling, 4) whether a succession plan was in place, 5) the time spent responding to the WSP, 6) the farmer's age, 7) years left farming, 8) years on property, 9) years spent as primary decision maker, 10) farmed area, 11) whether cotton was grown, 12) how seriously the WSP was perceived, 13) respondents sense of optimism, or 14) respondents rating of their own management skills.

This does not mean that relationships do not exist between the cluster and these items; what it does mean is that none of the relationships achieved statistical significance. It means that the hypothesis that there was a relationship between farmers' values (cluster group membership) and those variables could not be supported.

Qualitative Analysis

The qualitative section of the survey (see appendix) allowed respondents feelings regarding the WSP, and water reform more generally, to emerge without the interference of the researcher. Because the survey was exploratory in nature the information provided by the respondents was, as expected, broad and unfocussed. It was placed into categories for analysis which allowed themes to emerge. With further iterations of this survey it would be more useful to define the categories in advance in an effort to encourage a more focused response.

Lifestylers and *Providers* are more likely to intend to make WUE improvements in response to the entitlement reductions associated with the WSP than *Investors*. This could be because *Investors* having a more profit oriented approach have already identified the financial gains that are able to be obtained from WUE and taken advantage of them or it could be that because *Investors* have smaller entitlements they have already needed to make more efficient use of the water. Another possibility is that because *Investors* have smaller irrigated areas WUE improvements are less financially attractive because they are not supported by scales of economies.

Investors, when seeking out sources of useful information for their decision making about the WSP, are more likely to use paid farm advice than the two other groups. *Lifestylers* are more likely to use word of mouth and *Providers* are more likely to rely on information from authorities such as government departments and industry associations. This might be because the *Investors* are the lesser experienced farmers; without the

developed social and business networks of the other groups. The *Providers* are more production oriented, not aiming to generate profit for its own sake but for its role in achieving their family goals. Therefore they choose authorities as a source of information. *Lifestylers*, because they are more enmeshed in the farming lifestyle and have networks that have developed over the years prefer word of mouth.

There was a similarity in the responses to the question, ‘What would have made your decisions [about the WSP] easier to make? *Investors* suggest that they needed more information – they needed to know what the facts were. They also suggested that transparency, fairness and honesty were missing in their dealings with the government. *Lifestylers* wanted more prompt action from the government and also more certainty, decisiveness and clarity; as well as greater understanding and a willingness to listen from the department. Similar to *Lifestylers*, *Providers* criticised the government for a lack of action and for contributing to uncertainty with a lack of clear and concise advice.

Investors when asked about the influences on their decision making mentioned “growth of asset” and simply the need to make money or as one stated “\$ return on investment”. One stated that decisions were influenced by the need for “[g]etting bigger to remain viable”. This growth in farm size had a number of components to it. For some it was the need to improve “[f]arm viability”, but for others it was meeting other apparently psychological needs in the "...desire to be bigger and ‘successful’".

Lifestylers strongly emphasise the value of lifestyle considerations as an influence on their decision making. They list “lifestyle”, “stress”, and “rural lifestyle” as decision influences. One respondent suggested that the decision influences were “[l]ifestyle issues (although farming now has to offer more than a nice way of life)” others identified “workload” and “sustainable land use”. Another saw that the environment was a part of the farming lifestyle, identifying their decision influence as being “[t]he environment for bringing up your family” and the “health of family members”. Another identified strongly with his chosen career, "I am a ‘farmer’ ... it's ‘my job’. I trained to do it”.

Providers, more than either of the other groups, were very focused on their family as an influence on their decisions. The decision influences that they offered included; “family life”, "viability for future generations”, “employment for family & workforce”, “emotional and family reasons”, “thinking of their family” and “succession planning”. One described how he was influenced by concerns for the future well being of his family, “in my case buying this little bit of land was important for working for myself and my family”. The influences on the decisions of *Providers* are not all family related though; one said that “Most farmers want to maintain at least or better still improve the health of their land”. Another suggested that the influence was “Lifestyle decisions - pleasant surroundings” while another suggested “health”. One summed up the *Providers* approach to profit suggesting that “[n]obody with financial considerations would buy a farm.”

Investors, when describing what the WSP means to them, suggest that although the WSP was needed, it will be an unfair and costly burden for some. They suggest it has created uncertainty, affected confidence and will cause less productivity for irrigators which will

devalue assets and flow onto further undesirable socio-economic effects on the community. One stated that, “[f]irst and foremost it means less productivity and secondly it will affect our income thus the whole family farm and community will suffer”. Another offered the comment that it was, “[h]andled poorly, but needed”. Another irrigator offering a sober assessment suggested that the WSP means “... the farm is worth less if sold for retirement.”

Lifestylers, when asked what the WSP means to them, strongly suggested that WSP will lead to greater security of ground water and a sustainable water resource. They did recognise, however, that there are significant costs in achieving this. They expected lower incomes, assets that will be worth less and the need to develop other sources of income. Some did not expect that their businesses would survive the WSP. One irrigator suggested that “[t]he over-allocation of some areas was madness. The idea of one-fix-fits-all is also madness.” Another hinted at the potential for perverse effects arising from the WSP by suggesting that he will be “[l]ess sustainable because I will have to work the land harder to service debt”. *Lifestylers* recognise both the benefits and the costs of the WSP, one commented that, “[i]t will be good for our underground water supply for the future, but at a big cost and headache to everyone involved.” This was also reinforced by another irrigator who suggested that it “... is a complete disaster for us as a family and the whole Namoi Valley - less production, less jobs, less employment, less cash flow, less money in local towns. A socio-economic disaster.” *Lifestylers* expect to feel the financial impact of the WSP more acutely; one stated “I will go bankrupt if I lose my small allocation. I will not be able to service my bank debt and we will have to sell.” Another suggested with certainty, the “WSP will put us in bankruptcy and we’ll have to sell our farm, that will be the worst day of my life.”

Providers when explaining what the WSP means to them recognise the need for WSP but they also recognise the reduction in their profit that will also come with it. They suggest that the WSP will affect their families through succession issues and they also suggest that because it will mean a reduced ability to earn an income, leading to reduced employment, which will then have an effect on the community. One *Provider* suggested that the WSP “[c]ould be a handicap if one of my sons wants to take over.” Another describing the expected impact of the WSP suggested that, “[m]y feeling is that the WSP will have an adverse affect on my farm, which will ultimately affect my family and the community.” Another explained the impact of the WSP by suggesting that “[t]he community is affected, of course, by less money in the district because of unviable irrigation farms, less workers, families selling out, larger [businesses] taking over properties, district population shrinking.”

Each group agrees that water reforms such as the WSP are needed. Although they will all suffer financially; this financial penalty will affect them in different ways and they will respond to it in different ways. The *Providers* see the effect of the WSP in terms of their family. They are likely to make water use efficiency improvements. The *Lifestylers*, who appear to be the group that will suffer the greatest financial disadvantage, see that the WSP will lead to a deterioration of their lifestyle benefits. They are also likely to make efficiency improvements. The *Investors* see the effect of the WSP simply in terms of the

reduced profitability of their investment and are less likely to make water use efficiency improvements. It is possible that as farmers pass through various life and business stages that their values change to reflect their new goals, (or that their goals change to reflect their new values or even a bit of both).

Conclusion

Water is not just an economic good; but because people value its use in different ways, it also has a social dimension. To be successful water reform programs need to encourage the participation of both communities and individuals. Without the attention to the social side of water, through research such as this, those programs may not be successful.

Even though much of the quantitative data failed to achieve statistical significance, when interpreted with the qualitative data this research has shown that irrigator's values, when clustered according to the dimensions of family, land, water, community, lifestyle, and profit, can be used to predict likely involvement in water reform programs.

The government intends to recover water for the environment by encouraging irrigators participation in schemes such as the on-farm water use efficiency component of the "National Plan for Water Security" (Commonwealth of Australia 2007c). The voluntary and willing participation of irrigators will be required for this to be successful. However, each of the groups we have described in this paper has a different likelihood of carrying out water use efficiency improvements, and a different way in which they should be approached when communicating offers regarding government programs. The *Providers* are likely to make efficiency improvements so that their farm businesses are more profitable for their family and their family successors. When they consider making these decisions they gather their information through authoritative sources such as government, industry, and community bodies. *Lifestylers* are not motivated by family concerns but are likely to make improvements to their water use efficiency because they see it as the right thing to do; it fits with their concerns for the environment and using water responsibly. They gather their information through word of mouth. The *Investors* are motivated by profit and are less likely to make efficiency improvements. They have a preference for quality factual information that they gain from paid services.

By seeking to explain some of the influences on farmers' behaviour this research has added another perspective to those needing to tailour policy instruments and communications to better suit farmers. The social side of water resource management should not be an after thought; environmental reform policy instruments that recognise and respond to the between group variability of farmers are more likely to be adopted by farmers than those that assume that irrigators all have the same motivations.

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APPENDIX

Qualitative Survey Questions

1. Depending on your business position, and the severity and the timing of the cuts (if any) to your entitlements, the implementation of the WSP could be an opportunity that you can take advantage of, or a threat that you need to counter. For example you might be considering buying or selling land or water. What are the most important actions that you are planning to take in response to the WSP changes?
2. What sources of information have been the most useful for you when you were thinking about the above actions?
3. When you were considering the above actions, what would have made your decision easier to make?
4. Most people say that when farmers make large one-off decisions (like the sale or purchase of a farm) they are mostly influenced by the financial implications of their decisions. What other important factors do you think might have an influence on farmers' decision making in these instances?
5. Are you able to summarise what the WSP means to you? (This can also be how it affects your farm, your family, or your community).