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Water Reallocation Policies – The Importance of Rural and Urban Differences in Alberta, Canada

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***Abstract*—**There is currently intensive debate in Alberta, Canada, regarding rural to urban water reallocation. This paper explores the demographic and attitudinal influences that are associated with the acceptance of water reallocation policies and whether such acceptance differs between urban and rural residents. We investigate three policy orientations in regards to water policies: i) government intervention; ii) environmental protection; and iii) protecting irrigators' water rights. We find that urban dwellers are more likely to favour government intervention while rural dwellers are more likely to support policies that aim at protecting irrigators' water rights. While urban dwellers are also more likely to favour environmental protection, the difference is not statistically significant. We also find that other factors have a significant impact on policy choice irrespective of residence such as demographic and socioeconomic factors as well as the values people hold toward water and the environment.

***Keywords*—**Canada, rural, urban, water transfers.

I. Introduction

WATER scarcity is emerging as a major problem in many semi-arid regions of the world. Continued population and economic growth as well as urbanization processes have increased pressure to allocate more water for urban and industrial uses [1], [2] and for the environment [3]. Waterborne diseases, caused by poor water quality and inadequate supply for sanitation, have been identified as a major cause of death, illness and production losses and have further increased the demand for more water for urban uses [4]. Many rivers in semi-arid regions are suffering the environmental consequences of excessive extraction. This has resulted in poor water quality, reduced stream flow, and the loss of ecosystem service provision. Together, these have reduced the environmental and recreational values of water bodies. These processes, combined with increased environmental awareness and growing desires for water-based recreation, have caused a shift in community attitudes and values towards water. In turn, this has increased political pressure to leave more water in rivers to protect ecosystems and to allow for the adequate production of ecosystem services [5], [6].

Increased population and urbanization have also raised the issue of food security. Since the middle of the last century most of the increase in global food production has been generated through expanding irrigation. This expansion has been the major driver of increasing water extraction to unsustainable levels. In many rivers in semi-arid regions irrigated agriculture accounts for up to 80% of water entitlements and water use [7]. Considering that water extraction is already at unsustainable levels in most of these rivers, water managers and policy makers are faced with managing multiple demands for water and a need to make difficult choices. In most instances, policy makers need to consider not only reducing total extraction to protect ecosystems, but also to facilitate reallocation of existing water rights to meet increased demand [8], [9]. Considering that irrigation currently accounts for 80% of water use in many overstressed river basins, it is clear that this sector needs to play an important role in the reallocation process. The irrigation sector is likely to suffer reductions in its extractive entitlements to water, either through regulatory cuts to existing entitlements or through voluntary market based reallocations of parts of their entitlements to meet increased urban, industrial, and environmental/recreational demands.

Policy makers need to think carefully about how to facilitate such reductions or reallocations. Currently communities in regions where irrigation is important are very dependent on water as the engine for businesses and jobs. Taking a substantial part of that water will therefore have significant economic and social impacts, both on the irrigators and the communities depending on them. Further, in many regions reducing water available for irrigation may undermine food security for a growing population. Careful consideration of reallocation policies is necessary to minimize these negative impacts. The impact on communities and food security can be addressed to some extent by improving water use efficiency and productivity. The socio-economic impacts of reductions in water availability for irrigation can also be minimized by adjustment packages and buy-back schemes of water entitlements. Since irrigators in many parts of the world have legally-defined rights to water, proposals to reallocate water are more likely to succeed if they are supported by irrigators themselves. At the same time, many of the reallocation options require the use of tax revenues. Thus, such solutions also need to be acceptable to the wider community to make spending of public funds politically acceptable. These issues are at the core of this paper.

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This paper focuses on the South Saskatchewan River Basin in southern Alberta, a region that currently is facing considerable pressure on scarce water resources, and is confronted by pressure to reallocate water from the irrigation sector to the environment and other users. The basin has been closed to the issuance of new licenses and is facing significant increased demand from urban and industrial uses [10]. At the same time, and reflective of a world-wide trend, there is enormous pressure in the basin to ensure minimum flows of water to support ecosystem functions [11]. The paper investigates how peoples' values towards water influence their preferences for different water reallocation policies. Three potential policy directions are evaluated in the paper: i) government intervention; ii) environmental protection; and iii) protecting irrigators' water rights. We also sought to understand whether urban and rural household residents have similar views regarding the three approaches to reallocation policies. The identification of the influences associated with individuals' water policy preferences, as well as any differences between urban and rural residents, will assist policy makers in devising water management policies that are mutually beneficial to all residents and the environment.

II. Water Values and Water Reallocation Policy Preferences

Policy makers face significant challenges when designing and selecting water allocation and management institutions. This is largely due to the distinctive characteristics of water and the hypothesis that people's values towards water, including economic and non-economic values, determine how water is allocated [12]. Broadly, water values can be classified as direct and non-use values. Direct (or indirect) use values are benefits that directly (or indirectly) accrue to individuals who use water (or who benefit from others' use of the water). Non-use values of water arise either from humans knowing that ample water is there or from knowing that it is there for potential future use. Non-use values are divided into option values, quasi option values, existence values and bequest values [13]. In the past, water was mainly managed for its direct economic value, and agriculture accounted for the largest volumes of water consumed. Currently, the focus is shifting towards its non-use values, and specifically its value for conservation [14], [15].

As water becomes scarcer, it is valued more and also generates increased competition among sectors [16]. Provision of water to meet environmental needs is a major new source of competition. In the context of rural to urban water transfers, however, increased urbanization and growing per capita water use in urban areas are the main factors driving increases in demand [2]. Reference [9] argues that the resulting increase in economic efficiency in consumption by transfers can be mutually beneficial if compensation is paid. However, conflicts over water allocation and the negative effects of water transfers from rural to urban are well documented [16], [17]. Although the adoption of new, more efficient irrigation infrastructure can help to meet part of the increased demand, it is not sufficient to solve the issue of increased urban water demand [16]. Therefore, water resource managers and policy makers face the difficult task of reallocating a scarce resource for which various sectors compete [18].

Evidence suggests that policies to facilitate transfers from rural to urban/environmental users will cause less conflict and discontent if they are consistent with stakeholder values [19]. If voters believe environmental need for water should not be compromised, then a water management approach that safeguards the environment is more likely to be promoted by politicians and implemented successfully. The way people value water directly determines how they perceive water should be managed because values play a significant role in explaining beliefs and behaviors [20], [21]. In addition to the values people hold towards water, previous research suggests that other characteristics may also influence peoples' perception of water policy options; these include gender, place of residence, political standing, income and education.

Place of residence is of great interest since water transfers to meet increasing urban water demand often involves conflicts between rural and urban residents. Urban residents tend to be more liberal, have greater trust in government, have more environmental concerns and are more likely to be proponents of regulatory policies [22]-[27]. This suggests that urban residents would more likely prefer water management policies that rely on government regulation.

Other studies suggest that differences between rural and urban residents have been eroding since the 1970s due to significant migration between rural and urban areas [28], [29]. It has therefore been suggested that place of socialization has a more important influence on an individual's level of environmental concern and interaction with the natural environment [30], [31]. Similarly, it has been suggested that social links to natural extractive industries may be better indicators of the social basis of environmental concern [32].

Importantly, generalizations about the values or urbanites such as these are not fully justified as they are culturally specific in that they reflect the circumstances in the locations in which they took place. No single study has empirically investigated the associations between values and policy preferences regarding rural to urban and environmental water reallocation, and the differences between urban and rural (excluding farmers) residents. This study employs data collected from a 2009 survey in the province of Alberta, Canada, to investigate these issues. While the findings are specific to a particular geographic region, we suggest that they may be broadly relevant in other settings where urban and rural people are competing for water.

III. Study Area and Policy Context

Water availability and demand in Canada varies significantly. On the east and west coasts, water is relatively abundant. However water is scarcer in the central Prairie Provinces. Even in these provinces supply is quite high in the north with very low population and economic activity.

However, the southern part of these provinces is largely semi-arid, with low precipitation and high (and increasing) demand from growth in population and economic activity. Hence water scarcity is an emerging issue in these regions.

Alberta is one of these Prairie Provinces. More than 60% of all irrigation in Canada is concentrated around Lethbridge in the southern part of this province within the South Saskatchewan River Basin (SSRB) [33]. The SSRB also includes the major part of the Calgary-Edmonton Corridor—one of North America's fastest growing regions. Pressures on water resources within the SSRB have therefore been growing and environmental impacts are emerging with 22 of the 33 main stem river reaches in the SSRB rated as 'moderately impacted', five as heavily impacted, and three as degraded as a result of the current level of extraction [10]. At the same time, demand from the non-irrigation sector could increase by up to 136% by 2046 while irrigation demand could increase within the two main rivers by 10% and 20%. Consequently the SSRB was gradually closed for from 2001, no new license applications were accepted after 2005 [34].

Major policy reforms commenced with a new *Water Act* in 1999 and a new *Irrigation Districts Act* in 2000, both of which facilitated the introduction of water markets. In 2001, the province embarked on a policy review process to develop a long-term provincial water management strategy. This process resulted in the *Water for Life* strategy released in November 2003 [35]. The strategy identified improved water use efficiency and productivity as the primary method for securing water to meet water conservation objectives and new demand from consumptive users. One of the strategy's main objectives was to increase 2005 levels of water efficiency and productivity by 30 percent by 2015. Voluntary reallocations were identified as the means to facilitate the transfer of the saved water from existing users to new users and the environment. However, the strategy also emphasized that economic instruments would be used as necessary to achieve the objectives. Importantly, irrigation districts hold the vast majority of licensed volumes of water in the basin under the *Water Act*. Farmers in irrigation districts receive water from the districts under the *Irrigation Districts Act, 2000*. Transfers of water from rural to urban uses requires the transfer of water out of a district, under the *Irrigation Districts Act* such transfers need to be approved by a majority of district irrigators in a plebiscite.

Water markets have been very slow to emerge in Alberta [36]. The first major attempt of a rural to urban transfer to provide water for a major shopping mall, casino and race track at Balzac (north of Calgary) took place in 2007 when Alberta Environment approved a transfer of 2,500ML (dam3) from the Western Irrigation District (WID), the license holder, to the Municipality of Rocky View. The developer proposed to pay the WID 15 million Canadian dollars to replace a leaky canal with a pipeline, and, in return, would receive 2500ML of the saved water for the new development. In reality the pipeline would save more than the 2,500ML. This transfer should represent a clear win-win situation allowing for significant economic development while generating both a financial gain and access to more water for the WID, the district selling the water. However, the WID only approved the transfers in the plebiscite by the narrowest of margins, and the transfer attracted significant public controversy and opposition from environmental NGOs, water and electricity authorities and other special interest groups, resulting in court cases [37]. A survey of managers and board members of the 13 irrigation districts also indicated that there is very little support for the use of water markets or other economic instruments to facilitate water transfers, with only 24% in favour of such instruments [38].

Also in 2007, the Eastern Irrigation District applied to Alberta Environment to have its licenses amended to provide more flexibility to supply water for non-irrigation purposes in order to meet growing demands from surrounding communities and industries. Similar amendments had been made in the past for other irrigation districts. However, in this case, environmental lobby groups effectively opposed the amendment [37] causing Alberta Environment to stop processing the application pending further review of the water management and allocation system in Alberta. In 2009 the Minister of the Environment embarked on such a review and a number of reports and papers have been published to inform that process [39]-[42]. The amendment was finally approved but was promptly appealed with the outcome still pending.

The above examples illustrate that the government rely heavily on voluntary reallocation of water, and there is very little support for such policies amongst irrigators and within the wider community. Hence there is a strong need to better understand the values of residents of the basin, and how they perceive that water reallocation should take place. Alberta is therefore an ideal study area for filling the identified gap in the existing literature and providing important lessons for other regions in the world facing similar challenges.

IV. Methodology

This paper is based on a broad-based mail out survey. Questionnaires were randomly mailed to 3,000 households in Lethbridge, Alberta (a city with 86,659 urban water consumers) and to 3,000 households in Taber, Magrath, Raymond and Stirling (small towns around Lethbridge largely dependent upon irrigation). Two reminders were sent and cash prize incentives were offered to encourage participation. An adult member of the household was asked to complete the survey. A total of 1,165 valid surveys were returned; 429 were returned due to incorrect addresses, the resident having moved, or were deceased. This resulted in a response rate of 21%. After removing missing observations[1], 1,066 survey responses were available, with 609 and 457 in the urban and rural areas respectively.

The questionnaire consisted of three sections. In Section

[1] The records with incomplete information were also examined and it indicates these recodes were missing at random. Therefore dropping out these records did not bias any further analysis.

One, respondents were asked to rate 40 value statements that reflect different ways people value water on a 1-to-5 Likert Scale, ranging from strongly disagree to strongly agree. Section Two asked respondents to rate ten statements about the different ways water in Southern Alberta can be managed. The final section collected demographic and socio-economic information, information about the respondents' recreational use of water bodies, their provenance (i.e., whether they were raised in an urban or rural setting and the setting in which they had lived the longest).

V. Findings

A. Overall Assessment of Rural and Urban Differences on Values and Policies

A simple mean comparison table of the water value statements between urban and rural residents is presented in Table I.[2] A one-sided mean comparison test was conducted with the null hypothesis being responses from urban and rural residents are equal. For 12 statements the null hypothesis can be rejected and the alternative hypothesis that the urban average is greater than the rural average is accepted, which indicates urban residents are more agreeable to these statements than rural residents. The 12 statements signify the importance of environmental water values, the preference for water conservation over water extraction, and government's responsibility for water protection. There are eight statements (which in general emphasize the direct use value of water and the need to protect the property rights of irrigators) for which the null hypothesis can be rejected and the alternative hypothesis that rural average is greater than the urban average can be accepted.

Regarding water management policy options, Table II presents the average scores and mean comparison test between urban and rural residents. Urban residents are clearly more in favor of policy options that recognize the environment's right to water and the government's role in water policy. On the contrary, rural residents appear to support policy options favoring the direct use of water and the rights of irrigators.

TABLE I
MEAN COMPARISON OF WATER VALUE STATEMENTS BETWEEN URBAN AND RURAL

Statements	Urban	Rural	P-value **Bold: urban< rural**
1. A healthy, functioning aquatic environment should always take priority over human uses of water.	3.33	3.09	0
2. The environment's needs for water should be met before water is used for human economic purposes such as industry and agriculture.	3.32	3.1	0
3. I want future generations to be able to experience aquatic environments in southern Alberta that are healthier than the ones we have now.	3.95	3.82	0
4. The environment is important to me because of its natural beauty.	4.09	4.01	0.05
5. Healthy aquatic ecosystems add to the quality of life in the province of Alberta.	4.23	4.16	0.05
6. New subdivisions should not be allowed in this region if supplying the water they need would cause harm to the environment.	3.78	3.64	0.01
7. I would like public spaces to be planted with trees, shrubs and flowers that need less water.	4.14	4.02	0
8. I would feel a sense of pride if I knew that this region had a healthy natural ecosystem.	4.19	4.09	0.01
9. The way we manage water in our rivers in Alberta is outdated and not in line with society's current values.	3.28	3.11	0
10. I'm concerned that aquatic habitats in southern Alberta are not receiving enough protection.	3.6	3.46	0.01
11. I would get satisfaction from knowing that enough water was in the river to support natural ecosystems even if I didn't use the river for recreation.	4.11	4.01	0
12. The government should be responsible for ensuring that water quality and quantity are good enough to ensure a healthy environment.	4.15	4.07	0.04
1. Using water to create green and lush public spaces adds more to my quality of life than leaving the water in the river.	**2.76**	**2.88**	**0.03**
2. People have the right to modify the natural environment to meet their economic needs.	**2.48**	**2.59**	**0.03**
3. I would rather see Alberta's economy grow through more irrigated agriculture as opposed to having more water in the rivers.	**2.68**	**2.8**	**0.02**
4. Water should be made available for economic uses before the environment.	**2.32**	**2.5**	**0**
5. I enjoy having a lush green lawn and/or garden even if doing so may cause environmental harm to the river where the water comes from.	**2.31**	**2.41**	**0.03**
6. The aquatic environment of southern Alberta is healthy.	**3.05**	**3.16**	**0.01**
7. Irrigated agriculture produces locally grown, healthy food for me and my family.	**3.81**	**3.96**	**0**
8. Buyers and sellers of water licenses should be the ones who decide the price of water.	**1.95**	**2.06**	**0.03**

[2] Only statements with significant p-values for the one-sided mean comparison tests are reported. This also applies to Table II.

TABLE II
MEAN COMPARISON OF WATER POLICY MANAGEMENT OPTIONS BETWEEN URBAN AND RURAL RESIDENTS

Statements	Urban	Rural	P-value **Bold: urban< rural**
The government, rather than market forces, should decide who gets to use Alberta's water.	3.6	3.46	0.01
If water is to be traded among irrigation districts and/or municipalities, the government should set the price.	3.36	3.2	0
If an irrigation district or municipality is not using all of the water it has been allocated, then the government should be able to take that water for environmental purposes without compensation.	3.3	3.14	0.01
Minimum flows of water should be set for all rivers, and only the water above those minimum flows should be available for economic purposes such as irrigation.	3.89	3.64	0
All water licenses, no matter when they were issued or for what purpose, must be honoured.	**2.65**	**2.93**	**0**
Water that is saved through improved water use efficiency should be used to increase economic activity.	**3.08**	**3.28**	**0**

These summary statistics show that there are significant differences between urban and rural residents regarding their values and policy orientations towards water. The next section uses factor analysis and regression analysis to explore whether or not the differences between urban and rural residents still remain when all other demographic and socio-economic influences are controlled.

VI. IDENTIFYING CAUSAL FACTORS INFLUENCING PREFERENCE FOR POLICY ORIENTATION

A. Factor Analysis

Principal Components Factor Analysis was carried out to identify the number of value constructs people held towards water and to reduce the number of value statements to a manageable number of value constructs for subsequent analysis. From the initial 40 value statements, nine were used in the final factor analysis model. The Bartlett test of sphericity rejects the null hypothesis that variables are not inter-correlated at the 0.01 significance level and the Kaiser-Meyer-Olkin Measure of Sampling Adequacy for the model is 0.77, which indicates factor analysis of these nine value statements is appropriate. Three factors with Eigenvalue greater than one were retained, with each explaining 30, 13 and 12% of the variance, with a total of 55%, representing a reasonable percentage explained by the number of factors [43]. Factor loadings of each value statement are presented in Table III. Factor loadings below 0.30 are not reported as they are considered as both statistically [44] and practically insignificant [43]. A careful examination of Table III suggests that each construct represents a unique value dimension people hold towards water. For the first factor, statements one to three have significant loadings and they all represent the direct use or economic value of water. Hence this factor is named *economic*. Statements four to six represent the value of water for the environment and community in general and have significant loadings on the second factor; this factor is therefore named *environmental*. The last three statements represent the value of water as a property right and state that people who own the property right should have the right to use it to generate income. Thus the last factor is named *property*.[3] Factor scores for each construct are predicted by Thompson's regression method[4] [45] and are used as independent variables in our regression analysis to explain households' water policy preferences.

TABLE III
FACTOR ANALYSIS (FACTOR LOADINGS AND MODEL FIT STATISTICS)

	Economic	Environmental	Property
S1	0.82		
S2	0.82		
S3	0.82		
S4		0.66	
S5		0.63	
S6		0.79	
S7			0.56
S8			0.73
S9			0.71
Proportion of Variance Explained	30	13	12
Determinant of the correlation matrix	0.25		
Bartlett test of sphericity (Chi2 ; p-value)	1477; 0.000		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.77		

S1. The environment's needs for water should be met before water is used for human economic purposes such as industry and agriculture (reversed). **S2**. I would rather see Alberta's economy grow through more irrigated agriculture as opposed to having more water in the rivers. **S3**. Water should be made available for economic uses before the environment. **S4**. The environment is important to me because of its natural beauty. **S5**. Healthy aquatic ecosystems add to the quality of life in the province of Alberta. **S6**. Rivers tie communities together. **S7**. At least some of my household income depends directly on an activity that uses water from the river. **S8**. I think that water is a commodity that individuals and private groups should be able to buy and sell. **S9**. Buyers and sellers of water licenses should be the ones who decide the price of water.

B. Regression Analysis

Regression analysis was used to explore what is associated with people's water policy preferences and whether urban and rural residential status is associated with the preference. The ten water management policy statements in the survey were categorised as three broad policy orientations: i) government intervention, ii) environmental protection, and iii) protecting

[3] In order to examine whether urban and rural residents have different scores for each factor, a one-sided mean comparison test was conducted for each value construct. Results (available upon request) suggest that urban residents regard water's economic and property value lower than rural residents while they consider water's environmental value higher than rural residents, which reinforces the results in Table I.

[4] Each factor score will have a mean of zero and a standard deviation of one.

irrigators' water rights.

Table IV includes the statements for each of the policy orientations. In order to derive a general index indicating people's agreeableness on each policy orientation, we took the sum of the statements' Likert scale within each policy orientation. This produces an index for government intervention ranging from three to 15, for environment protection from four to 20 and for irrigators' water rights from three to 15. To make the indexes more understandable, we adjusted them into a one to five[5] scale (from strongly against to strongly for) the policy orientation in question. For example, a new index of five for the government intervention index indicates a strong orientation for the government's role in water management policy and was used as the dependent variable in our regression models.

TABLE IV
THREE WATER MANAGEMENT ORIENTATIONS

GOV	The government, rather than market forces, should decide who gets to use Alberta's water. If water is to be traded among irrigation districts and/or municipalities, the government should set the price. If an irrigation district or municipality is not using all of the water it has been allocated, then the government should be able to take that water for environmental purposes without compensation.
ENV	Private individuals and groups should be able to hold water licenses for environmental protection. Public funds should be used to improve irrigation systems only if the water that is saved is left in rivers. The government should buy water from current water license holders, such as irrigation districts, so that more water can be left in the river for the environment. Minimum flows of water should be set for all rivers, and only the water above those minimum flows should be available for economic purposes such as irrigation.
IRR	All water licenses, no matter when they were issued or for what purpose, must be honored. Public funds should be used to help larger water users (irrigators, industries and municipalities) to become more water efficient. Water that is saved through improved water use efficiency should be used to increase economic activity.

GOV-Government intervention; ENV-Environment Protection; IRR-Irrigators' water rights

These indexes are ordinal outcomes and an ordered probit model is an appropriate tool for their estimation. A formal ordered probit model is specified as follows: Define y^* ¬as a latent variable of the index y and the structural model is $y^* = x\beta + \varepsilon$, where x is a vector of explanatory variables and ε is a random error. We observe:

$y=1$ if $-\infty \le y^* < \mu_1$
$=2$ if $\mu_1 \le y^* < \mu_2$
$=3$ if $\mu_2 \le y^* < \mu_3$
$=4$ if $\mu_3 \le y^* < \mu_4$
$=5$ if $\mu_4 \le y^* < +\infty$,

and β, μ_1, μ_2, μ_3 and μ_4 are unknown parameters to be estimated by the maximum likelihood method using the log-likelihood function [46]. The definitions of the dependent and explanatory variables are presented in Table V.

VII. Results and Discussions

Results of the ordered probit regressions are displayed in Table VI. Overall the models fit reasonably with the McKelvey and Zavoina's $R2$[6] ranging from 0.16 to 0.28 and the percentage corrected predicted from 48 to 59%. The results indicate a significant difference between urban and rural residents in their perception of the three water management policy orientations, particularly regarding government intervention and irrigators' water rights. Everything else being equal, urban residents are significantly more supportive of government intervention (consistent with [22], [23], [25], [26]) while being less supportive of irrigators' water rights. It is also shown that urban residents are more oriented towards environmental protection than rural residents, but this difference is not statistically significant (also found by [26], [28]). We also tested the variable for where people were raised and where they had lived most of their lives. These models were inferior to the model reported in Table VI, in terms of the model selection criterion BIC (Bayesian information criterion), and the two variables were less significant than current residency. These findings are contrary to those of [30] and [31].

TABLE V
VARIABLE DEFINITIONS

GOV	index for government intervention (from 1 to 5)
ENV	index for environment protection (from 1 to 5)
IRR	index for irrigators' water right (from 1 to 5)
urban	1 if residential area is urban, 0 otherwise
male	1 if male, 0 otherwise
age	age of the respondent (semicontinuous)
hhdincdummy	1 if household income is 80,000 or over, 0 otherwise
stewardshipgroup	1 if a member of a watershed/watercourse stewardship group, 0 otherwise
environmentgroup	1 if a member of an environmental or conservation group, 0 otherwise
certdip	1 if education level is high school diploma or equivalent, 0 otherwise
degree	1 if education level is university bachelor, 0 otherwise
degreeabove	1 if education level is university bachelor degree above, 0 otherwise
nowateractivity	1 if there is zero number of activities that need access to water, 0 otherwise
whitecollar	1 if it is a white collar occupation, 0 otherwise
bluecollar	1 if it is a blue collar occupation, 0 otherwise
occ_recreation	1 if occupation is in Art, culture, recreation or sport, 0 otherwise
occ_primary	1 if occupation is in the primary industry, 0 otherwise
factor_economic	factor score of the economic factor
factor_ environment	factor score of the environment factor
factor_ propertyright	factor score of the property right factor

[5] For government intervention and irrigators' water right indexes, 3, 4 and 5 are reindexed to 1; 6, 7 and 8 are reindexed to 2; 9 is reindexed to 3; 10, 11 and 12 are reindexed to 4 and 13, 14 and 15 are reindexed to 5. For environment protection, 4, 5, 6 and 7 are reindexed to 1; 8, 9, 10 and 11 are reindexed to 2; 12 is reindexed to 3; 13, 14, 15 and 16 are reindexed to 4 and 17, 18, 19 and 20 are reindexed to 5.

[6] McKelvey and Zavoina's R^2 most closely approximates the R^2 obtained by fitting the linear regression model on the underlying latent variable [47], [48].

Regarding the other explanatory variables, results suggest gender, watershed/watercourse stewardship group membership, and attitudinal values are all significantly associated with views towards policies. Males are more oriented towards government intervention and less oriented towards environmental protection or irrigators' property rights; people with a watershed/watercourse stewardship group membership are less oriented towards government intervention or environment protection and more supportive of irrigators' water right. This is likely to reflect that most water stewardship group members are land owners. Such a result is in contrast to studies on farmers themselves. For example, in Australia, [49] found that being a member of Landcare or Waterwatch was a significant positive influence on environmental water behavioural intentions, and [50] found membership was a significant positive influence on environmental actions on farm.

People with a high score on the economic attitudinal factor are less oriented towards government intervention and environmental protection but are more supportive of irrigators' water rights. Those scoring highly on the environment attitudinal factor are more supportive of the environment and irrigators' rights; and those scoring highly on the property rights attitudinal factor are less supportive of government intervention and are more supportive of irrigators' rights. The consistency between people's values towards water and their water policy orientation is consistent with the general literature on value explaining beliefs [20], [21].

Furthermore, older people, those with higher incomes, and those employed in the art, culture, recreation or sport areas are more oriented towards the need for government intervention to solve water issues. Reference [51] found similar result that age is positively related to support for environmental regulation from a general population survey but income was found to be negatively associated with support for environmental regulation. People who do not regularly use water for recreational activities are less oriented towards environmental protection than those regularly using water for at least one recreational activity. This confirms findings by [52] and [53]. People who are employed in the primary industries are more oriented towards irrigators' property rights.

In order to explore whether any personal characteristics affect the water management policy orientations differently between urban and rural residents, we divided the sample into urban and rural groups and ran the regression models separately. A conventional Wald test was carried out to test whether the coefficients of each explanatory variable are equal in the urban and rural models. The results are shown in Table VI, which shows that there are only a few explanatory variables that have a significantly different impact on water policy orientation between urban and rural residents. Urban residents are more supportive of the government intervention policy if they do not regularly use water for recreation. Although the dummy for occupation in the art, culture, recreation or sport sector is significant in the urban model while insignificant in the rural model, the estimated coefficients do not differ significantly.

Rural residents were significantly less likely to support the environmental policy orientation if they were members of stewardship groups, were blue collar workers or did not

TABLE VI
PROBIT REGRESSION RESULTS OF WATER MANAGEMENT OPTIONS

	Government Intervention				Environment Protection				Irrigators' Water Rights			
	All	Urban	Rural	Wald	All	Urban	Rural	Wald	All	Urban	Rural	Wald
Male	0.21***	0.19*	0.22*	0.03	-0.30***	-0.33***	-0.28**	0.08	-0.15*	-0.05	-0.29**	2.08
Age	0.01***	0.01***	0.01**	0.06	-0.003	0.003	0.003	0.00	-0.001	-0.001	-0.002	0.00
Hhdincdummy	0.15*	0.17	0.16	0.00	0.08	0.06	0.1	0.06	0.004	0.01	0.01	0.00
stewardshipgroup	-0.97***	-0.94***	-1.21***	0.33	-0.67**	-0.13	-2.49***	21.42***	0.67**	0.37	1.64***	4.31**
environmentgroup	0.004	0.01	-0.01	0.00	0.01	-0.07	0.17	0.75	0.001	-0.02	0.06	0.08
certdip	0.02	0.04	-0.04	0.11	0.23*	0.61***	-0.21	9.78***	-0.02	-0.13	0.02	0.49
degree	0.14	0.12	0.16	0.02	0.13	0.47**	-0.23	4.70**	-0.11	-0.24	0.02	0.94
Degreeabove	0.14	0.27	-0.01	0.92	0.14	0.52**	-0.3	6.28**	0.04	-0.04	0.13	0.32
nowateractivity	0.04	0.20*	-0.16	4.92**	-0.17**	-0.04	-0.37***	3.89**	-0.08	-0.05	-0.1	0.09
whitecollar	0.08	0.05	0.18	0.39	-0.1	-0.2	-0.05	0.46	-0.12	-0.13	-0.08	0.06
bluecollar	-0.04	-0.1	0.1	0.81	-0.14	-0.05	-0.32*	1.25	-0.17	-0.01	-0.34**	2.24
occ_recreation	0.57*	0.83***	0.12	0.81	-0.17	0.12	-0.82	1.73	0.23	0.3	0.24	0.01
occ_primary	0.1	0.11	0.06	0.01	-0.1	-0.31	0.08	1.42	0.33**	0.47**	0.39*	0.05
factor_economic	-0.29***	-0.22***	-0.38***	3.32*	-0.50***	-0.55***	-0.46***	0.81	0.42***	0.47***	0.36***	1.49
factor_environment	0.04	0.07	-0.01	0.84	0.12***	0.10*	0.14**	0.24	0.08**	0.08*	0.11*	0.12
factor_propertyright	-0.13***	-0.11**	-0.15***	0.28	0.04	0.09*	-0.02	1.71	0.24***	0.25***	0.24***	0.02
urban	0.15**	-	-		0.11	-	-		-0.19***	-	-	
cut1 (μ_1)	-1.21***	-1.22***	-1.34***		-2.96***	-2.64***	-3.84***		-2.34***	-2.26***	-2.34***	
cut2 (μ_2)	0.14	0.04	0.12		-1.13***	-0.94***	-1.59***		-0.67***	-0.50*	-0.78**	
cut3 (μ_3)	0.52**	0.43	0.51		-0.65***	-0.48	-1.07***		-0.11	0.08	-0.24	
cut4 (μ_4)	2.26***	2.22***	2.20***		1.51***	1.77***	1.04***		1.68***	1.97***	1.52***	
obs.	1066	609	457		1066	609	457		1066	609	457	
chi2	138.27	77.41	85.34		242.77	136.5	176.25		197.28	144.91	72.78	
Log likelihood	-1265.4	-706.01	-550.47		-1098.21	-604.23	-474.48		-1276.71	-712.14	-553.1	
McKelvey & Zavoina's R^2	0.16	0.15	0.19		0.28	0.28	0.33		0.24	0.25	0.23	
Percentage correctly predicted	55	57	51		59	62	56		48	49	49	

a. Chi-squared statistic of Wald test for the null hypothesis that the coefficients of the urban model and rural model are equal. * p<.10; ** p<.05; *** p<.01.

participate in water recreation activities regularly. Educational dummies in the urban model are all significant while they are insignificant in the rural model. The differences are also statistically significant, which suggests the role played by low education attainment (lower than high school or equivalent) is only apparent among the urban residents.

Regarding the policy orientation that protects irrigators' rights rural residents were significantly more likely to support this policy orientation if they were members of a stewardship group. One final point regarding the Wald test is the results on the attitudinal variables. Generally the influences of the attitudinal variables are not significantly different between urban and rural residents. The only significant difference was that rural residents were significantly less likely to support the government role the more they aligned themselves with the economic value construct. This suggests that residential location has little influence on the magnitude of association between people's attitudes towards water and their subsequent water policy preferences.

VIII. Conclusions

This paper investigates the factors associated with three policy orientations towards water reallocation: i) government intervention; ii) environmental protection; and iii) protecting current water right holders. It also analyses the extent to which the level of acceptance varies between urban and rural households in Alberta, Canada. We find that urban dwellers are more likely to favour government intervention while rural dwellers are more likely to support policies that aim to protect current water right holders. While urban dwellers are also more likely to favour environmental protection, the difference is not statistically significant. This reflects the finding that urban residents have significantly lower attachment to water's economic and property values and significantly higher attachment to environmental water values than rural residents.

People's water values, as well as the interactions people have with water bodies, either through work or recreation, have a significant influence on their policy preferences. People holding strong economic water values are less oriented towards government intervention and environmental protection but more supportive of the rights of current licence holders. Those associating strongly with environmental water values are more supportive of environmental protection as well as the rights of current licence holders; while those associating strongly with the property rights of water are less supportive of government intervention and more supportive of protecting the rights of current license holders. People actively involved in using water bodies for recreational purposes are more likely to be supportive of the environmental protection policy orientation while people engaged in art, culture, recreation or sport, as well as older and wealthier people, are more oriented towards government intervention. Finally we found that residential location has little influence on the magnitude of association between people's attitudes towards water and their subsequent policy preference for water allocation.

The findings in this paper support the recent findings by [19] and suggest that policymakers will reduce social conflicts and achieve more predictable policy outcomes if they take the values of citizens into account during the processes of policy development, design and implementation, especially in sensitive areas such as water reallocation.

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