Water Communities in the Republic of Macedonia: an empirical analysis of membership satisfaction and payment behaviour

Gorton, M., Sauer, J., Peshevski M., Bosev, D. Shekerinov, D. and Quarrie, S.

Paper prepared for presentation at the 12th EAAE Congress
'People, Food and Environments: Global Trends and European Strategies',
Gent (Belgium), 26-29 August 2008

Water Communities in the Republic of Macedonia: an empirical analysis of membership satisfaction and payment behaviour

Gorton, M.[1], Sauer, J. [2], Peshevski, M. [3], Bosev, D. [3], Shekerinov, D. [3] and Quarrie, S.[4]

[1] School of Agriculture, Food and Rural Development, Newcastle University, Newcastle upon Tyne. UK
[2] Kent Business School, Imperial College London, UK.
[3] University of Ss. Cyril and Methodius, Skopje, Republic of Macedonia.
[4] Kraljice Natalije 39, Belgrade, Serbia

Abstract - **The performance of Water Communities (WCs), a form of self-managing organisation for irrigation, in the Bregalnica region of the Republic of Macedonia is investigated. Analysis, drawing on primary survey data, focuses on the decision of farmers to join a WC (Heckman selection probit model), determinants of farmers' satisfaction with their membership of WCs (ordered probit model) and factors associated with changes in farmers' water payment behaviour (non-parametric CLAD model). Key determinants identified include transparency and trust with respect to the structure and operation of the WC, cost recovery rates, farm size and irrigation costs. Membership satisfaction is an important determinant of payment behaviour. Lessons for sustainable self-management are drawn.**

Key Words - **Irrigation, Self-management, Water User Associations**

I. INTRODUCTION

In both developed and less developed countries there has been a broad shift in policy away from state based irrigation management towards supporting the development of private and independent, not-for-profit arrangements, particularly local Water User Associations (WUAs). This movement, which is often referred to as irrigation management transfer, has been promoted by nation states and international agencies such as the World Bank. While WUAs are widely seen to have the potential to be a superior institutional arrangement for local irrigation management, delivering meaningful benefits to farmers and taxpayers, it is nonetheless recognised that the actual performance of WUAs has been patchy [1]. It is important therefore to carefully evaluate the performance of WUAs and understand the principles that underpin successful self-government.

This paper seeks to contribute to this debate by evaluating the success of the introduction of Water Communities (WCs) in the Republic of Macedonia. Macedonia is a Balkan state where agriculture is the mainstay of rural livelihoods and substantial water deficiencies occur during the summer season, so that irrigation has a major impact on yields and hence incomes. By comparing performance across several WCs, which are a form of WUA that were created within a common external environment and institutional framework, it is possible to identify internal principles and qualities that are critical to success and determine variations in outcomes.

The identification of factors that underpin self-sustaining WUAs, is particularly pertinent for states in Central and Eastern Europe (CEE), that have undergone a transition from central planning to more market based economies. This transition in agriculture was characterised by substantial falls in agricultural output and decapitalisation [2]. Much state owned irrigation fell into disrepair and the establishment of local self-governance for economically sustainable irrigation has been seen widely as an essential task, although some have doubted whether this can be currently achieved in the Balkans [3]. Through the analysis of the performance of WCs in Macedonia we seek to contribute to these wider debates on factors underpinning successful self-management and opportunities for local irrigation management in CEE.

The performance of WUAs has previously been measured in three ways: membership rates, technical impact and cost recovery. Technical impact has been assessed in terms of changes in yields, water availability and area irrigated. Such assessments are typically based on expert opinion with little recourse to the views of ordinary members. Yet the sustainability of WUAs will depend ultimately on the satisfaction and retained membership of farmers. Moreover, previous assessments have tended to be based on comparisons of WUAs from different countries and market environments so it has been difficult to identify the relative importance of external factors compared to member / resource characteristics in influencing performance. Our analysis recognises these difficulties and compares the performance of WUAs created in the Bregalnica region of Macedonia under a common legal framework and time period. This allows for a comparison of cases with a similar external environment and therefore a clearer understanding of the role of internal (to the WUA, farm and farmer) factors. Performance is measured in terms of propensity to become a member, member satisfaction and farmers' payment behaviour.

II. THE MACEDONIAN CONTEXT

Bregalnica is a semi-arid region of the Republic of Macedonia for which water scarcity is significant. Rainfall is approximately 500 mm per annum and occurs principally in Autumn and Spring. Due to dry, hot summers, water deficits of approximately 450 mm for crops are typical [4]. The main crops grown in the Bregalnica region are wheat, maize, barley, alfalfa, rice, peppers, tomatoes, watermelons and grapes. Self-reported non-irrigated wheat and grape yields are 80 and 58% of irrigated levels respectively. Rice, peppers, tomatoes and watermelons are entirely dependent on irrigation for cultivation. As fruit and vegetables are the main high value added crops produced, agricultural incomes are heavily dependent on irrigation and this is acknowledged by farmers. From the farm survey outlined in Section 3, 94% of respondents agreed or strongly agreed with the statement that 'irrigation is very important for my livelihood'. Depending on topographical conditions and crop type, the structure of irrigation varies from flood irrigation for rice to, much more commonly, open channels and concrete tubes for arable and horticultural production.

As agricultural fortunes and the real level of public expenditure on rural infrastructure fell in the 1990s, the quality of the irrigation network deteriorated rapidly. In the Bregalnica region, the irrigated area declined from 59% of total utilized agricultural area in 1990 to 26% in 1996 [5].[1] During the 1990s, many of the concrete channels of the Bregalnica system became cracked and pumping stations moribund. Water can easily be stolen from such a system with it being common for farmers to punch holes in channels to irrigate their land without paying. It has been estimated that at least 20% of irrigated water was lost due to theft and leaks from open channels [6].

To improve efficiency, in 1998 a new Water Law was introduced, accompanied by a project for the rehabilitation and reconstruction of irrigation. The basis of the latter was an agreement between the Government of Macedonia and the World Bank. The project covered three irrigation networks: Tikves, Bregalnica and Polog. The purpose of the project was to reconstruct irrigation systems, making their use sustainable through introducing better technology and local management. We focus on Bregalnica.

In 2002 a protocol for transferring irrigation management was signed. WCs can be formed where the participants in a given area account for more than 50% of agricultural land in the community's territory and wish to manage irrigation and drainage matters collectively. The WC sets the prices of irrigated water and drainage to its members, which should reflect the true costs of delivering irrigated water, maintaining the network and ensuring adequate drainage. WCs negotiate the supply of water from a Public Water Enterprise. At the time of the establishment of the first WCs (May 2002), the average cost recovery rate was only 36%.[2]

III. DATA AND ECONOMETRIC METHODOLOGY

A. Data

Data on the performance of the WCs was collected via two methods. Firstly, in-depth interviews were conducted with a senior figure for each of the major WCs established in the Bregalnica region. The interviews collected information on the geographical area covered by the WC, membership, investment, main problems encountered and cost recovery. Data were collected for the first full three years of the existence of each WC. Secondly, to understand the reasons for the variation in WC performance in greater depth and to investigate the determinants of member satisfaction, a farm survey

[1] The Bregalnica irrigation system consists of a delivery network of 26,008 km.

[2] Measured as the percentage of the total billed amount for a given territory which was actually paid by farmers.

was conducted. In total, 249 survey responses were collected through face to face interviews.

The survey responses are divided into two groups: members of a WC (n=223) and farmers within the Bregalnica region who operate within a WC area but had chosen not to join the association (n=26). Data collection from the latter group allows us to understand why some farmers have not chosen to join their respective WC. The distribution of responses by farm size is presented in Table 1. Estimates from senior managers of the WCs suggest, that on average, approximately 87% of farmers in the geographical area covered by the WCs have joined. This suggests that the sample is broadly representative in terms of the balance of members and non-members.

Table 1 highlights that the majority of farmers sampled farm less than 2 hectares. This is in line with other estimates for Macedonia as a whole [4]. However, a detailed analysis of the representativeness of the sample is impossible because the last population census for the country was conducted in 1981 and no agricultural census has been administered since 1964. Non-members operate significantly smaller farm areas.

Table 1: Classification of Members and Non-Members of WCs by farm size (%)

Farm size	Member of a WC (n=223)	Non WC member (n=26)	Total (n=249)
Less than 1 ha	37.2	61.5	26.5
1 to 1.99 ha	26.0	7.7	22.5
2 to 2.99 ha	9.9	3.8	15.3
3 to 3.99 ha	5.4	7.7	9.6
4 to 4.99 ha	4.9	3.8	5.2
5 to 9.9 ha	6.3	11.5	11.2
10 to 19.99	5.4	3.8	5.2
20 ha+	4.9	0.0	4.4

Source: survey data

B. Econometric Analysis

Using these cross-sectional survey data we estimate, as a first step, a Heckman selection probit model to identify causal factors related to farmers' decisions to join a water community. Based on these estimates we calculate the inverse Mill's ratio to account for possible selection bias with respect to the estimation of the outcome equation modelled as an ordered probit model. Secondly, we investigate determinants of farmers' satisfaction with their membership of water communities including, beside other explanatory variables, the inverse Mill's ratio from the Heckman selection model. In a third modelling step we then explore significant factors for changes in farmers' water payment behaviour by estimating a censored least absolute deviations (CLAD) based model based on a non-parametric estimator. Here the estimates for water community membership satisfaction gained from our second model are used as an explanatory variable beside other socioeconomic characteristics. From this procedure we try to reveal if farmers' satisfaction with water services can explain some of the variation in their payment behaviour.

Model 1. It is expected that a farmer's decision to join a water community or not is influenced by a multitude of factors: socioeconomic characteristics at the household/farm level, production and irrigation technology characteristics, as well as personal attitudes towards and experiences with irrigation and water communities in general as well as with respect to their specific, local water community. It is likely that, in these regards, the characteristics of water community members will differ from non-members. Unobservable characteristics affecting the decision to become a member will be correlated with the unobservable characteristics affecting a farmer's level of satisfaction with his/her water community membership. Selectivity bias would be present, therefore, if we were to draw inferences about the determinants of membership satisfaction for all farmers based on the observed level of satisfaction of the subset which is actually a water community member. Heckman's two-stage sample selection model copes with such a selection problem by assuming that the farmers make two judgements with regard to membership and membership satisfaction, each of which is determined by a different set of explanatory variables [7]. Hence, it is based on two latent dependent variables models, where the decision to become a member or not is modelled as a selection equation specified as:

$$P_i = \begin{cases} 1 \text{ if } \ \alpha + \sum_j \beta_j hh_{ij} + \sum_k \gamma_k att_{ik} + \sum_l \delta_l irr_{il} + u > 0 \\ 0 \text{ otherwise} \end{cases}$$

where P_i is a binary variable which takes the value one if the farmer is a member of the local WC and zero if the farmer decided not to become a member, hh denotes the vector of socioeconomic characteristics of the household/farm, *att* stands for the personal attitudes of the farmer toward the structure and conduct of the WC, and *irr* for the irrigation technology related variables. α, β, γ & δ are the parameters to estimate, and *u* is the error term (the corresponding log-likelihood function for equation above is presented in [7]. The membership satisfaction equation is given by:

$$satis_i = \mu + \sum_m \kappa_m hh_{im} + \sum_n \tau_n att_{in} + \sum_r \omega_r irr_{ir} + \sum_s \psi_s comm_{is} + v$$

where *satis* takes the values:

$\{$1: 'very dissatisfied', 2: 'dissatisfied', 3: 'indifferent', 4: 'satisfied', 5: 'very satisfied'$\}$

respectively, hh denotes again the vector of socioeconomic characteristics, *att* stands for the personal attitudes of the farmer toward the structure and conduct of the WC, *irr* for the irrigation technology related variables, and $comm$ for water community cost related characteristics. $\mu, \kappa, \tau, \omega$ & ψ are the parameters to estimate, and *v* is the error term. Given the distribution of the dependent variable, we estimate the equation above as an ordered probit model.

To address the likely problem of small sample bias as well as heteroscedasticity, we estimate the robust covariance matrix using the Huber-White sandwich estimator [8, 9]. To examine the validity of the final model specification, we test for the group wise insignificance of the parameters by a common generalized likelihood ratio testing procedure. Finally a White test [9] was conducted to check for possible heteroscedasticity. To test for small-sample bias we further investigate the robustness of our estimates obtained by applying a simple stochastic re-sampling procedure based on bootstrapping techniques [10].

Model 2. Our second model focuses on explaining the variation in farmers' water payment behaviour. Among other variables, we also use [11] the estimates from Model 1 for farmers' satisfaction with their water community membership as an explanatory variable beside other socioeconomic household characteristics. From this procedure we try to reveal if farmers' satisfaction with water services can explain some of the variation in their payment behaviour.

Initial analyses revealed that essential model violations (heteroscedastic error terms and a non-normal error distribution) lead to highly inconsistent parametric estimation results with respect to censored model specifications. Consequently, we adopted a nonparametric censored least absolute deviations estimator (CLAD); which was developed by Powell [11, 12] as a generalization of the least absolute deviation estimation for non-negative dependent variables. Farmers' payment behaviour with respect to their water bill can be approximated as:

$$payincr_i = \max(x_i\beta + \varepsilon_i, L)$$

where *payincr* denotes the percentage change in the amount of their total water bill paid by the farmer in the study period from 2002 to 2004, x_i as a vector of the observable explanatory variables for farm *i* (i.e. socioeconomic characteristics of the household/farm, the personal attitudes of the farmer, the irrigation technology related variables, and water community cost related characteristics), β are the parameters to estimate, and ε is the error term. *L* stands for the lower censoring bound with respect to the dependent variable. The CLAD estimator of β minimizes the sum of absolute deviations, $|\varepsilon|$, assuming a conditional median restriction on the error term. The objective function can thus be specified as:

$$S_n(\beta) = \min\left\{\frac{1}{n}\sum_{i=1}^{n}\left|payincr_i - \max\{L, \beta x_i\}\right|\right\}$$

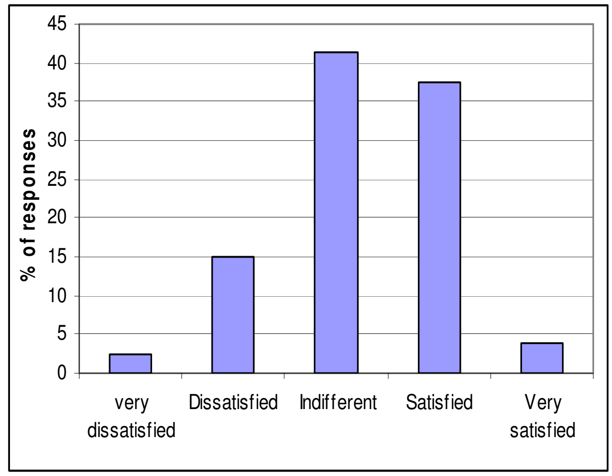
whereby the estimator uses the observations so that the median is preserved by monotonic functions. Hence, the CLAD estimator involves the minimization of an objective function that is not necessarily convex in β. Thus, obtaining a global minimum of the above equation implies the usage of numerical minimization algorithms based on the approximations of the first derivative. The optimization procedure follows Jonston and DiNardo [13]. A White test was conducted to check for possible heteroscedasticity. Since, finally, the estimator's asymptotic variance-covariance matrix involves the estimation of the density function of the error term, we use again bootstrap estimates of the standard errors with about 1,000 draws.

IV. RESULTS

Before reviewing the econometric models, it is informative to review key descriptive statistics. As part of the farm survey respondents were asked to rate their degree of satisfaction with their WC, on a 5-point Likert scale where 1 equals 'very dissatisfied' and 5 equals 'very satisfied' (Figure 1). Only 2.5% were 'very dissatisfied' with the majority being either 'indifferent' or 'satisfied'. A mere 3.8% were 'very satisfied'. By this measure, therefore, the introduction of WCs has been neither an unqualified success nor failure.

Regarding cost recovery, results are more positive. For the first two years following formation of the WCs, average cost recovery rates, measured as the percentage of billed amounts actually paid, were 72 and 70.6% respectively. This compares favourably to the comparable figure of 36% prior to formation. However, significant non-payment persists. The data presented in Figure 1 however mask significant differences between WCs. Comparing mean satisfaction scores for the first six WCs created, significant differences are apparent (*F* test = 2.87). Even with a common external framework, therefore, significant variations in the performance of WCs are evident, suggesting the importance of internal characteristics for explaining variations in satisfaction.

Figure 1: Overall satisfaction with water community original six WCs



Tables 2, 3 and 4 summarize the results for the estimated models. According to the different diagnosis tests performed all estimated model specifications are significant with no severe signs of misspecification. These conclusions are supported by the bootstrapped bias-corrected standard errors as well as the robust estimation technique applied for the Heckman selection specification which confirms the robustness of the various estimates. The hypotheses tests conducted with respect to the significance of explanatory variables indicate for Model 1 the relevance of socioeconomic characteristics, farmers' attitudes towards their water community's structure and conduct, utilised irrigation technology, and for Model 2, in addition, water community cost related characteristics.

Considering the specific variables included in Model 1, it is apparent regarding the impact of household characteristics on propensity to join a WC, only size of farm is significant (Table 2). Membership is not biased to a particular demographic group or related to years in education. Farmers' attitudes regarding the structure and conduct of their WC were measured via 5 point Likert scales, ranging from 1 'strongly disagree' to 5 'strongly agree'. Scale items were designed to measure farmers' trust in the WC and its senior managers, drawing on verified scale items developed in the supply chain management / marketing literature. The Likert scale items also captured the level of farmers' previous experience with local associations, degree of free riding, effective sanctions for opportunistic behaviour and commitment to the WC. The majority of these scale items are significant; propensity to join a WC is positively related to the WC having transparent resource use, clear geographical area, trust in the management board, effective systems of payment and transparent management structure. Good governance and accountability are thus vital. Considering irrigation technology, farmers for whom a higher proportion of their total farm is irrigated and those using flood technology (for rice) are more likely to join a WC. This suggests that commitment to WCs is higher where irrigation is more critical.

Table 2: Robust Two-Stage Heckman Selection Model – Bootstrapped Binary Probit Estimates

(n = 176) Independents	Coefficient[1]	robust z-value	bootstrapped bias-corrected standard error 95% confidence interval[2]
Stage 1 – selection equation	*dependent 1*: water community membership		
Socio-economic characteristics			
Hectares farmed	0.467**	2.17	[0.210; 0.221]
Proportion of land used for crops	-0.042	-0.62	[0.066; 0.069]
Proportion of household income derived from farming	-0.017	0.48	[-0.035; -0.036]
Proportion of household income derived from crops	-0.001	0.956	[-0.001; -0.001]
Age of farmer	0.204	0.620	[0.321; 0.337]
Level of education	-0.158	0.701	[-0.220; -0.231]
Farmers attitudes towards water community's structure and conduct			
Water communities improve the quality of irrigation	-0.011	0.986	[-0.011; -0.011]
WC guarantees transparent resource use	1.199***	2.54	[0.460; 0.484]
WC covers a clear geographical area	1.201***	2.72	[0.431; 0.453]
Irrigation is very important for livelihood	0.266	0.43	[0.603; 0.634]
Farmers have common view on irrigation management	-0.768***	-2.59	[0.289; 0.304]
Farmers maintain irrigation equipment for long-run use	-0.686*	-1.63	[0.410; 0.431]
Farmers consider only their short-term interest	0.067***	2.70	[0.024; 0.025]
Want to have a say in how irrigated water is delivered	1.515***	3.39	[0.436; 0.458]
Want to have a say in how irrigation equipment is maintained	-0.144	-0.29	[0.484; 0.509]
Trust in the leader of the WC	0.059	0.14	[0.411; 0.432]
Trust in the management board of the WC	1.679***	3.79	[0.432; 0.454]
Experience with involvement in local associations	-1.739***	-3.72	[0.456; 0.479]
Transparent management structure	1.037***	2.89	[0.350; 0.368]
Transparent relations between WC and water authority	-0.012	-0.02	[0.585; 0.615]
Easy to cut access to non-payers	0.779***	3.28	[0.232; 0.243]
Use of irrigated water can be effectively monitored	-0.632**	-2.16	[0.285; 0.300]
Transparent structure for conflict solution	0.343	1.11	[0.301; 0.317]
Irrigation technology related characteristics			
Proportion of total farm area irrigated	2.131***	3.05	[0.681; 0.716]
Proportion of total farm area irrigated by sprinkler technology	1.276	1.37	[0.908; 0.955]
Proportion of total farm area irrigated by flooding technology	1.696***	2.61	[0.634; 0.666]
Constant	-0.654	-0.08	[7.971; 8.379]
log pseudo-LL	*-19.114*		
Wald test of model significance, $chi^2(26)$	*91.00****		
McFadden's R2	*0.671*		
McKelvey/Zavoina's R^2	*0.899*		
Cragg & Uhler's R2	*0.741*		
Count R2 (adj Count R2)	*0.955 (0.556)*		
linear hypotheses tests on model specification ($chi^2(x)$)			
H_0: socio-economic characteristics related variables have no significant effect ($chi^2(6)$)	*46.40*** (rejected)*		
H_0: farmer's attitudes/experiences related variables have no significant effect ($chi^2(17)$)	*46.30*** (rejected)*		
H_0: irrigation technology related variables have no significant effect ($chi^2(3)$)	*19.97*** (rejected)*		

1: * - 10%-, ** - 5%-, *** - 1%-level of significance; 2: 1000 replications.

Table 3 presents the second stage of the Heckman Selection model concerning farmers' satisfaction with their membership. Empirical evidence suggests that membership satisfaction is related to household characteristics, the WC's conduct and performance and the technology employed in the case of flood irrigation. Regarding household characteristics, satisfaction is positively related to size of farm and level of education. Regarding the latter, fieldworkers who collected data perceived that better educated people more readily perceived the potential benefits of WC membership and, more importantly, were aware that benefits would accrue over time.

Significant, negative correlations between satisfaction and age, and proportion of household income derived from crops are evident. The latter may reflect that those who are more dependent on crops have higher requirements and demands for the WC. This may also explain the significant, negative coefficient for "irrigation is very important for my livelihood". Regarding other Likert scale items, members' satisfaction is positively related to trust in both the leader and management board of the WC, presence of a transparent management structure and structure for conflict solution. These relationships again highlight the importance of good governance much of which rests with trust of the senior managers of each WC. For instance, the satisfaction of members in one WC plummeted after the community's President damaged an irrigation channel and refused to pay for repairs.

The only significant relationship identified between irrigation type and members' satisfaction is a negative one for flood technology. Implementing effective sanctions to punish non-payers is more difficult in the case of flood irrigation in Macedonia as water typically flows freely between the plots of paying and non-paying farmers. Cutting supplies of water to non-payers would negatively impact on farmers who have paid their bills. This is also reflected in the positive correlation between cost recovery of the WC and membership satisfaction. Flood irrigation, because it demands greater quantities of water, is also more costly per hectare.

A positive correlation is apparent between membership satisfaction and increases in a farmer's water bills between the years 2002 and 2004. The latter variable can be considered a proxy for a growth in the size of land under WC irrigation. Individuals who are expanding their irrigated activities are thus more satisfied, suggesting that structural change is likely to help reinforce the WCs. Those farmers who are seeking to grow are more likely to be younger and better educated. The inverse mill's ratio is significant.

The results of Model 2, concerning relationships with changes in farmers' payment behaviour, are presented in Table 4. This analysis is critical to assessing the viability of WCs, given historically very low levels of cost recovery and the objective of WCs becoming financially sustainable local institutions. Significant relationships are uncovered between household characteristics, farmers' attitudes, WC characteristics and payment behaviour. Improvements in payment behaviour are associated with a higher dependence on crops. Those less dependent on irrigation have been less responsive to the WCs in terms of improving their payment behaviour and this may reflect that the sanction of withholding water is less severe to those not engaged in crop production. Improvements in payment behaviour are positively related to members' satisfaction (2^{nd} stage of Model 1) and the presence of effective sanctions for non-paying farmers. Improvements in payment behaviour thus depend on the presence of both a *carrot* (better service delivering higher satisfaction) and *stick* against opportunistic behaviour.

A positive correlation is apparent for the relationship between the expansion of irrigated farm area, proxied by the variable 'increase in water bill 2002 to 2004' and improvements in payment behaviour. This again suggests that structural change is broadly positive for establishing WCs. The coefficient for costs per hectare of land irrigated is significant and negative, indicating that lower fees are associated with improvements in payment behaviour. Older farmers have been significantly less responsive.

Table 3: Robust Two-Stage Heckman Selection Model – Bootstrapped Ordered Probit Estimates

(n = 176) Independents	Coefficient[1]	robust z-value	bootstrapped bias-corrected standard error 95% confidence interval[2]
Stage 2 – outcome equation	*dependent 2*: farmer's satisfaction with water community membership		
Socio-economic characteristics			
Hectares farmed	0.946**	2.15	[0.113; 0.120]
Proportion of land used for crops	-0.003	-0.19	[0.013; 0.021]
Proportion of household income derived from farming	-0.001	-0.15	[0.011; 0.009]
Proportion of household income derived from crops	-0.013***	-2.70	[0.005; 0.006]
Age of farmer	-0.273**	-2.04	[0.129; 0.130]
Level of education	0.360***	2.79	[0.124; 0.128]
Farmers' attitudes towards water community's structure and conduct			
WC guarantees transparent resource use	0.019	0.11	[0.164; 0.178]
Irrigation is very important for livelihood	-0.489***	-3.16	[0.183; 0.223]
Want to have a say in how irrigated water is delivered	-0.249	-1.09	[0.218; 0.221]
Want to have a say in how irrigation equipment is maintained	0.091	0.51	[0.169; 0.174]
Trust in the leader of the WC	0.478***	2.71	[0.171; 0.175]
Trust in the management board of the WC	1.089***	5.07	[0.207; 0.208]
Experience with involvement in local associations	0.363***	2.09	[0.159; 0.167]
Transparent management structure	0.885***	4.49	[0.181; 0.182]
Transparent relations between WC and water authority	0.118	0.65	[0.159; 0.164]
Transparent structure for conflict solution	0.269***	11.24	[0.216; 0.236]
Irrigation technology related characteristics			
Proportion of total farm area irrigated	-0.165	-0.43	[0.399; 0.413]
Proportion of total farm area irrigated by furrow technology	0.123	0.27	[0.376; 0.446]
Proportion of total farm area irrigated by sprinkler technology	0.059	0.18	[0.313; 0.322]
Proportion of total farm area irrigated by flooding technology	-0.828***	-2.27	[0.429; 0.448]
Water community cost related characteristics			
Cost recovery	0.297***	11.17	[0.023; 0.027]
Costs per hectare of land irrigated	0.002***	2.15	[7.88e-05; 8.78e-05]
Increase in water bill 2002 to 2004	0.001***	2.08	[5.46E-05; 6.91E-05]
inverse mill's ratio	-2.123***	-2.51	[0.698; 0.881]
log pseudo-LL	*-97.911*		
Wald test of model significance, $chi^2(24)$	*96.78****		
McFadden's R2	*0.620*		
McKelvey/Zavoina's R^2	*0.537*		
Cragg & Uhler's R2	*0.503*		
Count R2 (adj Count R2)	*0.946 (0.640)*		
linear hypotheses tests on model specification ($chi^2(x)$)			
H_0: socio-economic characteristic related variables have no significant effect ($chi^2(6)$)	*18.12*** (rejected)*		
H_0: farmer's attitudes/experiences related variables have no significant effect ($chi^2(9)$)	*29.48*** (rejected)*		
H_0: irrigation technology related variables have no significant effect ($chi^2(4)$)	*53.60*** (rejected)*		
H_0: water community cost related variables have no significant effect ($chi^2(3)$)	*12.20*** (rejected)*		

1: * - 10%-, ** - 5%-, *** - 1%-level of significance; 2: 1000 replications.

Table 4: Non-Parametric Cumulative Least Absolute Deviation Model – Bootstrapped Estimates

(n = 176)	coefficient[1]	t-value	bootstrapped bias-corrected standard error 95% confidence interval[2]
Dependent: proportional change in farms' water bill payment 2002 – 2004			
Independents			
Socio-economic characteristics			
Hectares farmed	-0.908	-0.94	[0.942; 0.990]
Proportion of land used for crops	0.437***	5.44	[0.078; 0.082]
Proportion of household income derived from farming	-0.447***	-8.28	[0.053; 0.055]
Proportion of household income derived from crops	0.433***	9.55	[0.044; 0.046]
Age of farmer	-0.608***	-0.56	[1.059; 1.113]
Level of education	0.938	0.88	[1.039; 1.093]
Farmers attitudes towards water community's structure and conduct			
Farmer's satisfaction with water community membership *(y_hat model 2)*	3.571***	3.25	[1.098; 1.071]
Easy to cut access to non-payers	4.147**	2.02	[2.053; 2.002]
Water community cost related characteristics			
Membership	-3.908	-0.85	[4.597; 4.483]
Costs per hectare of land irrigated	-0.003***	-6.02	[4.98E-04; 4.86E-04]
Increase in water bill 2002 to 2004	0.004***	13.71	[2.92E-04; 2.84E-04]
Irrigation technology related characteristics			
proportion of total farm area irrigated	-2.776	-0.78	[3.559; 3.470]
Constant	-17.411	-1.44	[12.091; 11.789]
minimum sum of deviations	2966.997		
Adj. McFadden's R2	*0.878*		
linear hypotheses tests on model specification ($chi^2(x)$)			
H_0: socio-economic characteristics related variables have no significant effect ($chi^2(6)$)			*20.96*** (rejected)*
H_0: farmer's attitudes/experiences related variables have no significant effect ($chi^2(3)$)			*4.76*** (rejected)*
H_0: water community cost related variables have no significant effect ($chi^2(3)$)			*84.05*** (rejected)*

V. CONCLUSION

In explaining variations in satisfaction and payment behaviour, the internal structure and conduct of the WC is highly significant. In particular, the presence of good governance and accountability contribute to the decision to join a WC, membership satisfaction and changes in payment rates. Analysis reveals that good governance requires effective leadership, transparency in resource allocation and trust in senior managers. While the constitutions of each WC can detail responsibilities and procedures to help maximise transparency and promote accountability, much will rest on local factors.

Cost recovery has improved dramatically since the introduction of the WCs. Model 2 reveals that improved payment behaviour depends on, amongst other variables, both the positive satisfaction of members and effective sanctions against non-payers. Previous studies have rarely paid attention to membership satisfaction, yet our analysis indicates that it is a critical determinant of payment behaviour and hence the long-run viability of WUAs.

In assessing whether WUAs can be usefully introduced, policy makers have to consider whether they can deliver both the *carrot* of a reliable service and *stick* of sanctions against opportunistic behaviour. Local, internal factors are significant in determining the actual size of carrots and sticks faced by farmers. Consequently, even if WUAs have been successfully introduced in one location, it does not follow that the same rules and procedures transferred to another location will generate comparable results.

ACKNOWLEDGEMENT

The research presented in this paper was funded by the EU FP6 INCO Western Balkans WATERWEB Project (FP6-2002-INCO-WBC–1).

REFERENCES

1. Meinzen-Dick, R.,Mendoza, M., Sadoulet, L., Abiad-Shields, G. and Subramanian, A. (1997) *Sustainable Water User Associations: Lessons from a literature review.* Washington, D.C.: The World Bank. Technical Paper 354.
2. Macours K. and Swinnen, J.F.M. (2002) Patterns of Agrarian Transition, *Economic Development and Cultural Change,* Vol.50(2), pp.365-395.
3. Theesfeld, I. (2004) Constraints on collective action in a transitional economy: the case of Bulgaria's irrigation sector, *World Development*, Vol. 32(2), pp.251-271.
4. World Bank (2006) Agriculture and EU Accession: Achieving FYR Macedonia's Agricultural Potential, Report No. AAA11-MK.
5. World Bank (1997) FYROM: Irrigation Rehabilitation and Restructuring Project: Staff Appraisal Report, Washington D.C., Report No. 17013 MK.
6. Peshevski, M., Boshev, D., Shekerinov, D. (2006) Management of water resources in transition period in Republic of Macedonia with special regard to hydromeliorative system Bregalnica. *Ekonomika Poljoprivrede*, No.3-4, pp.81-94.
7. Heckman, J. J. (1979) Sample Selection Bias as a Specification Error. *Econometrica* 47(1): 153-161.
8. Huber, P. J. (1967) The behavior of maximum likelihood estimates under nonstandard conditions. In *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability*. Berkeley, CA: University of California Press, vol. 1, 221–223.
9. White, H. (1980) A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica*, 48: 817-838.
10. Efron, B., R. J. Tibshirani (1993) *An Introduction to the Bootstrap*. Chapman & Hall, London.
11. Powell, J.L. (1984) Least Absolute Deviations Estimation for the Censored Regression Model. *Journal of Econometrics*, 25: 303 – 325.
12. Powell, J. L. (1986) Censored Regression Quantiles. *Journal of Econometrics*, 32: 143-155.
13. Jonston, J. and Di Nardo, J. (1997) *Econometric Methods*, 4th ed. New York: McGraw-Hill.

Corresponding author:

Matthew Gorton,
School of Agriculture, Food and Rural Development,
Newcastle University,
Newcastle upon Tyne,
UK.
matthew.gorton@newcastle.ac.uk