Can participatory water management improve residents' subjective life quality? A case study from China

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ABSTRACT

Public participation is practiced widely in modern water management, but its effect on residents' subjective quality of life (QOL) or happiness has not been revealed. In this research, using the difference-in-difference (DID) model, the effect of participation in water management on residents' subjective QOL or happiness is empirically researched based on data from China. The results show that the positive effect of participatory water management on residents' happiness is quite significant and the extra effect of participation behavior on the participant's happiness is outstanding with the coefficients 0.073 and 0.036 respectively which pass the significance test. In addition, according to the regression coefficients of controlled variables, four demographic variables, namely the age, health, education and income, also produce significant effects on residents' happiness. It is concluded that both the result and procedure of participatory water management can really improve the participants' happiness. Extensive participation should be enhanced actively so as to increase residents' happiness.

Key words | China, difference-in-difference method, participatory water management, subjective life quality

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INTRODUCTION

Currently public participation as a basic principle has been accepted and implemented widely in modern water management. Lots of studies have focused on participatory water resources management (Abdullaev *et al.* 2009; Korff *et al.* 2012; Kirono *et al.* 2014; Sanz *et al.* 2015; Furber *et al.* 2016; Graversgaard *et al.* 2017). However, can participatory water management improve residents' subjective quality of life? Few of the previous studies have answered this question well. It will be quite important to answer this question since improving the quality of life (QOL) is regarded as a major goal of policy and lifestyle (Schuessler & Fisher 1985), and the subjective QOL or happiness arising and reflecting objective life conditions such as income, cognition and relationship has been considered as the foundational goal of an individual life (Bentham 1789; Kesebir & Diener 2008; Richter 2009; Lyubomirsky & Boehm 2010; Joshanloo 2014). To reveal the effect of participatory water management on residents' QOL helps to deepen understanding of the value and the motivation of participation in water management.

Existing research has revealed the procedural significance of public participation to improve water management. Hirsch *et al.* (2010) conclude that the participation process provides an opportunity of meeting and discussion for stakeholders from different organizational levels and thus promotes communication between these organizations in the Uzbek (Amudarya) water management context. Kuper *et al.* (2009) point out that the design of a joint drip irrigation project in Morocco can produce a learning environment which bridges the knowledge

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differential among stakeholders to help them make better informed decisions. Korff *et al.* (2012) emphasizes the importance of learning during participation. As a result of learning, the following benefits are ascribed to participation: better quality decisions (also see Goharian & Burian 2018), better acceptance of decisions and so on. The findings of Kirono *et al.* (2014) show that the participation process provides important information water supply and demand, a clear consensus and shared learning of the water problem and identification of adaptation options. Furber *et al.* (2016) suggest that the shared vision planning approach in water management 'had some significant successes in terms of conflict management'. Obviously, the participation procedure of water management directly promotes the participants' objective QOL such as increasing their cognition, harmonizing their relationship and enhancing their capacity.

More studies have focused on the resulting benefits of participatory water management to resolve complex water problems. Pan *et al.* (2012) suggest that water use disputes and conflicts decreased substantially due to widely established farmers' water users associations (FWUA) in China (also see Apipalakul *et al.* 2015; Sanz *et al.* 2015). According to the findings of Abdullaev *et al.* (2009), the foundation of the Union of Water Users (UWU) in Ferghana Valley has supported canal de-silting and reduced illegal water withdrawals from the canal. Zhang *et al.* (2003) find that FWUA have produced positive effects on saving water, settling water disputes, saving labor, improving the quality of irrigation channels, and enhancing the water acquisition capacity of vulnerable groups in Zhanghe and Dongfeng irrigation districts of China. Based on a meta-analysis of 47 case studies from North America and Western Europe, Newig & Fritsch (2010) find that a highly polycentric governance system rather than a mono-centric one yields higher environmental outputs (also see Brombal *et al.* 2018). After estimating quantitative benefits of participation in irrigation systems in Cambodia, Asthana (2010) suggests that the stakeholders' participation produces better project outcomes. Fan *et al.* (2018) suggest the participatory water management benefit of promoting the adoption of micro-irrigation systems by smallholder farmers. Graversgaard *et al.* (2017) suggest that the use of water councils with stakeholder engagement in water planning helps to identify efficient solutions at lower costs, namely increasing the cost-effectiveness (also see Wright & Fritsch 2011). Empirical evidence from Malawi suggests that the net annual agricultural income of the poor, youths and female-headed farms participating in the scheme would have worsened had they not participated in the scheme (Jumbe & Nkhata 2015). Undoubtedly, these resulting benefits of participatory water management can further promote related residents' livelihood such as providing a safer water supply, suitable ecological environment or increasing their income.

The existing studies have offered some insights into the importance of participation in water management to resolve water problems and then improve the objective living conditions of residents. However, few studies pay attention to the effect of participation in water management on the participants' subjective QOL. According to procedure utility theory, humans can obtain some life satisfaction from both the outcome and the procedure of their behaviors (Frey Benz & Stutzer 2004). So, maybe participation in water management provides subjective benefit to the participants. In order to verify this hypothesis, empirical research on FWUA of Ganzhou district, northwest China, is presented using the DID model and ordered probit simulation method. The research results will promote the comprehensive understanding of the importance of participatory water management and be of benefit to more scientific decisions of water management.

METHODOLOGY

Variables selection and measurement

In order to simulate quantitatively the impact of participatory water management on participants' subjective QOL, the participants' self-reported happiness is taken as the dependent variable, and participatory conditions as independent ones in this empirical research. Because the impact may be disturbed by personal characteristics variables such as health, income, education level, etc, these factors are taken as the controlled variables.

Residents' happiness, as the dependent variable, is usually measured as the self-reported happiness of questionnaire respondents by answering the question 'On a scale from one to ten, where one is "very unhappy", two "quite unhappy", three "less unhappy", four "slightly unhappy" and five "no feeling", six "slightly happy", seven "a little happy", eight "more happy", nine "quite happy" and ten "very happy", how happy are you with your overall life?' (Ryff & Keyes 1995; WHOQOL Group 1998; Dolan *et al.* 2008). The reliability and validity of this method of measuring happiness have been confirmed in related studies (Robinson & Shaver 1976; Ellison 1983; Fordyce 1988; Veenhoven *et al.* 1993). In this case study, the self-reported overall life satisfaction of residents is used to substitute for their self-reported happiness in order to make the respondents correctly understand the meaning of happiness in the survey.

The participation condition of residents is a dump variable, and its value is assigned as 0 when the respondent does not participate in water management, and otherwise is assigned as 1. The controlled variables include gender, age, health, education, and income and the values assigned to them are shown in Table 1.

Research methods

The DID model is adopted seeing that this research especially focuses on the extra effect of the participation procedure in water management on the participants' happiness. DID is used widely to simulate the net effect of a policy on some property of a research object (Stancanelli 2004; Zhou & Ye 2005; Woodridge 2007; Lechner 2011; Li *et al.* 2012). The basic idea of the DID method is described as follows (Woodridge 2007). Firstly, the survey samples are divided into two groups, one of which is named as the 'treatment group' whose numbers participate in the policy decision, while the other is named as the 'control group' whose numbers are excluded from the decision-making process. Secondly, the average relative variances of the property indicator of the two groups affected by this policy are calculated respectively based on the investigation data before and after policy implementation. Thirdly, the difference between the two relative variances is computed. This *D*-value is just the net effect of the policy on this indicator variable of the 'treatment group', if there are no systematic differences of other factors affecting this variable in term of these two group samples. In order to clarify intuitively the idea of DID, Figure 1 is used as follows.

In the Figure 1, the Y-axis is denoted as the property variable values affected by the policy, while the T-axis is the time of the policy implementation. A′A and B′B are respectively the varying curves of the property variable

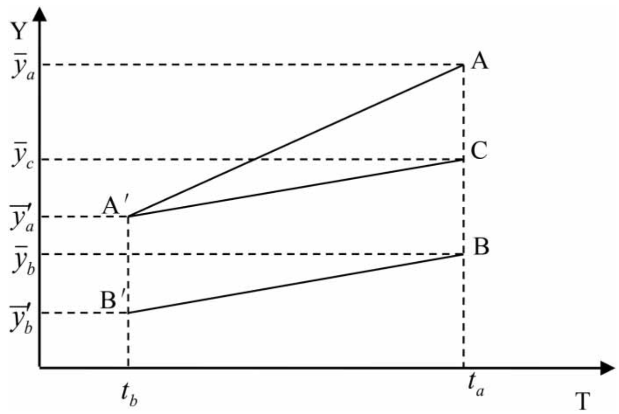

Figure 1 | Sketch map of DID.

Table 1 | The values assigned to the controlled variables

Controlled variables	Assigned values	Controlled variables	Assigned values	Controlled variables	Assigned values
Ages		*Health conditions*		*Monthly income*	
Under 30	0	Healthy	0	Under RMB 2,000	0
30–39	1	Unhealthy	1	RMB: 2,000–3,000	1
40–49	2			RMB: 3,000–4,000	2
50–59	3	*Education*		RMB: 4,000–5,000	3
60–69	4	Primary education	0	RMB: 5,000 and more	4
70–79	5	Middle education	1	*Genders*	
80 and older	6	Higher education	2	Male	0
				Female	1

average value of the 'treatment group' and the 'control group' due to the effect of the policy over time. The time points t_b and t_a are respectively when the policy just begins to be implemented and when the policy effect is evaluated after a period of time of the policy implementation. Thus when A′A is the parallel curve of B′B, the extra effect of the policy on the property variable average value of the 'treatment group' can be expressed as Equation (1):

$$(\bar{y}_a - \bar{y}'_a) - (\bar{y}_b - \bar{y}'_b) = \bar{y}_a - \bar{y}_c \tag{1}$$

The econometric model of DID is indicated by Equation (1) generally.

$$Y_{it} = \beta_0 + \beta_1 X_i + \beta_2 T_t + \beta_3 X_i T_t + u_{it} \tag{2}$$

In Equation (2), Y_{it} as the dependent variable refers to the observed value of the affected property indicator of sample i at time t. The independent variable X_i is a dump variable that denotes the attribute of the sample i and its assigned value is 1 when the sample i belongs to the 'treatment group', otherwise it is 0. The independent variable T_t is also a dump variable that denotes the attribute of the time t, and when time t refers to 'before the policy implementation' the assigned value of it is 0, otherwise, when time t refers to 'after the policy implementation' the assigned value of it is 1. The random error term u_{it} reflects the effect of other unobservable or controlled factors on Y_{it}, and β_0, β_1, β_2, β_3, as the model coefficients, are the parameters to be estimated. Among these parameters, β_3, as the coefficient of interaction item $X_i T_t$, reflects the net effect of the policy on this indicator variable of the 'treatment group', since the estimated value of β_3 can be expressed as Equation (3) using Equation (2) according to the idea of the DID model:

$$\hat{\beta}_3 = (\bar{Y}_{11} - \bar{Y}_{10}) - (\bar{Y}_{01} - \bar{Y}_{00}) \tag{3}$$

In order to check the robustness of the above estimations, other observable controlled variables are needed to be brought into this model, and so Equation (2) is extended to Equation (4):

$$Y_{it} = \beta_0 + \beta_1 X_i + \beta_2 T_t + \beta_3 X_i T_t + \boldsymbol{\lambda} \mathbf{Z}_{it} + u_{it} \tag{4}$$

In Equation (4), $\mathbf{Z}_{it}$ is the variables vector of the other observable intervention factors and $\boldsymbol{\lambda}$ is the parameter vector of it to be evaluated; $\boldsymbol{\lambda}$ reflects the impact of the intervention variables on the dependent variable. The meanings of other letters in this formula are the same as in Equation (2).

The residents' happiness is a qualitative latent variable and is not easily observed directly. The self-reported happiness of residents is an ordinal categorical variable in this research. So, the model parameters are estimated using the ordered probit model and maximum likelihood estimation developed by McKelvey & Zavoina (1975). The estimation program of the model parameters is as follows.

The dependent variable denoted as Y is given as a continuous latent variable and a series of boundary values $\delta_j (j = 1, 2, \ldots, j, \ldots, m)$ divides its value range into several intervals. A series of integer values of an ordinal categorical variable denoted as Y', namely 0, 1, 2, …, j, …, m, corresponds to these value intervals. The congruent relationship between Y' and Y is shown as $Y' = j \equiv \delta_{j-1} < Y \leq \delta_j$ with $\delta_0 = -\infty$ and $\delta_m = +\infty$. Provided the vector denoted as $\mathbf{X}$ is a series of independent variables affecting $Y$and $\boldsymbol{\beta}$ is the undetermined parameter matrix, the linear regression model of $Y$and $\mathbf{X}$ is shown as Equation (5):

$$Y_i = \boldsymbol{\beta} \mathbf{X}_i + e_i \quad e_i \sim N(0,\ 1) \quad i = 1, 2, \ldots N \tag{5}$$

In Equation (5), the coefficient matrix $\boldsymbol{\beta}$ and the boundary values δ_i are all the parameters to be estimated. And thus, responding to Y_i, the probability p of the value j of the ordinal categorical variable Y'_i is expressed as Equation (6):

$$p(Y'_i = j) = p(\delta_{j-1} < Y_i \leq \delta_j) \tag{6}$$

Putting the Equation (5) into Equation (6), Equation (7) can be obtained as the following:

$$\begin{aligned} p(Y'_i = j) &= p(\delta_{j-1} < \boldsymbol{\beta}\mathbf{X}_i + e_i \leq \delta_j) \\ &= p(\delta_{j-1} - \boldsymbol{\beta}\mathbf{X}_i < e_i \leq \delta_j - \boldsymbol{\beta}\mathbf{X}_i) \\ &= \Phi(\delta_j - \boldsymbol{\beta}\mathbf{X}_i) - \Phi(\delta_{j-1} - \boldsymbol{\beta}\mathbf{X}_i) \end{aligned} \tag{7}$$

The undetermined parameters in Equation (7) are estimated using the maximum likelihood estimation method, and the maximum likelihood function needed is shown as Equation (8):

$$L(X_1,\ X_2,\ \ldots, X_N; \boldsymbol{\beta}, \delta) = \prod_{i=1}^{N}\sum_{j=0}^{m} z_{ij}[\Phi(\delta_j - \boldsymbol{\beta}\mathbf{X}_i) - \Phi(\delta_j{}_{-1} - \boldsymbol{\beta}\mathbf{X}_i)] \quad (8)$$

In Equation (8), z_{ij} is the identifier, and z_{ij} is 1 when Y_i is equal to j, while z_{ij} is 0 when Y_i is not equal to j.

Data sources and acquisition

In this empirical research, Ganzhou district from China is selected as the case region. This region lies in the arid northwest China, which is known as the most arid region. Because of water-shortage, water-use conflict especially in rural irrigation areas has become more and more serious with the rapid population growth and economic development in this region since 1980s. In order to alleviate the water conflicts, FWUAs have been founded widely as the rural residents' participation and consultation platforms of water management since 2005. In each FWUA, the executive committee consists of one president and some executives selected from the water users' representatives and is responsible for daily water management. This participatory mechanism of water management has produced positive effects on resolving the local water problem (Pan *et al.* 2012).

Before collecting the data on variables, the rural residents' participation condition in water management of the case region had been investigated through interviewing. The presidents of eight FWUAs in total had accepted our interview. According to the interview results, almost all of the rural water users had joined the FWUA under local government impetus, and as members of the FWUA, the water users can be divided into two categories generally according to their participation degree in water management. One group is composed of the ordinary water users and the other one consists of the representatives of the ordinary water users. The ordinary water users do not really have the right of water management and are not involved in the actual water management but elect their own representatives. The representatives, however, have the actual rights to elect and recall the president and the executive members of the FWUA, and to propose, discuss and vote on the water management proposals besides feeding back the ordinary water users' opinions.

All of the variable data needed in this empirical research come from the sampling questionnaire investigation of the members of FWUAs in the case region in 2016. In order to ensure that the samples are representative, the method of stratified random sampling recommended by Yuan (2004) is adopted. During the sampling, four FWUAs are drawn out at random from the eight in the case region, and then the sample scale selected from each FWUA is identified according to the proportion of its numbers accounting for the total numbers in the case region and the total sample size needed in this empirical research. And the sample scales of the general water users and their representatives in each FWUA are determined according to the ratio between them and the samples identified of these FWUAs.

In the actual investigation, 600 questionnaires including 500 ordinary water users and 100 deputies were sent out to the sample residents and the samples' structure is roughly in line with the population structure. The valid questionnaires taken back were 394 in total including 332 from the ordinary water users and the others being from their representatives. The total sample size and its structure surveyed meet the statistical inference requirements in this empirical research.

In this empirical research, samples of the representatives of ordinary water users in the FWUAs are taken as the 'treatment group', for their happiness may be affected by the participation procedure due to their genuine participation in water management. And the samples of ordinary water users in the FWUAs are regarded as the 'control group' which may not be affected by the participation procedure but by the participation results. Based on the 394 samples' data the research results can be obtained using the DID model and ordered probit regression and are shown in the next section.

RESULTS AND DISCUSSION

Descriptive statistics analysis

As shown in Table 2, the average value of the residents' self–reported happiness is 7.165 in 2016 and is higher by 1.413

Table 2 | Descriptive statistics of happiness of numbers of WUA in Ganzhou district

Sample types	Happiness in 2005	Happiness in 2016	Differences
Whole samples	5.752 (0.22)	7.165 (0.18)	1.413** (0.27)
Ordinary water users (control group)	5.733 (0.29)	6.849 (0.25)	1.116** (0.26)
Representatives in WUA (treatment group)	5.784 (0.18)	7.605 (0.15)	1.821** (0.16)
Differences	0.051**	0.756**	0.705*

Notes: Standard errors in parentheses. Significance levels: *0.05 < p < 0.10, ** p < 0.05.

than the value in 2005 when the participatory water management policy began to be implemented. This means that the residents' happiness has been improved significantly on the whole since FWUAs were founded in the case region. The residents' happiness in both the 'treatment group' and the 'control group' has increased during the participation policy implementation, and the added values are respectively 1.821 and 1.116 with the difference being 0.705. This means that there may be an extra effect of the participation policy on residents' happiness of the 'treatment group' relative to the 'control group'. This net effect of participatory water management is significant in the case region according to the idea of DID, if there are no systematically different impacts of other factors on the two groups of residents' happiness. In addition, according to the standard errors in Table 2, the difference of residents' self–reported happiness is a little smaller in 2016 than about 10 years ago, which means the differential of residents' subjective QOL has decreased slightly.

Regression result analysis

In order to test the robustness of the descriptive statistic results above, the intervention variables are incorporated into the econometric model of DID, and then the parameters are estimated using the ordered probit model and the likelihood estimation method based on the software SPSS 19.0. Before regression analysis, correlation analysis is done to test the multicollinearity among the explanatory and control variables. The results show that there is no multicollinearity among the variables. The results are shown in Table 3.

Table 3 | Ordered probit model regression results

	Coefficient	*t*-value	Marginal effect (score 10)
β_1	0.073**	3.57	0.027
β_3	0.036*	2.29	0.018
Demographic variables			
Gender: female	0.028	1.38	0.014
Age:			
30–39	−0.065	−1.35	−0.035
40–49	−0.017	−0.26	−0.004
50–59	−0.005	−0.15	−0.006
60–69	0.301**	3.44	0.124
70–79	0.364**	3.76	0.143
80 and older	0.326**	3.52	0.129
Health condition: bad	−0.343**	−5.67	−0.147
Education:			
Middle education	0.057*	2.19	0.033
Higher education	0.043	0.74	0.021
Monthly average income:			
RMB: 2,000–3,000	0.059	1.49	0.025
RMB: 3,000–4,000	0.124*	2.37	0.046
RMB: 4,000–5,000	0.247**	3.46	0.084
RMB: 5,000 and more	0.195**	3.32	0.073
Observations	394		
Prob>*F*	0.005		

Significance levels: *0.05 < p < 0.10, ** p < 0.05.

As shown in Table 3, both the results and procedure of participatory water management in the case region produce significant effects on residents' happiness. The coefficient β_1 is 0.073, and passes the significance test at the confidence level $p < 0.05$, which means that the participatory water management has a positive effect on residents' happiness in the case region. The coefficient β_3 of the interaction item is 0.036, and passes the significance test at the confidence level $0.05 < p < 0.10$, which means the procedure of participatory water management has a significant net effect on the happiness of ordinary water users' representatives in the case region. The marginal effects reflect the proportion changes of persons belonging to the stated happiness levels when the independent variable increases by one unit. In this research, the marginal effect is evaluated with regard to the reference group. For brevity, only marginal effects for the top level of happiness (score 10) are shown in Table 2. An increase of the proportion of participants joining in FWUAs by one point raises the proportion of the very happy residents by 2.7%. And 1.8% of residents with maximum happiness increase when the proportion of ordinary numbers becoming deputies increases by 1%.

In addition, according to the coefficients of controlled variables in Table 3, four demographic variables, namely the age, health, education and income, also produce significant effects on residents' happiness. Relative to the residents younger than 30 and older than 18, the residents older than 60 are happiest and it seems that the residents from 70 to 79 years old are most happy, with the coefficient 0.364. The healthy residents are happier than those with bad conditions. The residents with middle education seem to be happier than ones with other education levels. In terms of the income factor, relative to the low income group the residents with income more than 3,000 RMB feel happier and the ones with income from 4,000 to 5,000 RMB are most happy.

CONCLUSIONS

Public participation has been implemented widely in modern water management. Existing studies have not revealed the benefits of participation in water management to improve the participants' subjective QOL. In this study, the impact of participatory water management on the subjective QOL of residents is researched empirically. The results of empirical research indicate that participatory water management does significantly improve residents' subjective QOL, and the participants obtain more happiness than the non-participants in water management. This result validates the existence of the procedural utility of participatory water management. So, in order to improve public happiness or subjective QOL, participatory water management should be implemented actively, and more water users and stakeholders should be involved in water management authentically. In terms of the case region, the following suggestions are given so as to increase residents' happiness. As members of FWUAs, the ordinary water users should be given more participation rights including making comments and suggestions on water management, having the same chance to be the water users' representatives. And meanwhile the excessive administrative intervention in FWUAs should be reduced, since the FWUA is the autonomous organization of farmers' water management.

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REFERENCES

Abdullaev, I., Kazbekov, J., Manthritilake, H. & Jumaboev, K. 2009 Participatory water management at the main canal: a case from south Ferghana canal in Uzbekistan. *Agricultural Water Management* **96** (2), 317–329.

Apipalakul, C., Wirojangud, W. & Tang, K. N. 2015 Development of community participation on water resource conflict management. *Procedia – Social and Behavioral Sciences* **186**, 325–330.

Asthana, A. N. 2010 Is participatory water management effective? Evidence from Cambodia. *Water Policy* **12** (2), 149–164.

Bentham, J. 1789 *The Principles of Morals and Legislation*. Printed for T. Payne and Son, London. Republished by Prometheus Books, London, UK, 1988.

Brombal, D., Niu, Y., Pizzol, L., Moriggi, A., Wang, J., Critto, A., Jiang, X., Liu, B. & Marcomini, A. 2018 A participatory sustainability assessment for integrated watershed management in urban China. *Environmental Science & Policy* **85**, 54–63.

Dolan, P., Peasgood, T. & White, M. 2008 Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. *Journal of Economic Psychology* **29** (1), 94–122.

Ellison, C. W. 1983 Spiritual well-being: conceptualization and measurement. *Journal of Psychology & Theology* **11** (4), 330–340.

Fan, Y., Park, S. & Nan, Z. 2018 Participatory water management and adoption of micro-irrigation systems: smallholder farmers in arid north-western China. *International Journal of Water Resources Development* **34** (3), 434–452.

Fordyce, M. W. 1988 A review of research on the happiness measures: a sixty second index of happiness and mental health. *Social Indicators Research* **20** (4), 355–381.

Frey, B. S., Benz, M. & Stutzer, A. 2004 Introducing procedural utility: not only what, but also how matters. *Journal of*

Institutional and Theoretical Economics JITE **160** (3), 377–401.

Furber, A., Medema, W., Adamowski, J., Clamen, M. & Vijay, M. 2016 Conflict management in participatory approaches to water management: a case study of Lake Ontario and the St Lawrence river regulation. *Water* **8** (7), 280.

Goharian, E. & Burian, S. J. 2018 Developing an integrated framework to build a decision support tool for urban water management. *Journal of Hydroinformatics* **20** (3), 708–727.

Graversgaard, M., Jacobsen, B. H., Kjeldsen, C. & Dalgaard, T. 2017 Stakeholder engagement and knowledge co-creation in water planning: can public participation increase cost-effectiveness? *Water* **9** (3), 191.

Hirsch, D., Abrami, G., Giordano, R., Liersch, S., Matin, N. & Schlüter, M. 2010 Participatory research for adaptive water management in a transition country – a case study from Uzbekistan. *Ecology and Society* **15** (3), 633–667.

Joshanloo, M. 2014 Eastern conceptualizations of happiness: fundamental differences with western views. *Journal of Happiness Studies* **15** (2), 475–493.

Jumbe, C. B. L. & Nkhata, R. 2015 Does participation in communal water management improve household income? Evidence from Malawi. *Water Resources & Rural Development* **5**, 31–46.

Kesebir, P. & Diener, E. 2008 In pursuit of happiness: empirical answers to philosophical questions. *Perspectives on Psychological Science* **3** (2), 117–125.

Kirono, D. G. C., Larson, S., Tjandraatmadja, G., Leitch, A., Neumann, L., Maheepala, S., Barkey, R., Achmad, A. & Selintung, M. 2014 Adapting to climate change through urban water management: a participatory case study in Indonesia. *Regional Environmental Change* **14** (1), 355–367.

Korff, Y. v., Daniell, K. A., Moellenkamp, S., Bots, P. & Bijlsma, R. M. 2012 Implementing participatory water management: recent advances in theory, practice, and evaluation. *Ecology & Society* **17** (6), 872–873.

Kuper, M., Dionnet, M., Hammani, A., Bekkar, Y., Garin, P. & Bluemling, B. 2009 Supporting the shift from state water to community water: lessons from a social learning approach to designing joint irrigation projects in Morocco. *Ecology and Society* **14** (1), 19.

Lechner, M. 2011 The estimation of causal effects by difference-in-difference methods. *Foundations and Trends in Econometrics* **4** (3), 165–224.

Li, H., Graham, D. J. & Majumdar, A. 2012 The effects of congestion charging on road traffic casualties: a causal analysis using difference-in-difference estimation. *Accident Analysis & Prevention* **49**, 366–377.

Lyubomirsky, S. & Boehm, J. K. 2010 Human motives, happiness, and the puzzle of parenthood: commentary on Kenrick *et al.* (2010). *Perspectives on Psychological Science* **5** (3), 327–334.

McKelvey, R. D. & Zavoina, W. 1975 A statistical model for the analysis of ordinal level dependent variables. *Journal of Mathematical Sociology* **4** (1), 103–120.

Newig, J. & Fritsch, O. 2010 Environmental governance: participatory, multi-level – and effective? *Environmental Policy & Governance* **19** (3), 197–214.

Pan, H. L., Xu, Z. M., Chen, H. X. & Zhou, L. 2012 Assessment on the performance of sustainable water resources management in arid region: a case of Ganzhou district, northwest China. *Journal of Arid Land Resources and Environment* **26** (7), 1–7.

Richter, D. 2009 On the pursuit of happiness. In: *Emotions and Understanding: Wittgensteinian Perspectives* (Y. Gustafsson, C. Kronqvist & M. McEachrane, eds), Palgrave Macmillan, Basingstoke, UK, pp. 185–201.

Robinson, J. P. & Shaver, P. R. 1976 Measure of social psychological attitudes. *Contemporary Sociology* **5** (4), 750.

Ryff, C. D. & Keyes, C. L. M. 1995 The structure of psychological well-being revisited. *Journal of Personality and Social Psychology* **69** (4), 719–727.

Sanz, D., Calera, A., Castaño, S. & Gómez-Alday, J. J. 2015 Knowledge, participation, and transparency in groundwater management. *Water Policy* **18** (1), 111–125.

Schuessler, K. F. & Fisher, G. A. 1985 Quality of life research and sociology. *Annual Review of Sociology* **11** (1), 129–149.

Stancanelli, E. 2004 *Evaluating the Impact of the French Tax Credit Programme: A Difference in Difference Model (No. 2004-07)*. Observatoire Francais des Conjonctures Economiques (OFCE), Paris, France.

Veenhoven, R., Ehrhardt, J., Ho, M. S. D. & de Vries, A. 1993 *Happiness in Nations: Subjective Appreciation of Life in 56 Nations 1946–1992*. Erasmus University Press, Rotterdam, The Netherlands.

WHOQOL Group 1998 The World Health Organization quality of life assessment (WHOQOL): development and general psychometric properties. *Social Science & Medicine* **46** (12), 1569–1585.

Wooldridge, J. 2007 *What's New in Econometrics? Lecture 10 Difference-in-Differences Estimation*. NBER Summer Institute, available at: www.nber.org/WNE/Slides7-31-07/slides_10_diffindiffs.pdf (accessed April 9, 2011).

Wright, S. A. L. & Fritsch, O. 2011 Operationalizing active involvement in the EU Water Framework Directive: why, when and how? *Ecological Economics* **70** (12), 2268–2274.

Yuan, F. 2004 *Tutorial of Social Research Methodology*. Peking University Press, Beijing, China, pp. 211–231.

Zhang, L. B., Liu, J. & Hu, D. H. 2003 Analysis on performance and questions of water users associations in China. *Issues in Agriculture Economy* **24** (2), 129–133.

Zhou, L. A. & Ye, C. 2005 The policy effect of tax-and-fees reforms in rural China: a difference-in-differences estimation. *Economic Research Journal* **8**, 44–53.

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