Journal of Hydrology 540 (2016) 1–16

Contents lists available at ScienceDirect

Journal of Hydrology

journal homepage: www.elsevier.com/locate/jhydrol

Exploring the relationship between subjective wellbeing and groundwater attitudes and practices of farmers in Rural India

J. Ward [a], M.E. Varua [b], B. Maheshwari [b,*], S. Oza [c], R. Purohit [d], Hakimuddin [e], S. Dave [b]

[a] Mekong Regional Futures Institute, 399 Interchange 21 Building, level, 32 Sukhumvit Rd, North Klongtoey, Wattana, Bangkok 10110, Thailand
[b] Western Sydney University, Locked Bag 1797, Penrith, NSW 2751, Australia
[c] Development Support Centre, Ahmedabad, India
[d] Maharana Pratap University of Agriculture and Technology, Udaipur, India
[e] Vidya Bhawan Krishi Vigyan Kendra, Udaipur, India

ARTICLE INFO

Article history:
Received 26 February 2016
Received in revised form 16 May 2016
Accepted 19 May 2016
Available online 8 June 2016
This manuscript was handled by Geoff Syme, Editor-in-Chief

Keywords:
Subjective wellbeing
Groundwater
Community institutions
Managed aquifer recharge

SUMMARY

Failure to effectively coordinate opportunistic extractions by individual well owners with groundwater recharge has led to increasing Indian groundwater scarcity, affecting future opportunities for improved rural livelihoods and household wellbeing. Investigation of the relationship between groundwater institutions, management attitudes and subjective wellbeing of Indian rural households has substantial potential to reveal initiatives that jointly improve aquifer sustainability and household wellbeing, yet has received limited attention. Subjective wellbeing was calculated as an index of dissatisfaction (IDS), revealing ranked importance and the level of dissatisfaction of individual factors selected from economic, environmental and social/relational wellbeing dimensions. High economic and environmental IDS scores were calculated for respondents in the Meghraj and Dharta watersheds, India, respectively. We tested an exploratory hypothesis that observed IDS differences were correlated with differences in life circumstances, (household attributes, income and assets) and psychological disposition (life guiding values and willingness to adapt). The distribution of ranked IDS wellbeing scores was estimated across four statistically distinct clusters reflecting attitudes towards sustainable groundwater management and practice. Decision tree analysis identified significantly different correlates of overall wellbeing specific to cluster membership and the watershed, supporting the research hypothesis. High income IDS scores were weakly correlated with actual total household income ($r < 0.25$) consistent with international studies. The results suggest a singular reliance on initiatives to improve household income is unlikely to manifest as improved individual subjective wellbeing for the Dharta and Meghraj watersheds. In conclusion, correlates were tabulated into a systematic decision framework to assist the design of participatory processes at the village level, by targeting specific factors likely to jointly improve aquifer sustainability and household wellbeing.

1. Introduction

India's groundwater story is uniquely scripted by millions of farmers operating autonomously managed wells leading to what Shah (2009) refers to as "atomistic irrigation manifest as groundwater anarchy". Maintaining groundwater dependent rural livelihoods without further reductions in already depleted hard rock aquifers continues as an increasingly critical dilemma facing irrigator communities in the Dharta and Meghraj watersheds located in Rajasthan and Gujarat respectively. Shah (2008, 2009) argues the dilemma is not confined to the two case study watersheds but is widespread throughout India's agricultural hinterland. Access to cheap pumps, subsidised electricity, changing crop patterns and increasing population have exacerbated the tensions typifying uncoordinated common pool groundwater resources.

The lack of formal or informal property rights (Ward and Dillon, 2012; Skurray and Pannell, 2012) and a general failure to develop institutional rules and enforceable sanctions to coordinate and manage extractions of individual well owners to meet hydrological limits has focussed attention on irrigator communities, nominally the village level, crafting their own institutional arrangements (Ostrom, 2003; Meinzen-Dick et al., 2002; Syme et al., 2012; Steenbergen, 2006; Maheshwari et al., 2014). Steenbergen (2006) cites two examples of community management in India: Nellore and Saurashtra where communities devised rules banning boreholes, promoting additional recharge and water saving to coordinate individual wells via informal norms, enforced by either local government or religious leaders respectively.

* Corresponding author.

http://dx.doi.org/10.1016/j.jhydrol.2016.05.037
0022-1694/

A common proposition articulated in an extensive and diverse corpus of wellbeing scholarship is the necessity of jointly meeting the imperatives of improved wellbeing and sustainable use of natural resources (Stiglitz et al., 2009; Anand and Sen, 2000; Gasper, 2004, 2007; White and Ellison, 2007). Stiglitz et al. (2009 p. 12) argue for the development of a 'statistical system that complements measures of market activity by measures centred on people's wellbeing and by measures that capture sustainability'. Such a system must, of necessity, be multi-dimensional, focus on the household and capture individual life evaluations and priorities, propositions consistent with *inter alia* Campbell (1981), Doyal and Gough (1991), Gasper (2007), McGregor et al. (2007), Nussbaum (2000) and White and Ellison (2007).

The reported research was guided by these literature based insights suggesting an investigation of the relationship between groundwater management attitudes (Varua et al., 2016), human values (Schwartz, 1992; Stern et al., 1998, 1999) and subjective wellbeing (Diener et al., 1999; Gasper, 2004, 2007; Gough and McGregor, 2007; Kahneman et al., 1999; Larson, 2010; Larson et al., 2013; Stiglitz et al., 2009) of Indian rural households has the potential to reveal initiatives capable of jointly improving both aquifer sustainability and household wellbeing.

Maheshwari et al. (2014) argue that participatory based approaches are necessary to assist groundwater dependent communities in the Meghraj and Dharta watersheds develop institutions to jointly achieve sustainable aquifer management and improve their prioritised wellbeing factors and dimensions. Cited impediments include limited knowledge of aquifer dynamics at state and individual level, a lack of expertise and experience of irrigator communities to negotiate rules and sanctions between conflicted water interests and coordinate individual well operations. Participatory processes were central to the development of the vector of subjective wellbeing factors posed to the irrigator respondents (Gasper, 2007; Camfield et al., 2009; Larson, 2010) and the focus of eventual research application.

The primary objective of the research was the development of an empirically based framework to guide the design of participatory processes to assist groundwater dependent communities craft institutions to jointly manage local aquifers and improve wellbeing. The research was focussed on three intentionally exploratory research questions: (i) what are the priority factors of subjective wellbeing perceived by irrigators in the Dharta watershed in Rajasthan and the Meghraj watershed in Gujarat; (ii) are wellbeing factors consistent across watershed and village levels and (iii) are wellbeing factors consistent across households who hold similar life guiding values and attitudes to groundwater management? A series of three main analytical steps, based on field data from a randomised face to face survey was implemented to investigate the three research questions. First, subjective wellbeing factors were selected by interviewed respondents and enumerated as an Index of Dissatisfaction (IDS) (Larson, 2010). Second, ANOVA established significant differences in the mean IDS wellbeing scores across four statistically distinct clusters that reflect respondent attitudes towards groundwater management and practice (Varua et al., 2016). Third, QUEST decision tree analysis identified a parsimonious set of five variables that were significantly correlated with the wellbeing cluster construct. In conclusion, correlates were tabulated into a systematic decision framework to assist the design of participatory processes at the village level.

2. Subjective wellbeing, development and groundwater

Gasper (2007 Table 2.3), in an extensive review of the diverse conceptualisations and ontology of wellbeing and needs, defines objective wellbeing as the 'externally approved, normatively endorsed, non-feeling features of a person's life; and subjective wellbeing as 'feelings of the person whose wellbeing is being estimated'. Diener et al. (1999 p. 277) regard subjective wellbeing as a general domain of scientific interest, comprised of a "broad category of phenomena that includes people's emotional responses, domain satisfaction and global judgements of life satisfaction". Frey and Stutzer (2002), Diener et al. (1999) and Kahneman and Krueger (2006) distinguish three conceptual dimensions requiring independent assessment: positive and negative affects; life satisfaction (the cognitive element) and eudaimonia (the most fundamental concept going back to the Greek philosophy and referring to a good or virtuous life as whole).

The affective element represents a hedonic evaluation guided by emotions and feelings while the cognitive element is an information based appraisal of how one's life measures up to expectations and resembles an individual's envisioned "ideal life" (Rishi and Mudaliar, 2014). Quantitative research on subjective wellbeing focuses on life satisfaction as an immediate concept that is a more than a transitory emotional reaction (Kahneman and Krueger, 2006; Diener et al., 1999), but refrains from claiming that it has any normative content. This is the concept mainly discussed in this paper.

Parfit (1984) proposed three concepts of wellbeing: hedonism, or wellbeing as pleasure; desire theories or wellbeing as the fulfilment of preferences/desires; and objective list theories or wellbeing as the attainment of the elements in a list of what makes a life well-lived. Gasper (2004) argues substantive is a more appropriate term than objective and cites Nussbaum's list (Nussbaum, 2000) derived through consultation and debate within a particular political community. "Nussbaum's list has aspects of all these types: it derives from the use of formal criteria combined with ethical intuitions, and is to be elaborated and operationalized in each political context" (Gasper, 2004, p. 8).

Designing multi-dimensional "lists" that correspond to political context is a common thread in the subjective wellbeing and development literature (*inter alia* Biswas-Diener and Diener, 2001; Gough and McGregor, 2007; McGregor et al., 2007; White and Ellison, 2007; Camfield et al., 2009). For example, McGregor et al. (2007) distinguished wellbeing outcomes (happiness, life satisfaction, welfare) and processes (freedoms, rights, capabilities) when developing a wellbeing questionnaire trialled in Bangladesh and Peru that investigates the relationships between resources that individuals command, the needs they are able to satisfy and quality of life they are able to attain. Resource dimensions were defined as Social, Cultural, Material, Natural Resources and Human, combined with variables eliciting intermediate needs not met (for example food, housing, health, education, family relations).

Larson (2010) and Larson et al. (2013) extend the Australian Unity Wellbeing Index, developed by Cummins et al. (2003) as a three dimensional wellbeing index (economic and services, environment and social), aligned to local wellbeing perceptions through consultation and applied to natural resource management. The instrument deployed to elicit subjective wellbeing priorities of irrigators in the Meghraj and Dharta watersheds followed Larson's approach, corresponds with Nussbaum's notion of a contextualised, substantive wellbeing list, and focussed on depleted groundwater as the cardinal natural resource requiring sustainable management.

Estimating the linkage between wellbeing as perceived by Meghraj and Dharta irrigators and well owner coordination is a first step in meeting the dual objectives of wellbeing and sustainability (Stiglitz et al., 2009). However the relationship between wellbeing and water scarcity, either in the case of poor water quality or the lack of water access or both, has received limited attention in reviewed studies. Exceptions are Bookwalter and Dalenberg (2004), who used ordered logit techniques in a survey of South Africa respondents to demonstrate that water plays an important