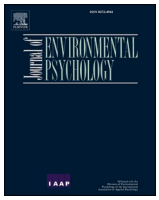
Journal of Environmental Psychology 81 (2022) 101818

Contents lists available at ScienceDirect

Journal of Environmental Psychology

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



Can participation promote psychological ownership of a shared resource? An intervention study of community-based safe water infrastructure

Benjamin Ambuehl [a,c,*], Bal Mukunda Kunwar [b], Ariane Schertenleib [a], Sara J. Marks [a], Jennifer Inauen [c]

[a] Eawag: Swiss Federal Institute of Aquatic Science and Technology, Switzerland
[b] Helvetas Swiss Intercooperation, Nepal
[c] University of Bern, Institute of Psychology, Switzerland

ARTICLE INFO

Handling Editor: W. Schultz

Keywords:
Psychological ownership
Participation
Water
Sustainable development
Environmental contamination
Resource management
Longitudinal intervention study
Dilemma of the commons

ABSTRACT

Previous research suggests that community-based participation, a process through which beneficiaries can actively influence and define the direction and execution of development programs, can promote long-term uptake, use, and management of shared resources, such as community-based safe water infrastructure. However, results are heterogeneous. Psychological ownership theory and initial evidence suggests that participation promotes positive outcomes for shared resources by fostering sense of ownership through three routes: having control, intimate knowledge, and investing the self. This study used community-based safe water infrastructure as an example to investigate how various forms of participation affect acceptance, use, and functionality of a shared resource and whether this effect is mediated by psychological ownership. We conducted a nonrandomized cluster-based controlled trial with pre–post intervention assessment (N = 369) in 33 villages in rural Nepal, where safe water infrastructure is shared. Participatory intervention activities (e.g., influence in decision-making, contributing materials and labour) favourably affected self-reported outcomes and use of the water supply infrastructure but not observed functionality or drinking water quality. In conclusion, this study supports the assumption that participation can foster psychological ownership, which in turn can support successful management of a shared resource.

Our individual human behaviour plays a key role in protecting and restoring the shared natural environment, which is under pressure due to climate change, decreasing biodiversity, and other factors (Inauen et al., 2021). But personal and collective goals often clash when using environmental resources (Sloot et al., 2018). One of the environmental resources most under pressure due to human behaviour is water (Steg & Vlek, 2009; Vlek & Steg, 2007): More than a quarter of the world's population cannot access safe drinking and cooking water (Bain et al., 2018). Anthropogenic contamination, especially faecal contamination of water, is a leading cause of diarrhoeal diseases globally (Prüss-Ustün et al., 2019). In Nepal, for example, up to 77% of drinking water samples are faecally contaminated (Shrestha et al., 2017).

Shared resources, such as safe water infrastructure, have the potential to decrease human impact on the environment and prevent adverse health impacts. In recent decades, the water sector has therefore increased efforts around the world to install new and rehabilitate existing community-based safe water infrastructure, including rural piped water supplies (WHO/UNICEF, 2021). However, ensuring sustainable safe water supply infrastructure in low- and middle-income countries remains a challenge (Fischer et al., 2020; Harvey & Reed, 2007). In particular, safe water infrastructure fails due to negligent operation and maintenance (Kabir & Howard, 2007; Naiga et al., 2015). This is often attributed to how water users and operation and maintenance teams interact (Khwaja, 2009). The participation of communities in planning, installing, and managing shared resources has been suggested as one solution to ensure long-term functionality and access to shared resources (Prokopy, 2005).

1. Participation and management of shared resources

In the context of international development, participation has been defined as a process through which beneficiaries can actively influence and define the direction and execution of community development, in contrast to processes where they are only the recipients of shared

* Corresponding author. Eawag, Ueberlandstrasse 133, 8600, Duebendorf, Switzerland.
E-mail address: benjamin.ambuehl@eawag.ch (B. Ambuehl).

https://doi.org/10.1016/j.jenvp.2022.101818
Received 7 September 2021; Received in revised form 30 April 2022; Accepted 7 May 2022
Available online 15 May 2022

resources (Abbott, 1995). The United Nations' Sustainable Development Goal (SDG) 6b, for example, specifies participation as a critical means of ensuring sustainable safe water access. In rural water supply planning, participation has been targeted through involvement of communities in decision-making, promoting attendance to community meetings, and asking the community to make cash, in-kind, or labour contributions to water infrastructure community development projects (Bisung et al., 2014; Whittington et al., 2007; Woolcock & Narayan, 2000).

Participation has been identified as an instrument central to sustainable management of shared resources (Adhikari et al., 2014; Agrawal & Gupta, 2005). Certain limitations have been identified, especially when focusing solely on voluntary action (Murty, 1994), but in general, participation is seen as a very important contribution to common property resource management (Sahoo & Swain, 2013). For example, enhancing participation was found to increase care for a lake (Peck et al., 2021), and shared management improved the maintenance of solar energy systems (Jenny et al., 2007). Participation was identified as a key step in developing a shared vision for successful planning of water resource management (Palmer et al., 2013). A concept that has been theorized to link participation to resource management is psychological ownership. For example, participation was linked to a sense of ownership over shared IT infrastructure (Kwon, 2020), and in development projects, project beneficiary participation predicted via psychological ownership how sustainable a project was (Aga et al., 2018). However, how different forms of participation influence psychological ownership has not been distinguished.

2. Psychological ownership

Psychological ownership is a theory that combines individual and social aspects (Rudmin & Berry, 1987). Psychological ownership is defined as "the state wherein a person or community feels as though a target of ownership is his/hers or theirs" (Pierce et al., 2001, p.299). It is conceptualized as both a cognitive state and affect towards a target of ownership. This means that the individual can articulate the concept intellectually but also has a feeling of ownership. According to theory, psychological ownership serves to satisfy various basic motives (e.g., efficacy). It manifests as having a close connection between the target of ownership and the extended self (Jo et al., 2021). The concept is distinct from legal ownership, as the latter exists beyond the individual and in reality. By contrast, psychological ownership does not necessarily correspond with legal ownership: it is perceived.

2.1. Routes to psychological ownership

Psychological ownership is hypothesized to be evoked through three routes: (a) getting to know the target of ownership, for instance by experiencing the object); (b) investing the self in the target of ownership, for example by contributing effort; and (c) having control over the target of ownership, for instanced by being involved in decision-making (Pierce et al., 2003; Pierce & Jussila, 2010). Several cross-sectional survey studies in organizational contexts support these hypothesized routes to ownership (e.g., Han et al., 2010; Liu et al., 2012).

Routes to psychological ownership can be manipulated by involving stakeholders: by fostering participation. For example, correlational evidence suggests that psychological ownership of latrines relates to safe sanitation in community-led safe sanitation programmes (Tomberge et al., 2021). Further, one experimental study showed that psychological ownership of public goods can be increased by manipulating routes to psychological ownership; for example, screening a video increases intimate knowledge and psychological ownership of a beach (Peck et al., 2021). However, not all forms of participation seem to evoke psychological ownership equally (Aga et al., 2018; George et al., 2015; Marks et al., 2014; Tomberge et al., 2021). Studies involving safe water infrastructure have provided evidence that inviting community members to participate in decision-making (Ambuehl et al., 2021; Contzen & Marks, 2018; Marks & Davis, 2012) and upfront investment in the system (Marks & Davis, 2012) relate to increased psychological ownership. In turn, neither token nor small cash payments effectively enhanced ownership (Madajewicz et al., 2021; Marks & Davis, 2012). No further routes to psychological ownership have been investigated so far. Prospective studies investigating routes to psychological ownership are completely lacking.

2.2. Consequences of psychological ownership

Psychological ownership is assumed to relate to positive outcomes, for example by shaping individual and collective attitudes and behaviour (van Dyne & Pierce, 2004). For example, it increases individuals' willingness to protect natural resources and engage in pro-environmental behaviour (Preston & Gelman, 2020). Psychological ownership was also found to enhance positive attitudes, commitment, and stewardship behaviour with natural goods (Peck et al., 2021) and with shared services in society (Paundra et al., 2017). Compared to legal ownership, psychological ownership leads to reduced exploitation of a natural environment (Jiang et al., 2019) and fosters other sustainable behaviours (Suessenbach & Kamleitner, 2018). However, territorial behaviour—protective behaviour towards the target of ownership—can occur (Brown & Zhu, 2016).

The consequences of psychological ownership for safe drinking water infrastructure have received little empirical attention. Marks et al. (2013) found psychological ownership to be associated with confidence in water system functionality, better management practices, and improved infrastructure condition in Kenya. Cross-sectional mixed-methods research on safe water supply in Nepal suggests that increased psychological ownership relates to greater acceptance of and responsibility for maintenance and use of the shared infrastructure. It also increases confidence in the functionality of the water system, but it does not actually increase functionality (Ambuehl et al., 2021). Nevertheless, no longitudinal intervention study has been conducted on the routes to psychological ownership of safe water infrastructure or its consequences.

3. Participation and psychological ownership of shared safe water resources

In summary, previous observational research suggests that community participation may foster psychological ownership in line with the routes to psychological ownership specified in theory. Consequently, participation may enhance the long-term management of shared resources. However, previous studies have predominantly relied on cross-sectional designs to investigate these questions. What are lacking are longitudinal and experimental studies that test whether participation promotes positive outcomes by enhancing psychological ownership, which would help understand how participatory interventions work (Michie et al., 2013). Such studies can provide important insights into improving interventions (Inauen et al., 2020) and thus to promoting long-term successful and sustainable management of commons and pro-environmental behaviour.

In this study, we provide a first prospective test of these assumptions in the domain of safe water management. The study investigated the effects of a participatory intervention on the acceptance, use, and management of community-based safe water infrastructure in rural Nepal and the mediating role of psychological ownership. We extend Contzen and Marks's (2018) model and postulate that participation in the water safety programme increases psychological ownership of the shared infrastructure, which in turn influences acceptance, maintenance, use, negative behaviour (e.g. overuse), and the functionality of the target. On the basis of previous findings in published literature, we hypothesized that participation promotes the following safe water outcomes: (1a) greater acceptance, such as a positive attitude towards the infrastructure; (1b) greater preparatory behaviour, such as maintenance

of infrastructure; (1c) greater use of infrastructure; (1d) lower negative behaviour, thus reducing overuse of limited available commons; and (1e) greater functionality as measured in, for instance, water quality. Second, we aim to test whether psychological ownership explains the effects of participation on outcomes. We hypothesize that psychological ownership mediates the effect of participation on (2a) acceptance, (2b) preparatory behaviour, (2c) use of infrastructure, (2d) negative behaviour, and (2e) functionality.

4. Methods and participants

We carried out a nonrandomized cluster-based controlled trial with pre–post intervention assessment. The study took place in four municipalities of Karnali Province and one municipality of Sudur Paschim Province in Nepal.

4.1. Clusters and participants

Amongst the communities served by the Helvetas' integrated water resources management (IWRM) programme, study communities qualified for enrolment if they met the following criteria: a population of less than 5000 people; primarily served by a gravity-fed piped supply; no pre-existing centralized water treatment works; and located not more than 2 h walking distance from one of the laboratories installed for water quality analysis. Drawing on this sample frame of K = 33 communities, we purposively assigned 21 communities to the intervention group and

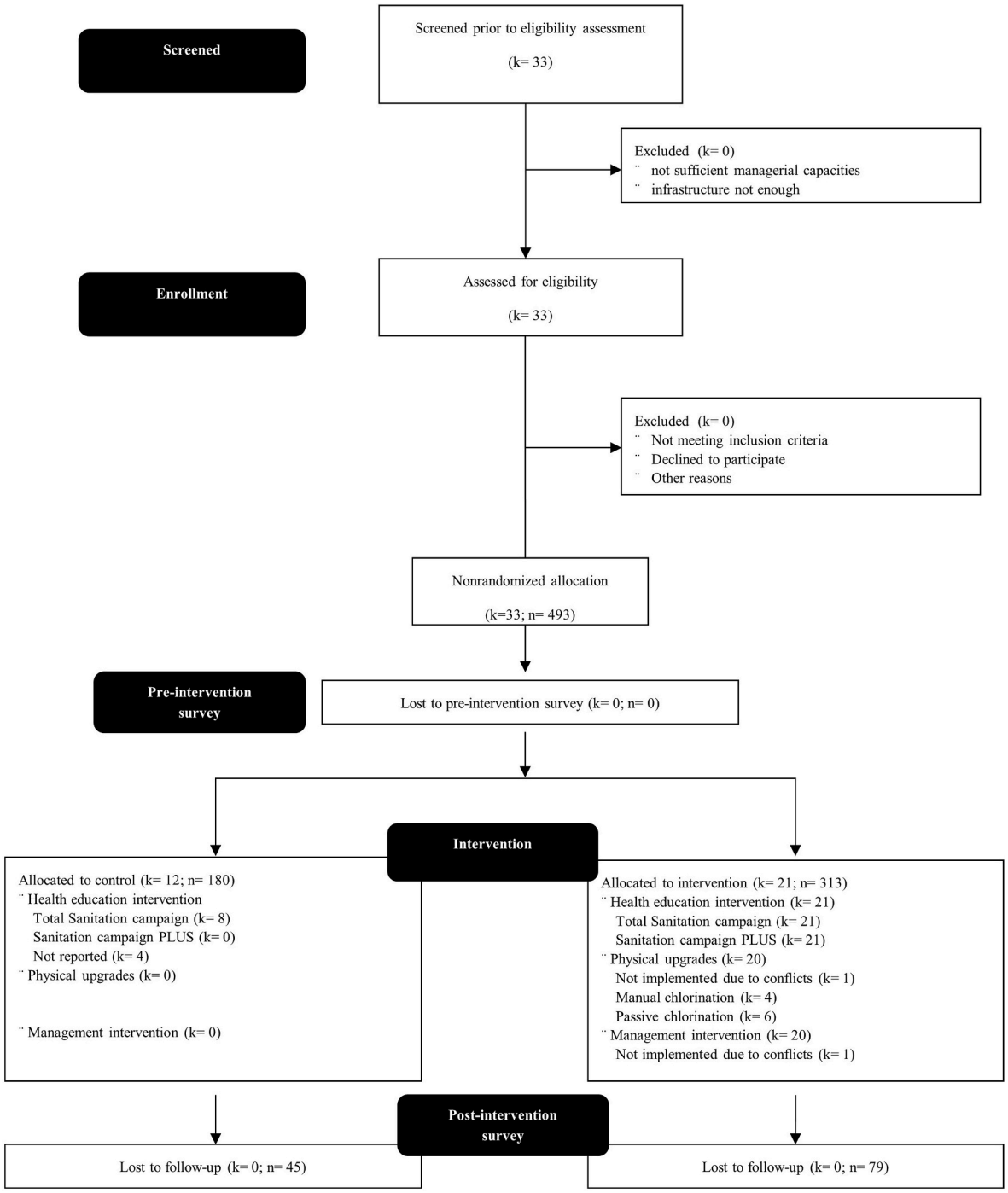


Fig. 1. Flow diagram for clusters and participants according to CONSORT (Eldridge et al., 2016).

12 matching communities to the control group. Intervention communities were selected based on access and proximity to rural laboratories to which samples could be transferred within 2 h of collection, including processing time in the laboratories. Then, control communities were matched according to similarity of locality (e.g. climate, topography, access to roads), while being located far enough in distance from intervention communities to avoid a spillover effect. The oversampling of intervention communities was done for the primary purpose of the study: which was to validate the water safety planning (WSP) framework of the WHO (Rickert et al., 2014). The WSP framework aims at (1) mobilising and training local actors in construction, operation management, and maintenance of drinking water and irrigation schemes; (2) providing adequate sanitation facilities at home and in school; (3) implementing water source conservation and upgrading drinking water schemes; (4) mobilising and training local actors in preparing and using the water use master plan, promoting water integrity/governance, and advocate good practices (see Table S1 for more details).

The survey sample comprised N = 369 individuals (N = 493 at baseline) in semi-structured computer-assisted personal interviews. The choice of participants in the communities was random, with 15 households selected from a complete list of residents in the village that benefitted from the same drinking water scheme. Ages of interviewees were 18 or above, and their role in the family was preferably head of the household and responsible for water, sanitation, and hygiene. Individuals and clusters followed the flow diagram in Fig. 1.

4.2. Independent variable: Participatory intervention

The interventions delivered through the IWRM programme of Helvetas can be categorized into three packages: general health and hygiene promotional activities, water supply infrastructure upgrades, and improved managerial practices. We mapped the intervention activities to the corresponding theory-based routes to psychological ownership. We describe this in detail in Table S1 in the supplementary materials.

To foster intimate knowledge, communities took part during the feasibility study and project implementation (e.g. attending meetings, helping in mapping and planning infrastructural upgrades), and communities were also trained in governance and financial management for proper operation to promote transparency and accountability. To foster investment of the self, communities were made responsible for supporting the scheme construction with cash, labour, and arrangement of materials. To foster having control, the water users' committee coordinated with various stakeholders for financial and technical assistance, organized and took part in construction work and ongoing operation and maintenance, and recruited a village maintenance worker who was responsible for the operation and maintenance of the scheme and collection of a water tariff. Communities were trained in participation practices for sustained water supply, sanitation, and hygiene (e.g. how to maintain water distribution channels).

The 21 intervention communities in this study received an intensive version of each package, whereas control communities received no package or only health and hygiene promotion.

Packages two and three of IWRM (Table S1) depend on the water safety planning (WSP) framework that is promoted by the WHO (Rickert et al., 2014). WSPs (Sutherland & Payden, 2017) are a participative tool to support planning, operation, and maintenance of water supply. They are tailored to the specific situation of a given water supply, and they encourage a shift towards more participatory planning of the water supply (Whittington et al., 2007). This is why intensive community participation and training are core features before and throughout the IWRM programme.

Four control communities did not receive the Total Sanitation campaign, a part of the IWRM programme (see Table S1) by Helvetas. One intervention community did not implement infrastructural upgrades because of internal conflicts. All but one of the communities involved reported that manual chlorination was challenging and subsequently dropped this aspect of the intervention.

4.3. Outcome measures

The survey assessed participatory activities and psychological ownership at baseline. At follow up, 16 months later, the survey asked about psychological ownership and safe water outcomes. All items included in the study are listed in Table 1.

We translated and backtranslated all items to Nepali and pretested in one community not included in the analyses. Interviewers had five days of training, and data collection was supervised. The interviewers measured psychological ownership for items with unipolar 5-point visual Likert scales, each with five dots of increasing size (Harter et al., 2020). To create composite scores for constructs such as psychological ownership, we summed corresponding items. Finally, we normed all scores to values of 0–1, with higher values indicating a higher score on this construct. For binary items, 1 indicated the presence of an outcome.

4.3.1. Psychological ownership

We adapted the validated individual psychological ownership scale (van Dyne and Pierce, 2004) to assess psychological ownership of the water system in the Nepali context (Ambuehl et al., 2021). We used five items with the highest face validity in this cultural context. For the data analysis, we also removed one reverse-coded item from the scale due to low item–total correlations. Internal consistency (Cronbach's alpha) was calculated as ICC with a 95% confidence interval (Bravo & Potvin, 1991) at baseline of 0.46 [0.37–0.55], and at endline of 0.76 [0.75–0.82]. The removal of further items did not improve reliability. A measure of re-test reliability cannot be calculated from baseline to endline, because psychological ownership is expected to change even in the control group.

4.3.2. Routes to psychological ownership

We measured routes to psychological ownership as independent variables and operationalized them with eight measures, targeting the three routes to psychological ownership. For control, we assessed perceived influence in decision-making about upgrading and running water schemes, deciding about planning service delivery, and involvement of the household in planning water supply. For intimate knowledge, we assessed frequency of attendance of water users' committee meetings, and knowing the village maintenance worker. For investment of the self, we assessed personal contribution of labour, contribution of materials, and contribution of cash during the infrastructural upgrades.

4.3.3. Consequences of psychological ownership

We measured the consequences of psychological ownerships as dependent variables and operationalized as the following groups: For acceptance, we measured perceived water taste, liking treated water, satisfaction with the water supply, and perceived safeness. For caretaking, we measured willingness to take care and responsibility for the water supply. For use of infrastructure, we measured use of water supply and exclusive use of water supply as water source. For treatment, we measured the importance of treatment. For negative behaviour, we measured overuse, territoriality, and source switching. For functionality, we measured self-reported functionality, availability of water supply, expected functionality, frequency of interruption, confidence in repairing, and *E.coli* risk.

4.3.4. Microbial water quality

Faecal contamination of household stored drinking water samples was assessed using the membrane filtration technique with Compact-Dry™ Plates (Nissui Pharmaceutical Co., Ltd, Japan) and 24-h incubation at 37 °C. Quality control measures included daily positive and negative lab controls and two duplicate samples processed in each study community. Further details on laboratory procedures are described in Bänziger et al. (2021).

Table 1
Items used in survey.

Concept	Item	Coding
Scale (van Dyne & Pierce, 2004), measured at baseline and endline		
Psychological ownership	How much do you agree with the following statement?	
	This is MY water system	0 = agree not at all to 1 = agree very much
	This is our COMMUNITY'S water system.	0 = agree not at all to 1 = agree very much
	My family is one of the owners of the water system	0 = agree not at all to 1 = agree very much
	The water system is owned by all the people who live in this village.	0 = agree not at all to 1 = agree very much
Participatory activities, measured at baseline		
Involvement	Is anyone in this household involved in the water supply system in this community?	0 = No; 1 = Yes (FCH volunteer, VMW, WST, WUSC)
Decision-making	During PLANNING of the water system, did anyone in your family participate in deciding about the level of service to be delivered by the system?	0 = No; 1 = Yes
Influence	Overall, who do you think had the MOST influence over decisions about the water system during planning and construction?	0 = Committee (Donor, NGO, local government, leaders, WUSC); 1 = All users
Water users' committee meetings	How often does WUSC meet with water users to discuss issues about the water system?	0 = Never/Don't know; 1 = as needed; 2 = 1 to 6 meetings a year; 3 = Monthly
Village maintenance worker	Is there a village maintenance worker (VMW) to look after your main drinking water scheme?	0 = No; 1 = Yes
Contribution cash	Did your family contribute cash to the construction of the village's water system?	0 = No; 1 = Yes
Contribution cash (amount)	How much MONEY did your family contribute toward the water system during the construction phase?	0 = 0; 1 = Rs $\leq$ 3000; 2 = Rs 3001–5000; 3 = Rs $\geq$ 5001
Contribution cash (regularly)	Do the villagers contribute regularly to the water scheme?	0 = No (Not at all, when needed); 1 = Yes (regularly)
Contribution labour	Did your family contribute labour to the construction of the village's water system?	0 = No; 1 = Yes
Contribution materials	Did your family contribute materials to the construction of the village's water system?	0 = No; 1 = Yes
Outcomes, measured at endline		
1. Acceptance		
Perceived water taste:	How good do you perceive the taste of drinking water from the water system?	0 = not at all good to 1 = very good
Liking treated water	How much do you like or dislike drinking treated water?	−1 = dislike it very much to 1 = like it very much
Satisfaction	How satisfied are you with your main drinking water source?	0 = Dissatisfied; 1 = Satisfied
Safeness	How safe do you think your main drinking water source is for drinking?	−1 = not at all to 1 = very much
2. Preparatory behavior		
Caretaking	How much do you feel that you personally need to take care of the water system?	0 = not at all to 1 = very much
Responsibility	How responsible do you feel for the repairing of the water system in case of interruption?	0 = not at all to 1 = very much
3. Health behaviour		
Use	Which water source do you use as MAIN drinking water source?	0 = other (Rainwater harvesting, open unprotected source, open protected source, unmanaged piped scheme, river, lake, bottled water); 1 = piped water scheme (Private tap, community tapstand)
Exclusive use	Do you also use other water sources for drinking?	0 = No; 1 = Yes
Treatment	How often did you treat your drinking water in the past 2 weeks?	0 = never to 1 = always
Importance of treatment	How important is it for you to treat your water before drinking	0 = not at all to 1 = very much
4. Negative behaviour		
Overuse	How often did you collect more water from the water system than you actually need in the last two weeks?	0 = never to 1 = always
Territoriality	How much does it bother you when other people collect their water from the water system?	0 = not at all to 1 = very much
Source switching	How often did you collect your water from other sources than the water system in the past 2 weeks?	0 = Never; 1 = Rarely; 2 = Half of the times; 3 = Most of the times; 4 = Always
5. Functionality		
Self-reported functionality	Is your main drinking water source functioning now?	0 = No (not, not well); 1 = Yes
Availability	Is your main drinking water source available when needed?	0 = No (Never, sometimes); 1 = Yes
Expected functionality	How confident are you that your water system will be functional one year from now?	0 = not at all confident to 1 = very much confident
Interruption:	How many days did the interruption last?	
Confidence in reparation	If main drinking water scheme needed repairs, how confident are you that the problem could be fixed within 1 week?	0 = Not confident (not at all, somewhat confident); 1 = Very confident
Water quality	E.coli count (CFU per 100 ml)	0 = 0; 1 = 1–10; 2 = 11–100; 3 = 101-TNTC
Covariate		
Socio-economic status	About how much does your household spend PER MONTH on regular expenses (regular expenses = food, transport, clothing, and school fees)?	

Note: CFU = Coliform units; FCH = female community health; TNTC = too numerous to count; VMW = village maintenance worker; WUSC = water users' committee; WSTF = water safety task force. Reliability analysis of the psychological ownership scale was assessed by Cronbach's α at pre-intervention survey = .56 and post-intervention survey = 0.79.

4.3.5. Functionality

Bonsor et al. (2018) distinguish functionality of water schemes from sustainability of infrastructure. Functionality is a snapshot of sustainability. We follow this understanding, and our definition of water supply scheme functionality also includes water quality (Walters & Javernick-Will, 2015). Subsequently, we define a safe water supply system as functional when it produces water flow of a good quality of water at a particular time.

4.4. Analyses

The data analysis was carried out in three steps. Firstly, the effect of participation on psychological ownership and safe water outcomes was tested using condition (intervention group = 1 vs. control group = 0) as the independent variable to predict changes in psychological ownership and safe water outcomes. Since we used a nonrandomized design, conducting analysis with change scores is preferable compared to regressed

change (Deeks et al., 2003). The modelling approach we used were generalized estimating equations (GEE) that account for the nested structure of the data: individuals nested in water systems (Liang & Zeger, 1986). Secondly, to identify which forms of participation related to psychological ownership, we computed a model with forms of participation as predictors and psychological ownership of the water system as the outcome. For the consequences of psychological ownership, we fitted separate GEEs for continuous outcomes and dichotomous outcomes. As effect size measures for the GEE models, we calculated odds ratios (ORs) with asymptotic Wald 95% confidence intervals (CIs) for dichotomous outcomes. We interpreted them as the percentage increase (values > 1) or decrease (values < 1) in the outcome for a unit increase in the predictor. These analyses were adjusted for intervention, gender, and socio-economic status (SES).

Thirdly, we estimated the relationship of participatory activities with change in psychological ownership and consequences in mediation models (Fig. 2). Mediation analysis can indicate how participation affects change in outcomes because they test the underlying mechanisms by which two variables affect each other (Baron & Kenny, 1986). In line with the assumptions of mediation analysis, we only tested mediation for participatory activities that showed a significant relation to changes in psychological ownership (established in Step 2). For each form of participation and outcome combination, we tested a separate mediation model following procedures proposed by Preacher et al. (2007) and using the PROCESS SPSS macro (Hayes, 2012). Confidence intervals were computed by bootstrapping 1000 resamples to test for positive indirect effects of the interventions on outcomes. Because these models referred to separate hypotheses, no control for the error rate was necessary (Bender & Lange, 2001).

4.5. Ethics & registration

We conducted the research in accordance with the Declaration of Helsinki and obtained ethical approval from the institutional review board of the first author's institution (Eawag Ethics Committee, policy directive 16-09). We obtained written informed consent from each participant prior to data collection. The study received government approval in Nepal as part of the Helvetas IWRM research programme.

5. Results

See Table 2 for the sample characteristics.

Descriptive statistics of survey items are presented in Table 3. Control and intervention groups differed at baseline only in whether they contributed materials to the water system (treatment group contributed significantly more materials $t(491) = -1.987$, $p = .047$); compare with Table S2 in supplementary materials.

Table 2
Sample characteristics.

Characteristics	n	%f	M	SD
Age	369		38.11	14.37
Gender				
Female	259	70.2		
Male	110	29.8		
Education level				
College or higher	10	2.71		
no formal schooling (illiterate)	106	28.7		
no formal schooling (literate)	125	33.9		
Primary	64	17.3		
Secondary	63	17.1		
None	1	0.27		
Ethnicity				
Bramihin Chhetr Thakuri	252	68.3		
Dalit	81	22		
Janajati	34	9.21		
Other	2	0.54		
Occupation in household				
Agriculture (independent)	198	53.7		
Agriculture (employed)	24	6.5		
Agriculture (labourer)	6	1.63		
Agriculture (business)	107	29		
Small business	4	1.08		
Government employed	28	7.59		
Labourer (daily)	2	0.54		
Expenses per month (NPR [a])			10509.65	6463.56
Land owning (Ropanis [b])			6.81	7.75
People living in household			6.35	2.71
Children in household			2.78	1.63
Children going to school			2[a]4	1.41

Note: N = 369, %f = relative frequency, n = Total Sample size; M = Mean; SD = Standard deviation.
[a] Nepali Rupee, 118 NPR = 1 US-$.
[b] Ropanis 30 = 1.5 ha.

5.1. Intervention effect

In the intervention group, individuals were more satisfied with the water system (OR = 1.83; $p = .014$) than the control group, expected functionality was higher (B = 0.11;$p = .018$), reported overuse less (B = −0.11; $p = .006$), and responsibility for the water system greater (B = 0.07; $p = .033$). Further, people reported greater importance of water treatment (B = 0.04; $p = .046$) and more frequent treatment of the water after collecting it from the water system (B = 0.127; $p = .035$). There were no group differences in changes in psychological ownership (B < .01; SE = 0.03; $p = .468$).

5.2. Participatory activities and changes in psychological ownership

Although an overall effect of the intervention was absent on psychological ownership, several individual forms of participation related to changes in psychological ownership: We found greater psychological

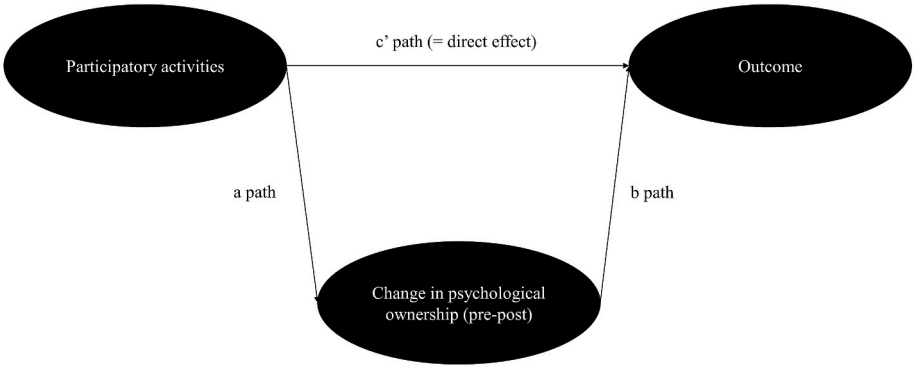


Fig. 2. Schematic representation of mediation model.

Table 3
The relationship between different forms of participation and psychological ownership.

	B	SE	p
Intervention	.02	.03	.468
Influence in decision-making	-.05	.02	.005
Decision about planning of service delivery	.07	.02	.002
Involvement of household in planning of water supply	.00	.02	.894
Water users' committee meetings frequency	.08	.03	.007
Village maintenance worker	.04	.03	.282
Contribution: labour	-.09	.04	.021
Contribution: materials	.11	.05	.026
Contribution: cash	.02	.02	.481
Gender	-.01	.02	.645
Socio-economic status	.00	.01	.436

Note: N = 369, 33 schemes, Dependent variable = Difference in psychological ownership, B = Parameter Estimates, SE = Standard error. All *p* values are two-tailed. Probability distribution: normal, link function: identity.

ownership in individuals who influenced decision-making about the service levels, who reported more frequent meetings with the water users' committee, and who contributed materials or labour. We found lower psychological ownership in individuals who influenced decision-making about the water system and who contributed labour (see Table 3).

5.3. Psychological ownership and safe water outcomes

Table 4 GEE results indicated that individuals with greater psychological ownership also reported greater acceptance on all measures except satisfaction and greater responsibility for the water system. Further, greater psychological ownership related to increased use of the water system, more frequent water treatment after collection from it, less reported overuse, and greater optimism regarding functionality.

Table 4
Relationship between changes in psychological ownership and safe water outcomes.

	B	*SE*	*p*	OR	CI95	
					LL	UL
Acceptance						
Perceived water taste	.15	.06	.013			
Liking treated water	.75	.10	<.001			
(Binary) Satisfaction	-.96	1.06	.365	.38	.05	3.05
Safeness	-.71	.24	.004			
Caretaking						
Caretaking	.49	.06	<.001			
Responsibility	.38	.05	<.001			
Use of infrastructure						
(Binary) Use	5.02	2.43	.039	151.81	1.30	17766.91
(Binary) Exclusive Use	.7	1.48	.613	2.11	.12	38.22
Treatment	.44	.14	.001			
Importance of treatment	.29	.05	<.001			
Negative behaviour						
Overuse	-.21	.09	.024			
Territoriality	-.16	.09	.084			
Source switching	-.15	.12	.208			
Functionality						
(Binary) Self-reported functionality	1.35	.99	.176	3.87	.55	27.46
(Binary) Availability	1.26	.87	.148	3.52	.64	19.29
Expected functionality	.39	.08	<.001			
Interruption	.31	10.07	.976			
(Binary) Confidence in repairing	3.46	.68	<.001	31.78	8.40	120.36
E.coli risk	.80	.32	.805			

Note: N = 369, 33 schemes, independent variable = psychological ownership, HH = household, WUSC = water users' committee, B = parameter estimates, SE = standard error, OR = odds ratio, CI95 = confidence interval, LL/UL = lower/upper limit of the confidence interval. All *p* values are two-tailed. For continuous items: probability distribution: normal, link function: identity. For binary items: probability distribution: binomial, link function: logit.

5.4. Mediation analysis

To test whether the various forms of participation relate to outcomes via changes in psychological ownership, we performed mediation analysis. We found that for five categories of outcomes, psychological ownership mediated some effects of participatory activities on consequences (Table 5). Water users' committee meetings and participation in decision-making were the predominant routes by which psychological ownership partially mediated the link to outcomes. We did not find a mediating effect of psychological ownership on functionality.

6. Discussion

The present study is the first to use an intervention study design to investigate whether participation leads to sustainable use and management of a shared resource, in this case community-based safe water infrastructure. We further investigated whether this relationship is mediated by psychological ownership for the shared infrastructure. The participatory intervention positively affected several safe water outcomes compared to the control group, but not psychological ownership. However, several specific participatory activities related to favourable safe water outcomes, and some of these relationships were explained by changes in psychological ownership.

We found greater satisfaction with the water supply, increased expected functionality, greater sense of responsibility, and lower reported overuse in intervention communities than in control ones. In addition, the intervention group reported that households treated drinking water more frequently. However, we did not find an intervention effect for either observed water quality or improved functionality of safe water infrastructure. This may not be surprising, as several other studies also found little evidence for any effectiveness of participatory water safety planning interventions on overall outcomes, especially in rural contexts (e.g., String et al., 2020; van den Broek & Brown, 2015). One set of likely explanations can be found in the nature of participation: communities did not participate enough (Jiménez et al., 2019), or participation was not in the right form (Kayaga, 2013), or did not last long enough (Ferrero et al., 2019). Another explanation could be that structural factors, such as external support programmes (Miller et al., 2019) and design-matched infrastructure (Marks et al., 2018), are necessary to improve water quality and observed functionality of infrastructure.

In line with our assumptions, we found that certain participatory activities related to increased psychological ownership. Involvement in decision-making, attending water users' committee meetings, and contributing materials were each independently associated with greater psychological ownership of the safe water infrastructure. In contrast, influence in decision-making for all users was negatively associated with psychological ownership. An explanation for this could be, that if the influence is distributed too broadly in the public, this can lead to diffusion of responsibility, and thus to lower psychological ownership in the individual (Beyer et al., 2017). Contribution of labour related to decreased psychological ownership too. This confirms findings from cross-sectional studies (e.g., Contzen & Marks, 2018; Marks & Davis, 2012) that not every form of contribution invokes feelings of ownership equally, and these feelings may be very short-lived (Kamleitner & Erki, 2013). Financial contributions, in particular, are seen as less important than intrinsic contributions to determining long-lasting behaviour change (Kaiser et al., 2020; Ryan & Deci, 2000). Therefore, although labour contributions undoubtedly play a practical role in water supply projects by reducing overall project costs and using local materials by delegating construction activities, their role in influencing community

Table 5
Mediation models according to schematic representation of mediation in Fig. 2.

	a path			b path			c' path			indirect effect		
	B	*SE*	*p*	B	SE	p	*B*	*SE*	*p*	*B*	LL	UL
Outcomes X Forms of participation												
Acceptance (confidence in functionality)				0.23	0.05	<0.001						
Influence on decision-making	−0.08	0.04	<0.001				0.00	0.04	0.10	−0.02	−0.05	0.00
Decision about planning of service delivering	0.12	0.05	<0.001				**0.10**	**0.05**	**0.03**	**0.03**	**0.00**	**0.06**
Water users' committee meetings	0.17	0.05	<0.001				0.02	0.05	0.64	**0.04**	**0.01**	**0.07**
Contribution: labour	−0.07	0.04	<0.001				0.01	0.04	0.79	−0.01	−0.04	0.01
Contribution: materials	0.06	0.04	<0.001				0.01	0.04	0.87	0.01	0.00	0.03
Caretaking				0.33	0.04	<0.001						
Influence on decision-making	−0.08	0.04	<0.001				**−0.06**	**0.04**	**<0.001**	−0.02	−0.06	0.01
Decision about planning of service delivering	0.12	0.05	<0.001				**0.17**	**0.04**	**<0.001**	**0.04**	**0.01**	**0.08**
Water users' committee meetings	0.17	0.05	<0.001				**0.01**	**0.04**	**<0.001**	**0.05**	**0.02**	**0.10**
Contribution: labour	−0.07	0.04	<0.001				**0.02**	**0.04**	**<0.001**	−0.02	−0.05	0.01
Contribution: materials	0.06	0.04	<0.001				**−0.07**	**0.04**	**<0.001**	0.02	0.00	0.04
Use of infrastructure				0.13	0.05	0.01						
Influence on decision-making	−0.08	0.04	<0.001				0.06	0.05	0.22	−0.01	−0.03	0.00
Decision about planning of service delivering	0.12	0.05	<0.001				−0.08	0.05	0.14	0.02	0.00	0.04
Water users' committee meetings	0.17	0.05	<0.001				**0.13**	**0.05**	**0.01**	**0.02**	**0.00**	**0.05**
Contribution: labour	−0.07	0.04	<0.001				−0.05	0.05	0.31	−0.01	−0.03	0.00
Contribution: materials	0.06	0.04	<0.001				**−0.10**	**0.04**	**0.03**	0.01	0.00	0.02
Use of infrastructure (treatment of water after collection)				0.31	0.05	<0.001						
Influence on decision-making	−0.08	0.04	<0.001				0.00	0.04	0.99	−0.02	−0.06	0.01
Decision about planning of service delivering	0.12	0.05	<0.001				0.04	0.05	0.37	**0.04**	**0.00**	**0.08**
Water users' committee meetings	0.17	0.05	<0.001				**−0.10**	**0.05**	**0.05**	**0.05**	**0.01**	**0.09**
Contribution: labour	−0.07	0.04	<0.001				−0.02	0.04	0.73	−0.02	−0.06	0.01
Contribution: materials	0.06	0.04	<0.001				**−0.09**	**0.04**	**0.03**	**0.02**	**0.00**	**0.04**
Negative behaviour: Overuse				−0.14	0.05	0.00						
Influence on decision-making	−0.08	0.04	<0.001				−0.07	0.04	0.11	0.01	0.00	0.03
Decision about planning of service delivering	0.12	0.05	<0.001				−0.08	0.05	0.09	**−0.02**	**−0.04**	**0.00**
Water users' committee meetings	0.17	0.05	<0.001				−0.05	0.05	0.34	**−0.02**	**−0.06**	**0.00**
Contribution: labour	−0.07	0.04	<0.001				−0.05	0.04	0.28	0.01	0.00	0.03
Contribution: materials	0.06	0.04	<0.001				0.04	0.04	0.38	−0.01	−0.02	0.00
Functionality (self-reported)				0.02	0.05	0.72						
Influence on decision-making	−0.08	0.04	<0.001				**0.10**	**0.05**	**0.03**	0.00	−0.01	0.01
Decision about planning of service delivering	0.12	0.05	<0.001				−0.02	0.05	0.06	0.00	−0.01	0.02
Water users' committee meetings	0.17	0.05	<0.001				**0.10**	**0.05**	**0.04**	0.00	−0.02	0.03
Contribution: labour	−0.07	0.04	<0.001				−0.02	0.05	0.63	0.00	−0.01	0.01
Contribution: materials	0.06	0.04	<0.001				−0.01	0.04	0.85	0.00	−0.01	0.01

Note: N = 3.

ownership feelings remains uncertain. Alternatively, this finding may potentially be attributable to baseline differences in contributing materials. The findings of our mediation analysis speaks against this interpretation, however. We found that only certain ways of fostering psychological ownership work well, and contributing material is not one of them. Therefore, we may argue that the baseline differences in contribution of materials are negligible for the intervention effect.

Psychological ownership was associated with multiple positive safe water outcomes in this study, including increased acceptance and caretaking of safe drinking water infrastructure, increased use of infrastructure, and reduced negative behaviour. This agrees with findings from research on other shared resources. For example, greater psychological ownership was associated with increased satisfaction with community development, higher self-esteem, and increased quality of contributions for virtual communities (Lee & Suh, 2015); increased perceived usefulness and perceived ease of use of a new learning environment (Yim et al., 2019); acceptance of and increased participation in new technology adaptation (Pare et al., 2006); augmented car sharing (Paundra et al., 2017); and increased service use in an access-based service economy (Fritze et al., 2020). Contrary to our hypotheses, psychological ownership did not relate to more distal outcomes such as functionality, and all of the effects found were weak. These findings are in line with earlier studies on shared resources and psychological ownership (Shu & Peck, 2018), and also from organizational research, where for example van Dyne and Pierce (2004) found no incremental prediction of psychological ownership on distal outcomes. In our study, an explanation may be that technical expertise and influence over functionality are often assigned to an exclusive selection of villagers: the water users' committees. Hence, users may not have a significant direct influence on functionality and water quality. This may further explain why the activities of water users' committees are so strongly related to users' psychological ownership. Users who report attending more frequent committee meetings are most likely to be close and follow the news of what happens in the water users' committee and subsequently have more knowledge about and increased influence over the water scheme and thus have a higher psychological ownership of it.

Finally, the effects of some forms of participation on outcomes were mediated by psychological ownership whereas others were not. A potential explanation for this may lie in the fact that some forms of participation were more accepted than others, wherefore the communities engaged in them to differing extents. For example, households could decide whether to contribute materials, money, or labour to infrastructural upgrades. Participation in community meetings and election of water users' committee members were voluntary elements in the intervention. One practical implication of this finding is that interventions do not need to cover all forms of participation to promote psychological ownership. Instead, participatory activities that are guided by institutional frameworks, but are selected by the community itself may be more effective. Selection of participatory interventions could be coupled with assessment of users' needs and preferences for different water service attributes (e.g., choice experiments) and from there, the needs of the community become more clear and thus inform

the extent and type of participation. Like this, in-depth activation of participatory forms based on self-realization may prove to be most effective.

6.1. Limitations & future directions

The present study provided valuable first insights into the effects and mechanisms of participation on the use and maintenance of a shared resource, here safe water infrastructure. The results hint that psychological ownership can only be triggered by a few in-depth forms of participation. However, psychological ownership is found to relate beneficially to several positive safe water outcomes and negatively to hindering safe water outcomes. More research is needed to investigate the extent of generalizability to other shared resources. There are also some limitations to be acknowledged.

At baseline, we found that internal consistency of our measurement scale for psychological ownership was very low, compared to the originally validated measurement scale (i.e. van Dyne & Pierce, 2004). This could be due to the novel context of application. Future research should investigate validity and reliability of the psychological ownership measurement scale towards safe water infrastructure.

We used mediation analysis to show how participatory activities related to safe water outcomes by enhancing psychological ownership. However, psychological ownership did not fully mediate the effect of participation on safe water outcomes, and effect sizes were small. Future research should therefore investigate additional potential mediators. For example, participation may influence various outcomes for safe water supply by promoting people's concern about safe water consumption and consideration of future consequences (Bruderer Enzler et al., 2019; Kaiser et al., 1999).

Although this was the first intervention study of participation on outcomes via psychological ownership, the nonrandomized study design with purposeful assignment of communities to treatment and control group is a limitation; third-variable bias cannot be ruled out. In future research, a randomized controlled design should be used to replicate what we have found.

Another limitation is that we found very high psychological ownership at baseline. This may be explained by the previous activities of Helvetas in these communities. Helvetas works with communities in a very participatory way on an ongoing basis. Therefore, many participatory activities are regularly implemented in the communities, and the mechanism of action presented in this study can only assesses additional effects. Replication is therefore necessary in conditions with low previous participatory activity.

Finally, insufficient detailed descriptions were available to precisely code all intervention content. Therefore, the active ingredients of the intervention remain rather imprecisely defined. Future studies should emphasize the establishment of detailed implementation reports based on systematic description and reporting guidelines for interventions developed in behavioural science (Toomey et al., 2020).

7. Conclusion

This study used the example of water supply management to provide support for the assumption that participatory approaches can foster psychological ownership to achieve improved safe water supply. This is in line with application recommendations for means of implementation approaches as formulated in SDGs (e.g., SDGs 6b) for guaranteeing sustainable behaviour change and development. Even though we established psychological ownership as a mediating factor, we find that forms of participation differ in the extent to which they strengthen feelings of ownership and achieve safe water outcomes. This suggests that different forms of community participation might be important for different target resources. We recommend critical advance assessment of forms of participation and in-depth activation techniques to identify those relevant to effective community engagement.

Our findings extend previous findings, for example that psychological ownership enhances stewardship of public goods (Peck et al., 2021), and they can also be generalized to other community-managed systems and environments. We have identified psychological ownership as an additional factor in environmental psychology (Russell & Fielding, 2010) that can contribute to behaviour change for successful protection and sustainable management of shared resources and thus, to a beneficial environment for the individual and the community.

Author Statement

Benjamin Ambuehl: Investigation, Methodology, Data curation, Formal analysis, Software, Writing – original draft, Writing – review & editing, Bal Mukunda Kunwar: Investigation, Methodology, Writing – original draft, Writing – review & editing, Ariane Schertenleib: Investigation, Methodology, Project administration, Data curation, Writing – original draft, Writing – review & editing, Sara J. Marks: Conceptualisation, Methodology, Funding acquisition, Writing – original draft, Writing – review & editing, Jennifer Inauen: Conceptualisation, Methodology, Funding acquisition, Writing – original draft, Writing – review & editing.

Disclosure

This research was supported by the Swiss Agency for Development Cooperation (Project number 7F-09963.01.01) and this document is an output from the REACH programme funded by UK Aid from the UK Foreign, Commonwealth and Development Office (FCDO) for the benefit of developing countries (Programme Code 201880). However, the views expressed and information contained in it are not necessarily those of or endorsed by FCDO, which can accept no responsibility for such views or information or for any reliance placed on them.

There are no competing interests to report.

Acknowledgments

We thank the Helvetas staff (Madan Bhatta, Nirima Thapa), Helvetas enumerators (Netra Thama, Ramesh Yogi, Mahendra Adhikari, Ujir Singh, Meghraj Pandey, Lok Bohora, Mina Sunar, Lalita Bhandari, Chandra Dangi, Ganesh Bista, Satya Shahi, Mukesh Sharma), Carola Bänziger, and Vica M. J. Tomberge for their contributions to this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2022.101818.

References

Abbott, J. (1995). Community participation and its relationship to community development. *Community Development Journal, 30*(2), 158–168.

Adhikari, S., Kingi, T., & Ganesh, S. (2014). Incentives for community participation in the governance and management of common property resources: The case of community forest management in Nepal. *Forest Policy and Economics, 44*, 1–9.

Aga, D. A., Noorderhaven, N., & Vallejo, B. (2018). Project beneficiary participation and behavioural intentions promoting project sustainability: The mediating role of psychological ownership. *Development Policy Review, 36*(5), 527–546. https://doi.org/10.1111/dpr.12241

Agrawal, A., & Gupta, K. (2005). Decentralization and participation: The governance of common pool resources in Nepal's Terai. *World Development, 33*(7), 1101–1114.

Ambuehl, B., Tomberge, V. M. J., Kunwar, B. M., Schertenleib, A., Marks, S. J., & Inauen, J. (2021). The role of psychological ownership in safe water management: A mixed-methods study in Nepal. *Water (Switzerland), 13*(5). https://doi.org/10.3390/w13050589

Bain, R., Johnston, R., Mitis, F., Chatterley, C., & Slaymaker, T. (2018). Establishing sustainable development goal baselines for household drinking water, sanitation and hygiene services. Issue 12. In *Water (Switzerland), 10*. MDPI AG. https://doi.org/10.3390/w10121711.

Bänziger, C., Schertenleib, A., Kunwar, B. M., Bhatta, M., & Marks, S. J. (2021). Assessing microbial water quality, users' perceptions and system functionality following a

combined water safety intervention in rural Nepal. *Frontiers in Water, 3*, Article 750802. https://doi.org/10.3389/frwa.2021.750802
Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173–1182. https://doi.org/10.1037/0022-3514.51.6.1173
Bender, R., & Lange, S. (2001). Adjusting for multiple testing—when and how? *Journal of Clinical Epidemiology, 54*(4), 343–349. https://doi.org/10.1016/S0895-4356(00)00314-0
Beyer, F., Sidarus, N., Bonicalzi, S., & Haggard, P. (2017). Beyond self-serving bias: Diffusion of responsibility reduces sense of agency and outcome monitoring. *Social Cognitive and Affective Neuroscience, 12*(1), 138–145.
Bisung, E., Elliott, S. J., Schuster-Wallace, C. J., Karanja, D. M., & Bernard, A. (2014). Social capital, collective action and access to water in rural Kenya. *Social Science & Medicine, 119*, 147–154. https://doi.org/10.1016/j.socscimed.2014.07.060
Bonsor, H., MacDonald, A., Casey, V., Carter, R., & Wilson, P. (2018). The need for a standard approach to assessing the functionality of rural community water supplies. *Hydrogeology Journal, 26*(2). https://doi.org/10.1007/s10040-017-1711-0
Bravo, G., & Potvin, L. (1991). Estimating the reliability of continuous measures with cronbach's alpha or the intraclass correlation coefficient: Toward the integration of two traditions. *Journal of Clinical Epidemiology, 44*(4–5), 381–390. https://doi.org/10.1016/0895-4356(91)90076-L
van den Broek, M., & Brown, J. (2015). Blueprint for breakdown? Community based management of rural groundwater in Uganda. *Geoforum, 67*, 51–63. https://doi.org/10.1016/j.geoforum.2015.10.009
Brown, G., & Zhu, H. (2016). 'My workspace, not yours': The impact of psychological ownership and territoriality in organizations. *Journal of Environmental Psychology, 48*, 54–64. https://doi.org/10.1016/j.jenvp.2016.08.001
Bruderer Enzler, H., Diekmann, A., & Liebe, U. (2019). Do environmental concern and future orientation predict metered household electricity use? *Journal of Environmental Psychology, 62*, 22–29. https://doi.org/10.1016/j.jenvp.2019.02.004
Contzen, N., & Marks, S. J. (2018). Increasing the regular use of safe water kiosk through collective psychological ownership: A mediation analysis. *Journal of Environmental Psychology, 57*, 45–52. https://doi.org/10.1016/j.jenvp.2018.06.008
Deeks, J. J., Dinnes, J., & D'amico, R. (2003). Evaluating non-randomised intervention studies HTA health technology assessment NHS R&D HTA programme. Issue 27. In *Health technology assessment, 7* www.hta.ac.uk/htacd.htm.
Eldridge, S. M., Chan, C. L., Campbell, M. J., Bond, C. M., Hopewell, S., Thabane, L., & Lancaster, G. A. (2016). CONSORT 2010 statement: Extension to randomised pilot and feasibility trials. *BMJ, i5239*. https://doi.org/10.1136/bmj.i5239
Ferrero, G., Setty, K., Rickert, B., George, S., Rinehold, A., DeFrance, J., & Bartram, J. (2019). Capacity building and training approaches for water safety plans: A comprehensive literature review. *International Journal of Hygiene and Environmental Health, 222*(4), 615–627. https://doi.org/10.1016/j.ijheh.2019.01.011
Fischer, A., Hope, R., Manandhar, A., Hoque, S., Foster, T., Hakim, A., Islam, M. S., & Bradley, D. (2020). Risky responsibilities for rural drinking water institutions: The case of unregulated self-supply in Bangladesh. *Global Environmental Change, 65*. https://doi.org/10.1016/j.gloenvcha.2020.102152
Fritze, M. P., Marchand, A., Eisingerich, A. B., & Benkenstein, M. (2020). Access-based services as substitutes for material possessions: The role of psychological ownership. *Journal of Service Research, 23*(3), 368–385. https://doi.org/10.1177/1094670520907691
George, A. S., Mehra, V., Scott, K., & Sriram, V. (2015). Community participation in health systems research: A systematic review assessing the state of research, the nature of interventions involved and the features of engagement with communities. *PLoS One, 10*(10), Article e0141091. https://doi.org/10.1371/journal.pone.0141091
Han, T. S., Chiang, H. H., & Chang, A. (2010). Employee participation in decision making, psychological ownership and knowledge sharing: Mediating role of organizational commitment in Taiwanese high-tech organizations. *International Journal of Human Resource Management, 21*(12), 2218–2233. https://doi.org/10.1080/09585192.2010.509625
Harter, M., Inauen, J., & Mosler, H.-J. (2020). How does community-led total sanitation (CLTS) promote latrine construction, and can it be improved? A cluster-randomized controlled trial in Ghana. *Social Science & Medicine, 245*, Article 112705. https://doi.org/10.1016/j.socscimed.2019.112705
Harvey, P. A., & Reed, R. A. (2007). Community-managed water supplies in Africa: Sustainable or dispensable? *Community Development Journal, 42*(3), 365–378. https://doi.org/10.1093/cdj/bsl001
Hayes, A. F. (2012). *Process: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling*.
Inauen, J., Contzen, N., Frick, V., Kadel, P., Keller, J., Kollmann, J., Mata, J., & van Valkengoed, A. M. (2021). Environmental issues are health issues. *European Psychologist, 26*(3), 219–229. https://doi.org/10.1027/1016-9040/a000438
Inauen, J., Lilje, J., & Mosler, H. J. (2020). Refining hand washing interventions by identifying active ingredients: A cluster-randomized controlled trial in rural Zimbabwe. *Social Science & Medicine, 245*. https://doi.org/10.1016/j.socscimed.2019.112712
Jenny, A., Fuentes, F. H., & Mosler, H. J. (2007). Psychological factors determining individual compliance with rules for common pool resource management: The case of a Cuban community sharing a solar energy system. *Human Ecology, 35*(2), 239–250.
Jiang, M., Wang, H., & Li, M. (2019). Linking empowering leadership and organizational citizenship behavior toward environment: The role of psychological ownership and future time perspective. *Frontiers in Psychology, 10*. https://doi.org/10.3389/fpsyg.2019.02612
Jiménez, A., LeDeunff, H., Giné, R., Sjödin, J., Cronk, R., Murad, S., Takane, M., & Bartram, J. (2019). The enabling environment for participation in water and sanitation: A conceptual framework. *Water (Switzerland), 11*(2). https://doi.org/10.3390/w11020308
Jo, H., Aryee, S., Hsiung, H. H., & Guest, D. (2021). *Service-oriented high-performance work systems and service role performance: Applying an integrated extended self and psychological ownership framework*. Human Relations, 00187267211035656.
Kabir, A., & Howard, G. (2007). Sustainability of arsenic mitigation in Bangladesh: Results of a functionality survey. *International Journal of Environmental Health Research, 17*(3), 207–218.
Kaiser, F. G., Henn, L., & Marschke, B. (2020). Financial rewards for long-term environmental protection. *Journal of Environmental Psychology, 68*, Article 101411. https://doi.org/10.1016/j.jenvp.2020.101411
Kaiser, F. G., Wölfing, S., & Fuhrer, U. (1999). Environmental attitude and ecological behaviour. *Journal of Environmental Psychology, 19*(1), 1–19. https://doi.org/10.1006/jevp.1998.0107
Kamleitner, B., & Erki, B. (2013). Payment method and perceptions of ownership. *Marketing Letters, 24*(1), 57–69. https://doi.org/10.1007/s11002-012-9203-4
Kayaga, S. (2013). Effective water safety management of piped water networks in low-income urban settlements. *Journal of Water, Sanitation and Hygiene for Development, 3*(3), 402–410. https://doi.org/10.2166/washdev.2013.105
Khwaja, A. I. (2009). Can good projects succeed in bad communities? *Journal of Public Economics, 93*(7–8), 899–916. https://doi.org/10.1016/j.jpubeco.2009.02.010
Kwon, S. (2020). Understanding user participation from the perspective of psychological ownership: The moderating role of social distance. *Computers in Human Behavior, 105*, Article 106207.
Lee, J., & Suh, A. (2015). How do virtual community members develop psychological ownership and what are the effects of psychological ownership in virtual communities? *Computers in Human Behavior, 45*, 382–391. https://doi.org/10.1016/j.chb.2014.12.002
Liang, K.-Y., & Zeger, S. L. (1986). Longitudinal data analysis using generalized linear models. *Biometrika, 73*(1), 13–22. https://doi.org/10.1093/biomet/73.1.13
Liu, J., Wang, H., Hui, C., & Lee, C. (2012). Psychological ownership: How having control matters. *Journal of Management Studies, 49*(5), 869–895. https://doi.org/10.1111/j.1467-6486.2011.01028.x
Madajewicz, M., Tompsett, A., & Habib, M. A. (2021). How does delegating decisions to communities affect the provision and use of a public service? Evidence from a field experiment in Bangladesh. *Journal of Development Economics, 150*, Article 102609. https://doi.org/10.1016/j.jdeveco.2020.102609
Marks, S. J., & Davis, J. (2012). Does user participation lead to sense of ownership for rural water systems? Evidence from Kenya. *World Development, 40*(8), 1569–1576. https://doi.org/10.1016/j.worlddev.2012.03.011
Marks, S. J., Komives, K., & Davis, J. (2014). Community participation and water supply sustainability: Evidence from handpump projects in rural Ghana. *Journal of Planning Education and Research, 34*(3), 276–286. https://doi.org/10.1177/0739456X14527620
Marks, S. J., Kumpel, E., Guo, J., Bartram, J., & Davis, J. (2018). Pathways to sustainability: A fuzzy-set qualitative comparative analysis of rural water supply programs. *Journal of Cleaner Production, 205*, 789–798. https://doi.org/10.1016/j.jclepro.2018.09.029
Marks, S. J., Onda, K., & Davis, J. (2013). Does sense of ownership matter for rural water system sustainability? Evidence from Kenya. *Journal of Water, Sanitation and Hygiene for Development, 3*(2), 122–133. https://doi.org/10.2166/washdev.2013.098
Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M. P., Cane, J., & Wood, C. E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine, 46*(1), 81–95. https://doi.org/10.1007/s12160-013-9486-6
Miller, M., Cronk, R., Klug, T., Kelly, E. R., Behnke, N., & Bartram, J. (2019). External support programs to improve rural drinking water service sustainability: A systematic review. *The Science of the Total Environment, 670*, 717–731. https://doi.org/10.1016/j.scitotenv.2019.03.069
Murty, M. N. (1994). Management of common property resources: Limits to voluntary collective action. *Environmental and Resource Economics, 4*(6), 581–594.
Naiga, R., Penker, M., & Hogl, K. (2015). Challenging pathways to safe water access in rural Uganda: From supply to demand-driven water governance. *International Journal of the Commons, 9*, 237–260.
Palmer, R. N., Cardwell, H. E., Lorie, M. A., & Werick, W. (2013). Disciplined planning, structured participation, and collaborative modeling—Applying shared vision planning to water resources. *JAWRA Journal of the American Water Resources Association, 49*(3), 614–628.
Pare, G., Sicotte, C., & Jacques, H. (2006). The effects of creating psychological ownership on physicians' acceptance of clinical information systems. *Journal of the American Medical Informatics Association, 13*(2), 197–205. https://doi.org/10.1197/jamia.M1930
Paundra, J., Rook, L., van Dalen, J., & Ketter, W. (2017). Preferences for car sharing services: Effects of instrumental attributes and psychological ownership. *Journal of Environmental Psychology, 53*, 121–130. https://doi.org/10.1016/j.jenvp.2017.07.003
Peck, J., Kirk, C. P., Luangrath, A. W., & Shu, S. B. (2021). Caring for the commons: Using psychological ownership to enhance stewardship behavior for public goods. *Journal of Marketing, 85*(2), 33–49. https://doi.org/10.1177/0022242920952084
Pierce, J. L., & Jussila, I. (2010). Collective psychological ownership within the work and organizational context: Construct introduction and elaboration. *Journal of Organizational Behavior, 31*(6), 810–834. https://doi.org/10.1002/job.628

Pierce, Kostova, & Dirks. (2001). Toward a theory of psychological ownership in organizations. *Academy of management review*.

Pierce, J. L., Kostova, T., & Dirks, K. T. (2003). The state of psychological ownership: Integrating and extending a century of research. *Review of General Psychology, 7*(1), 84–107. https://doi.org/10.1037/1089-2680.7.1.84

Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research, 42*(1), 185–227. https://doi.org/10.1080/00273170701341316

Preston, S. D., & Gelman, S. A. (2020). This land is my land: Psychological ownership increases willingness to protect the natural world more than legal ownership. *Journal of Environmental Psychology, 70*, Article 101443. https://doi.org/10.1016/j.jenvp.2020.101443

Prokopy, L. S. (2005). The relationship between participation and project outcomes: Evidence from rural water supply projects in India. *World Development, 33*(11), 1801–1819.

Prüss-Ustün, A., Wolf, J., Bartram, J., Clasen, T., Cumming, O., Freeman, M. C., Gordon, B., Hunter, P. R., Medlicott, K., & Johnston, R. (2019). Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. *International Journal of Hygiene and Environmental Health, 222*(5), 765–777. https://doi.org/10.1016/j.ijheh.2019.05.004

Rickert, B., Schmoll, O., Rinehold, A., & Barrenberg, E. (2014). *Water safety plan: A field guide to improving drinking-water safety in small communities*. Geneva, Switzerland: WHO Press.

Rudmin, F. W., & Berry, J. W. (1987). Semantics of ownership: A free-recall study of property. *Psychological Record, 37*(2), 257–268. https://doi.org/10.1007/BF03394988

Russell, S., & Fielding, K. (2010). Water demand management research: A psychological perspective. *Water Resources Research, 46*(5). https://doi.org/10.1029/2009WR008408

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Sahoo, R., & Swain, M. (2013). Contribution of common property resources for sustainable rural livelihoods in Odisha: Prospects and constraints. *Journal of Rural Development, 32*(3), 245–261.

Shrestha, A., Sharma, S., Gerold, J., Erismann, S., Sagar, S., Koju, R., Schindler, C., Odermatt, P., Utzinger, J., & Cissé, G. (2017). Water quality, sanitation, and hygiene conditions in schools and households in Dolakha and Ramechhap Districts, Nepal: Results from A cross-sectional survey. *International Journal of Environmental Research and Public Health, 14*(1), 89. https://doi.org/10.3390/ijerph14010089

Shu, S. B., & Peck, J. (2018). Solving stewardship problems with increased psychological ownership. In *Psychological ownership and consumer behavior* (pp. 227–237). Springer International Publishing. https://doi.org/10.1007/978-3-319-77158-8_14.

Sloot, D., Jans, L., & Steg, L. (2018). Can community energy initiatives motivate sustainable energy behaviours? The role of initiative involvement and personal pro-environmental motivation. *Journal of Environmental Psychology, 57*, 99–106. https://doi.org/10.1016/j.jenvp.2018.06.007

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology, 29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

String, G. M., Singleton, R. I., Mirindi, P. N., & Lantagne, D. S. (2020). Operational research on rural, community-managed Water Safety Plans: Case study results from implementations in India, DRC, Fiji, and Vanuatu. *Water Research, 170*, Article 115288. https://doi.org/10.1016/j.watres.2019.115288

Suessenbach, S., & Kamleitner, B. (2018). Psychological ownership as a facilitator of sustainable behaviors. *Psychological Ownership and Consumer Behavior*, 211–225.

Sutherland, D., & Payden. (2017). Observations and lessons learnt from more than a decade of water safety planning in South-East Asia. *WHO South-East Asia Journal of Public Health, 6*(2), 27. https://doi.org/10.4103/2224-3151.213788

Tomberge, V. M. J., Harter, M., & Inauen, J. (2021). The importance of collective and individual psychological ownership for safe sanitation: A multilevel analysis in rural Ghana. *Global Public Health*. https://doi.org/10.1080/17441692.2021.1928260

Toomey, E., Hardeman, W., Hankonen, N., Byrne, M., McSharry, J., Matvienko-Sikar, K., & Lorencatto, F. (2020). Focusing on fidelity: Narrative review and recommendations for improving intervention fidelity within trials of health behaviour change interventions. *Health Psychology and Behavioral Medicine, 8*(1), 132–151. https://doi.org/10.1080/21642850.2020.1738935

van Dyne, L., & Pierce, J. L. (2004). Psychological ownership and feelings of possession: Three field studies predicting employee attitudes and organizational citizenship behavior. *Journal of Organizational Behavior, 25*(4), 439–459. https://doi.org/10.1002/job.249

Vlek, C., & Steg, L. (2007). Human behavior and environmental sustainability: Problems, driving forces, and research topics. *Journal of Social Issues, 63*(1), 1–19. https://doi.org/10.1111/j.1540-4560.2007.00493.x

Walters, J. P., & Javernick-Will, A. N. (2015). Long-term functionality of rural water services in developing countries: A system dynamics approach to understanding the dynamic interaction of factors. *Environmental Science & Technology, 49*(8), 5035–5043. https://doi.org/10.1021/es505975h

Whittington, D., Hanemann, W. M., Sadoff, C., & Jeuland, M. (2007). The challenge of improving water and sanitation services in less developed countries. *Foundations and Trends® in Microeconomics, 4*(6—7), 469–609. https://doi.org/10.1561/0700000030

WHO/UNICEF. (2021). Progress on household drinking water, sanitation and hygiene 2000-2020: Five years into the SDGs. In *Joint water supply, & sanitation monitoring programme*.

Woolcock, M., & Narayan, D. (2000). Social capital: Implications for development theory, research, and policy. *The World Bank Research Observer, 15*(2), 225–249. https://doi.org/10.1093/wbro/15.2.225

Yim, J. S.-C., Moses, P., & Azalea, A. (2019). Predicting teachers' continuance in a virtual learning environment with psychological ownership and the TAM: A perspective from Malaysia. *Educational Technology Research & Development, 67*(3), 691–709. https://doi.org/10.1007/s11423-019-09661-8