Journal of Development Economics 150 (2021) 102609

Contents lists available at ScienceDirect

Journal of Development Economics

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

Regular Article

How does delegating decisions to communities affect the provision and use of a public service? Evidence from a field experiment in Bangladesh[☆]

Malgosia Madajewicz[a,*], Anna Tompsett[b], Md. Ahasan Habib[c,d]

[a] Center for Climate Systems Research, Columbia University, New York, USA
[b] Stockholm University, Sweden
[c] NGO Forum for Public Health, Dhaka, Bangladesh
[d] KTH Royal Institute for Technology, Sweden

ARTICLE INFO

Keywords:
Community participation
Delegation of decisions
Elite capture
Drinking water

ABSTRACT

Most development practitioners would list engaging communities in the provision of public services among best practices for improving access. However, whether community participation enhances provision and use of public services relative to a non-participatory approach is largely unknown because few studies compare impacts when the same public service intervention is implemented with and without community participation. This field experiment compares three approaches to providing safe water in rural Bangladesh. Delegating decisions to the community increases use of safe water by about 80% relative to a top-down provider making the same decisions but only when the approach to delegating decisions limits elite influence.

1. Introduction

Inadequate access to public services undermines livelihoods around the world. Policy-makers and practitioners have embraced the view that participation by communities who use public services in the provision of those services has the potential to improve access (see, for example, World Bank, 2003). Communities have information about their needs, capacities, and constraints, and an interest in a good outcome that a service provider who is not based in the community may not have. Engagement can improve trust and acceptance of the project in the community. However, community participation could also have negative effects on governance of public services and other types of projects.[1] Most salient in our context, community elites may capture project benefits more easily in a participatory setting. Whether the advantages of community participation outweigh the disadvantages under any conditions remains largely unknown because few studies compare outcomes of a given intervention carried out with community participation to outcomes achieved when the same intervention is carried out with an approach that is not participatory.

This study uses a randomized control trial to evaluate whether delegating decisions to the community improves the outcomes of an intervention relative to outcomes attained when a top-down provider makes

☆ Funded by the National Science Foundation Grant 0624256 *DHB: Decentralization and Local Public Goods: How Does Allocation of Decision-making Authority Affect Provision?* The funder was not involved in any stage of the project. An earlier version of this paper was circulated under the title “Community participation in decision-making: Evidence from an experiment in safe drinking water provision in Bangladesh”. The randomized control trial (RCT) is registered with the AEA RCT Registry (AEARCTR-0003555). We thank Regina Dolgoarshynnikh, Ji Meng Loh, and Alexander Pfaff for their contributions as co-PIs on the grant that funded this work. We thank NGO Forum for Public Health for their partnership in undertaking this study, in particular Executive Director Mr S.M.A. Rashid. We also thank Alexander van Geen and Prosun Bhattacharya for their scientific inputs and support during the project. Kabid Ahmed, Md. Shamsul Karim, Fatema Tuz-Zohora, and Md. Rofirobi Uddin provided excellent research assistance. Thanks to Achyuta Adhvaryu, Andreas Madestam, Suresh Naidu, Eric Verhoogen, and seminar participants at Columbia University, Stockholm University, the Stockholm School of Economics, Örebro University, Oslo University, AEA, ASWEDE, CEPR-PODER, the N.G.O. Research Network Annual Workshop, and SIOE for helpful comments and suggestions. The authors alone are responsible for any remaining errors. Declarations of conflict of interest: none for Madajewicz and Tompsett, Habib declares that he is employed by the NGO Forum for Public Health, the partner NGO in the study.

* Corresponding author. 2880 Broadway, New York, NY, 10025, USA.
E-mail address: mm1174@columbia.edu (M. Madajewicz).

[1] Recent reviews of the positive and negative effects of community participation include Wong (2012), Mansuri and Rao (2013), King and Samii (2014), Wong and Guggenheim (2018), White et al. (2018) and Casey (2018).

https://doi.org/10.1016/j.jdeveco.2020.102609
Received 16 February 2020; Received in revised form 13 October 2020; Accepted 26 December 2020
Available online 20 January 2021
0304-3878/

the same decisions. Our intervention offers village communities the opportunity to install deep tubewells, which supply safe drinking water. Different parties decide the location of each well under three different approaches to decision-making. The location affects who can walk to the well and who can restrict the use of the well. For example, influential people can prevent other households from using wells located on their land. The outcome of interest is whether or not a household uses safe drinking water.

In this paper, the term “top-down” characterizes an approach in which a provider who is not part of the community makes decisions about a public service offered to a community. Top-down decision-making has been prevalent historically, and it remains common despite the promotion of participatory approaches. Even when non-profit, non-governmental organizations (NGOs) manage the delivery of public services, community engagement is often limited to informing or consulting community leaders, while the NGO makes project decisions (Mansuri and Rao, 2013). Any provider who is not part of the community can choose to make a particular decision in a top-down way or to delegate the authority to make the decision to the community. The provider who decides the location of wells in the top-down approach in this study is a NGO.

We compare the **top-down** approach to two participatory approaches to decision-making, which are designed to address the additional question whether limiting the influence of community elites affects the performance of the participatory approach relative to the top-down one. The influence of community elites on use of safe water depends on the extent to which elites are self-interested. Self-interested elites may capture project benefits if they limit access to a well by influencing the location of the well in their favor and/or if an elite household restricts access to a well placed on their land. In the **community participation approach**, the community organizes itself to decide the location of wells. The **regulated community participation approach** is a hybrid, in which the community decides the location but the top-down provider imposes two novel rules designed to limit potential elite capture and broaden participation in decision-making: (a) communities must decide locations in a meeting, which is subject to participation requirements that include women and low income households, and (b) decisions must be unanimous in order to be implemented. The rules explicitly address three different ways in which elites maintain influence: (1) they reduce elites’ ability to make decisions in secret, (2) they increase the number of people who participate in decision-making, and (3) they give all participants veto power.

The intervention increases the percentage of households who use safe drinking water under each of the three approaches to decision-making, relative to control villages, but the increase is largest when communities make decisions subject to rules that limit the influence of elites, under the regulated community approach. Use of safe drinking water increases by 27 percentage points in villages that are assigned to the regulated community approach, which is over 80% more than under the other two treatments and the difference is statistically significant. The increase is 14 percentage points in villages that are assigned to the top-down approach and an essentially identical 15 percentage points under the community participation approach. The two rules that we impose on decision-making in the regulated approach are not necessarily optimal, but they are sufficient to improve outcomes relative to an unrestricted participatory approach.

Communities install a similar number of new wells under all three approaches. Our evidence supports two possible reasons why the regulated approach nevertheless has a greater impact on use of safe water. Regulated communities (1) place the wells that they install through the project closer to more households, and they (2) may negotiate broader access to community wells installed by the project as well as existing and new privately owned safe wells. The third possibility is that negotiations that take place in community meetings under the regulated approach motivate more households to switch to safe wells, although we do not have evidence that confirms this explanation.

In regulated community villages, households switch to using safe water not only from the project wells but also from existing and new privately owned safe wells, while this does not occur under the other two approaches. Negotiations that result in installation of new community wells under the regulated approach may produce new agreements about use of private wells and/or may convince more households to switch to safe water.

The regulated community approach may place wells closer to more households and broaden access to wells installed by the project relative to the top-down approach for two reasons. First, communities may have better information than does the top-down provider. Second, communities may reduce elite capture more efficiently under the regulated approach than the top-down provider can. In the absence of information about who would allow access to a well if it were built on their land and with no way to monitor or enforce access after the well is built, the top-down provider’s strategy to avoid elite capture is to locate wells on public land whenever possible. However, placing wells on public land, which is scarce in Bangladeshi villages, may increase distance to the well. Communities may use local information and ability to enforce agreements about access to place wells closer to more households under the regulated approach, as data on distances to wells installed by the project show.

One reason why the regulated approach increases use of safe wells relative to the community approach appears to be that it restrains elite capture. In most community participation villages, a few influential individuals select locations that benefit them. More people participate in decision-making and contribute to funding wells under the regulated approach, and they seem to negotiate locations and/or access agreements that benefit more people.

The top-down and the community approaches produce similar outcomes but for different reasons. The top-down approach most likely has sparser information about local conditions, while elite capture appears to be more prevalent under the community approach. The comparison between the top-down and the community approaches may differ in other contexts, depending on the objectives of the top-down provider, the importance of local information, and the degree to which community elites pursue the public interest versus their own.

The regulated approach may increase welfare substantially more than do the other two approaches. We estimate the benefit of switching to a safe well to be US$625 per household over a ten-year, expected lifetime of a well based on the estimate of income gains due to improved health in Pitt et al. (2020). Accounting for increased distance that households walk when they switch to safe water in our study population reduces the benefit by US$100 for the regulated approach and by US$150–180 for the other two approaches. A much larger proportion of the population switches to safe water under the regulated approach, while differences in implementation costs between the three approaches are small.

Nevertheless, the large majority of participants express satisfaction with all three approaches to decision-making, though they consider the community participation approach to be less fair. Participants are more likely to report that they agree with decisions made under the top-down approach and perceive the approach to be more fair than the community participation approach, and they perceive both community approaches to favor influential persons more than the top-down approach. These results contrast with the literature, which notes that community participation may influence outcomes through greater acceptance of the project by the community (Mansuri and Rao, 2013) and that participation may improve satisfaction with the project even if it has no effect or even an adverse effect on outcomes (Alatas et al., 2012; Beath et al., 2017; Olken, 2010).

We implement a benevolent version of the top-down approach, in which the top-down provider seeks to maximize impact on use of safe water. Even in this case, we find that decision-making by the community results in a larger increase in use of safe water as long as the approach limits the influence of elites. In the presence of multiple, competing objectives, whether honest or corrupt, top-down provision may be even less effective.

In other contexts, an additional disadvantage of community participation in decision-making may arise because communities may lack the required scientific and/or technical expertise, as for example in Khwaja (2004). In our study, the project provides all necessary technical information under all three approaches.

In order to isolate the effect of the decision-making process, we hold all other aspects of the intervention constant across the three decision-making processes, including the approach to funding safe wells. Communities contribute a small proportion of the installation costs of each well, which is consistent with Bangladeshi national policy. The relative outcomes of the top-down and the participatory approaches to decision-making may be different if the top-down provider funds the full cost of each well in all three approaches, for example because more external funding may alter participation in decision-making (Gugerty and Kremer, 2008). Communities raise the contribution for similar number of wells under all three approaches, but more households contribute under the regulated and the top-down approaches than under the community approach.

The assignment of villages to decision-making approaches was random for all treated villages, while the assignment to treatment and control was random for 85% of the final sample.[2] Differences between treatment effects generated by the three approaches to decision-making have a causal interpretation because assignment of decision-making processes to treatment was random among all treated villages. Estimates of impacts attained by each approach relative to the control group represent the causal effects when we exclude the villages in the part of the study area where the problem occurred with randomization, and if conditions hold for the validity of a difference-in-difference estimator in the full sample. We estimate a difference-in-difference regression equation in samples with and without the villages in which assignment to treatment was not random and with and without the control villages. Both the comparison between decision-making processes and the estimates of impact relative to the control group remain almost identical whether or not we include villages that were not randomly assigned. The final sample focuses on villages in which deep tubewells are feasible. In villages in which hydro-geological conditions prevented the drilling of deep tubewells, the project could not provide safe water regardless of approach to decision-making.

The main contribution that this study makes to the literature on decentralizing governance of public services and other development projects to communities is that we compare the impacts of a public service program attained with participatory approaches to the impacts attained with a top-down approach, using a field experiment. There are few precedents in the literature. Olken (2007) uses an experiment to assess the level of corruption that results when communities are given incentives to monitor inputs into village roads and corruption that occurs when the government audits inputs. The results in Olken (2007) are quite different from ours. In Olken (2007), none of the participatory approaches are more effective than are government audits, although their performance improves when they limit elite capture. The results may differ because the benefits of community participation depend on the relative abilities of the top-down provider and the community to influence the outcomes of their decisions. In Olken (2007), communities may not be able to achieve better outcomes than the government if their ability to punish corruption is sufficiently weaker. In our study, communities may be able to use information and/or influence behavior in ways that the top-down provider cannot. The difference in results is particularly striking because we consider a top-down approach that is designed to maximize benefits to the community while Olken (2007) does not.

Two other experimental studies—Alatas et al. (2012) and Alatas et al. (2019)—ask how well non-participatory and participatory approaches target households who are below a pre-determined poverty line for a cash transfer program. They find that targeting by participatory approaches conforms less well to the pre-determined poverty line but results in higher satisfaction with the targeting process, because communities have a different conception of poverty. Alatas et al. (2019) conclude that the welfare cost of elite capture in transfer programs is small. The problem of local public good provision is a very different one from the problem of targeting individual cash transfers. The potential welfare costs of elite capture may be much more important. In our case, we do not find that communities express greater satisfaction with the participatory processes.

None of the remaining experimental studies[3] show whether the intervention that is implemented in a participatory way would have resulted in different outcomes if it had been implemented with a non-participatory approach. One group of studies compares outcomes of interventions carried out with community participation to a counterfactual in which there is no intervention, equivalent to our control villages.[4] Other studies compare outcomes obtained by increasing community participation in a pre-existing participatory process to a counterfactual with less participation,[5] or compare different participatory approaches to selecting development projects.[6]

The remainder of the paper is organized as follows. In section 2, we describe the problem with access to safe drinking water in Bangladesh that motivates the intervention. Section 3 describes the intervention. Section 4 uses a simple model to illustrate how different decision-making processes influence use of safe drinking water. We describe selection of study sites and assignment to treatment in section 5 and the data collection process in section 6. We verify randomization in section 7. We present the methodology in section 8. Section 9 compares impacts of the three decision-making approaches on use of safe drinking water. Section 10 shows that the results are robust to a number of alternative specification choices. Section 11 investigates why the three approaches to decision-making perform differently. Section 12 concludes.

2. Context

Education campaigns in the 1970s and 1980s in Bangladesh successfully encouraged people to switch from surface water, which is often contaminated with pathogens, to groundwater. However, in the 1990s high levels of naturally-occurring arsenic were discovered in the groundwater. Daily use of arsenic-contaminated water at the Bangladeshi safe water standard of 50 parts per billion (ppb) is associated with an additional 1 in 100 lifetime risk of cancer, rising to more than 1 in 10 for water that is highly contaminated (Smith et al., 2000).[7] The resulting epidemic of diseases associated with arsenic exposure in Bangladesh has been called “the largest poisoning of a population in history” (Smith et al., 2000).

In 2007, when this project began, more than 97% of households in our sample were using groundwater drawn from a tubewell, the majority of which were privately owned. In the study areas, 95% of wells have arsenic concentrations above 50 parts per billion (ppb). Village

[2] The villages that were not randomly assigned to treatment or control are all in one study area, in which the partner NGO mistakenly assigned all villages to treatment.

[3] Most of the evidence regarding the pros and cons of community participation is descriptive. Mansuri and Rao (2013) provide a review.

[4] Avdeenko and Gilligan (2015), Banerjee et al. (2010), Casey et al. (2012), Fearon et al. (2009, 2015), Humphreys, de la Sierra, and van der Windt (2019).

[5] Banerjee et al. (2010), Beuermann and Amelina (2018), Björkman et al. (2017), Björkman and Svensson (2009), Duflo et al. (2015), Pandey et al. (2009), Pradhan et al. (2014), Sheely (2015).

[6] Beath et al. (2017, 2018), Olken (2010).

[7] The Bangladeshi standard is itself five times higher than the WHO standard of 10 ppb.

residents strongly prefer wells to other sources, and use of contaminated wells persists despite widespread awareness of the arsenic problem. Among respondents to our baseline survey, 83% had both heard of arsenic and believed that water with high concentrations of arsenic was unsafe to drink; and another 15% said that they had heard of arsenic after the interviewer probed further.[8]

Determining the level of arsenic in water requires a chemical test. The Bangladeshi government has tested many but not all wells, and has marked the tested wells green if they are safe and red if they are not. In our sample, more than 90% of households believed that they knew whether the well they were using was safe or not.[9] Among households whose well status we were able to verify, 97% were correct about the well status at baseline, as we discuss further in Section 8.

Some households whose wells are unsafe use other households' safe wells. This is possible because the distribution of arsenic is not uniform. Even in densely inhabited village clusters, neighboring wells frequently have very different arsenic concentrations (see for example van Geen et al., 2002). In our sample, 51% of households collect water from unsafe sources at baseline,[10] even though 95% of tubewells are unsafe.

Safe water is a local public good. The great majority of privately-owned wells reach depths at which arsenic contamination is more likely (van Geen et al., 2003). Arsenic contamination declines with depth of the well. Wells that reach deeper, safe aquifers and other safe sources of water are much more expensive than the ubiquitous privately-owned wells. For the great majority of households whose own wells are unsafe or who do not own a well, safe water sources must be provided at the community level.

The study villages are primarily rural. The most common household occupation is farming. Around a third of households self-identify as poor or very poor, a third self-identify as low-income, and a third as medium or high income. Traditional hierarchical elites co-exist with elected leadership structures. Almost all communities (92%) report that some of their leaders become leaders because of wealth, land ownership, or hereditary status and almost all households (85%) identify community leaders who are landowners. Just under half of all communities (48%) report that some of their leaders are democratically elected, and just over half of all households (56%) identify a community leader who is democratically elected.

3. The intervention

We carried out the intervention between 2007 and 2011 in partnership with NGO Forum for Public Health (NGOF), a large Bangladeshi NGO that has more than 30 years of experience with safe water and sanitation projects. We began with an information campaign in all villages, treatment and control, designed to ensure that all were equally well informed about the arsenic problem. We then implemented the project sequentially, completing all steps in one cluster of neighboring villages at a time.

The following elements of the intervention were the same in all treatment villages:

Safe drinking water technology We offered the same safe water technologies in all treatment villages with the same hydro-geological conditions. The technologies included several types of tubewell, which are the most familiar and preferred sources of drinking water in this region. We offered alternatives where tubewells were not feasible, but the alternatives had significant disadvantages, which we elaborate in Appendix A1. Few communities chose to install alternatives.

Funding rule Each village had to contribute between 10% and 20% of the cost of each source and could install at most 2 or 3 sources of safe water, depending on the installation price, because of the project budget constraint.[11] The required contribution varied by type of technology and number of sources chosen because of the installation costs. Only those sources for which the community raised the contribution within 12 weeks were installed.

The funding rule necessarily implies that communities decide how many safe water sources they will install, up to the maximum number of offered sources, under each approach to decision-making.[12] The funding rule itself is constant across the three approaches to decision-making. Keeping the approach to funding constant is important because community members' decisions about water sources are likely to be influenced by investment of own money in addition to the effect of who is making the decision, which is the focus in this experiment (Mansuri and Rao, 2013). Community contribution requirements for rural water supply systems are national policy in Bangladesh. NGOs follow the policy. In addition, community contributions enable the project to serve more communities.

Community meetings The project held community meetings in all treatment villages, at which project staff explained that the project would offer sources of safe drinking water and outlined the conditions. The conditions depended on the approach to which the village was assigned. Project staff publicized the meetings in each village. Village residents decided whether or not to attend.

Technical information Project staff provided all technical information: identified feasible safe water technologies, tested the water after installation, and replaced problematic water sources. In the participatory approaches, the project staff determined whether sites selected by the communities would yield safe water. Otherwise, the communities chose different locations. The project staff managed the well installation under all three approaches because all communities preferred that the staff do so.

Field staff The same project staff implemented the project under all three decision-making processes.

Maintenance Residents were informed that they would be responsible for maintaining the safe water source in the future and for paying all maintenance costs.[13]

3.1. Decision-making processes

Different decision-makers had the authority to decide the location of the water source under the three approaches to decision-making. Different decision-makers also had the authority to decide the choice of technology but, in practice, all communities chose tubewells whenever possible. We informed each community about the process for the specific decision-making approach that was allocated to the village during the community meeting that we organized in each treatment village.[14]

The top-down process (TD) The top-down provider, in our case NGOF staff to whom we also refer as project staff, makes all decisions with the one exception that community members decide how much they

[8] We conducted an information campaign about arsenic before the baseline survey but very few households reported that they first heard about the arsenic problem from our campaign.

[9] 92% of households at baseline; 99% at follow-up.

[10] Most of these households are using unsafe tubewells. In the sample, 39% of households use unsafe tubewells, 8% of households use tubewells of unknown safety, and 2% use other unsafe sources, primarily surface water.

[11] See Table A1 in Appendix A1 for details.

[12] The top-down provider could decide the number of sources in the TD approach only if the top-down provider fully funded the sources of water, which would have to be the case in all three decision-making processes in order to keep the approach to funding constant across the three decision-making processes. We did not have sufficient resources to randomize both the approach to funding and the approach to decisions about location.

[13] The time period of our grant did not allow us to fund maintenance. Most development projects, not only research projects, are unable to fund long-term maintenance. Replacement parts are widely available at low cost for standard deep tubewells.

[14] We did not inform residents that the process would be different in other villages, although some learned of the differences.

will contribute to fund the sources of water. The NGOF staff strove to maximize impact on use of safe drinking water. In each village, the staff collected information from the community and by observation about locations of existing safe water sources relative to locations of households. The staff then decided which types of water sources would be installed and where they would be located. They presented each selected location at the community meeting as a take-it-or-leave-it offer. NGOF only installed those of the offered sources for which the community raised the contribution.

The community participation process (CP) delegates decisions about the types of water sources and where the sources should be located to the community. Communities had a period of 1–2 weeks to make these decisions. Project staff did not impose any rules about how decisions should be made.

The regulated community participation process (RCP) allows the community to decide the types and locations of water sources but the project staff impose two rules to limit elite influence:

1. The community has to make decisions in the community meeting organized by the project, which should be attended by a minimum of 20 people, with a minimum of 5 low-income women, 5 low-income men, 5 higher-income women, and 5 higher-income men.
2. The decisions have to be unanimous.

The RCP is the only approach in which the community-wide meeting served to decide well locations. Under the RCP approach, villages held as many community-wide meetings as were needed to reach consensus or to decide to stop the process, although most communities finalized the decisions in a single meeting.[15] The project staff monitored compliance with the rules: they ensured that the attendance requirements were met, that people were allowed to participate, and that only unanimous decisions were implemented.

The staff held four preliminary meetings in each RCP village in order to motivate groups that are typically excluded from community decision-making in Bangladesh to participate. Women and low-income people are likely to choose not to participate even if their participation is allowed because their opinions are typically disregarded and they may even fear repercussions if they voice views that are different from the views of the elites. Field staff met with each of the following groups separately: low-income women, higher-income women, low-income men, and higher-income men. Village residents who self-identified as belonging to the relevant groups decided whether or not to attend.

4. A simple model of decision about well location

We use a highly simplified model, which focuses on the decision where to locate the tubewells, to illustrate several mechanisms that result in different use of safe drinking water and welfare under the three approaches to decision-making. The model presents one case, consisting of a particular community geography and reasonable assumptions about land ownership and preferences.

The simple community geography in our model consists of a triangle with side length d with an elite household residing at one vertex, two non-elite households at another vertex, and a plot of public land at the third vertex, as shown in Fig. 1. Each household owns a plot of land, and each plot of land, including the public land, can accommodate a community well. A household can restrict access to a well built on their own land. No one can restrict access to a well built on public land. Under the status quo, each of the three households uses a private, unsafe well, which is located on their own land.

The decisions proceed in the model as in the project. The top-down provider decides which of the three decision-making approaches described in the previous section governs the process of installing a community well. Next, either communities or the top-down provider decide where to locate a well, depending on the approach. Then landowners decide whether or not to allow other households to access a well that is located on their land, and households decide whether or not to use a well. First, we determine which households use a well in a given well location. Second, we investigate how the approach to decision-making influences the location of the well.

[15] At least one community held three meetings before making decisions.

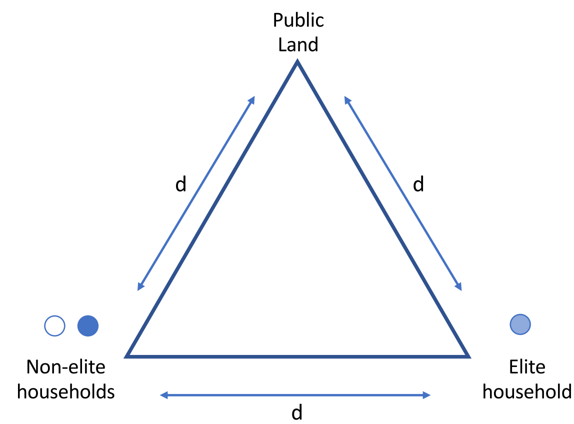


Fig. 1. Idealized community geography.

Installing a safe well yields the following payoff for each household i:

$$V_i = \alpha_i - \delta_i - \gamma_i + \theta_i \sum_{j \neq i} U_j \quad (1)$$

where:

$$U_j = \alpha_j - \delta_j - \gamma_j$$

$$i, j = e, nea, nee$$

$$\alpha = \begin{cases} a > 0, & \text{if a household adopts a safe well} \\ 0, & \text{otherwise} \end{cases}$$

$$\delta = \begin{cases} d > 0, & \text{if a household uses a well that is located at another vertex} \\ 0, & \text{otherwise} \end{cases}$$

$$\gamma = \begin{cases} g > 0, & \text{if others use a well located on the household's own land} \\ 0, & \text{otherwise} \end{cases}$$

$$\theta_i \geq 0$$

The term α captures the benefit of adopting a safe well, through improved health and potentially higher income, relative to the status quo of using an unsafe well. The parameter δ measures the travel cost to the well. Landowners incur a disutility cost $\gamma = g$ if a well is built on the household's own land and other households use the well, because the household has to accommodate frequent presence of well users on their land. The term θ_i is an altruism parameter. If $\theta_i > 0$, then the household i cares about the payoffs to the other households, denoted j. Although we label θ_i an altruism parameter, it could also capture strategic interest in others' welfare, for example because households wish to secure the future support of other households. For tractability, we assume that altruistic households only care about the private dimensions of other households' payoff functions, denoted U_j. The subscript i takes value e for the elite household, and nea or nee for two types of non-elite households, as we explain below.

We assume that one non-elite household has a high θ_i, and therefore allows other households to use a well that is built on their land, while the other non-elite does not care at all about others' utility, i.e. has $\theta_i = 0$. A household whose $\theta_i = 0$ excludes others from using a well built on their land because the payoff a obtained when the household excludes others is always larger than $a - g$, the payoff that results when the household allows others to access the well. Households allow access to a well that is on their land when their utility gains from allowing access exceed g, the utility cost of letting others use the well, which happens when $\theta_i > \frac{g}{2a-d} = \overline{\theta}_{ne,12}$. We refer to non-elites as either allowing access to a well on their land, for $\theta_{nea} > \overline{\theta}_{ne,12}$, or excluding others, for $\theta_{nee} = 0$.[16]

The private payoff to a household who uses a well built on someone else's or public land is $a - d$. We assume that $a > d$, so that households always adopt a safe well if they are allowed to access the well. Further, we assume that $d > g$, which implies that a purely selfish household, whose $\theta_i = 0$, would prefer to install the well on their own land and incur the disutility cost of allowing access rather than walk to a well located at another vertex.

Each household knows the payoff functions of the other households, including how altruistic every other households is. Also, each household knows the community geography.

The location of the well depends on the decision-making process. Table 1 shows the five possible outcomes to which we refer in the discussion below. Each outcome is associated with a payoff to each of the households and to a value of social welfare. Considering only the private dimensions of households' payoff functions, total social welfare is[17]:

$$W = \sum_i U_i \tag{2}$$

The outcome that maximizes social welfare places the well on the land that belongs to the non-elite who allows access. This location also minimizes the sum of all households' distances to the well.

The community participation process If the top-down provider applies the CP approach to decision-making, we assume that the elite household chooses the well location to maximize their own payoff, denoted V_e. The assumption that the elite selects the outcome in the CP approach is simplistic, but it seems to capture well the decision-making process in the project villages. Respondents in each focus group discussion in a CP village mentioned that influential individuals chose the well locations in small meetings. This is consistent with evidence that most Bangladeshi village communities have highly hierarchical social structures (Lewis and Hossain, 2008). A small number of influential men generally comprise the elected village councils and dominate community decisions. Women and lower income households rarely participate in public decision-making.

The location that the elite household chooses depends on the household's altruism parameter. If θ_e is sufficiently low, the household chooses to place the well on their own land and they do not allow other households to use the well (outcome 2 in Table 1). If θ_e is sufficiently high, the elite places the well on the land that belongs to the non-elite who allows access, which is the welfare-maximizing outcome. For some values of parameters a, d, and g, an intermediate range of altruism may exist such that the elite installs the well on their own land and allows other households to use the well.[18] We illustrate the outcomes in Fig. 2a for the case in which the range of θ_e for which the elite chooses outcome 1 does exist.

The regulated community participation process If the top-down provider follows the RCP process to install the well in the community, we assume that the elite household proposes the initial allocation since this is likely to be the case in practice. Each non-elite household can veto the proposal made by the elite household. The community cannot install any allocation unless all households agree to it.

We assume that a household who uses their veto receives an additional private payoff R, which may be positive or negative. The payoff R may be positive because the non-elite household may derive some net benefit from using their veto, for example, because they expect that rejecting an unfair offer will discourage future selfish behavior or because they gain utility from punishing unfair behavior.[19] Alternatively, a positive payoff from using the veto could be motivated with a more complex model, in which we allow repeated, alternating offers and the length of the game is indeterminate; in each period there is a probability that the game continues for one more period. In this case, using a veto may secure a better offer. The payoff R may be negative for example because the elite can punish the non-elite household in the future for using the veto. We assume that R is no larger than the minimum payoff that a non-elite household would receive in the welfare-maximizing outcome, which is a.[20] We assume that all households know the value of R and, for simplicity, that it is the same for both non-elite households. The elite household will make an offer that gives payoffs that are no less than R to each non-elite household. Otherwise, a non-elite household will veto the offer and no well will be built, and the elite household anticipates the veto.

The elite household selects the option that maximizes their own payoff among the set of options that will be accepted by the non-elites. If R is sufficiently high ($R > \overline{R} = a - d$), the elite will offer outcome 3 regardless of the value of θ_e because the non-elite will veto any other offer.

If $0 < R \leq \overline{R}$, the outcome depends on θ_e. An elite whose θ_e is low enough that they would choose outcome 2 under the CP approach will offer outcome 3 under the RCP approach. This household cannot offer to install the well on their own land because they cannot credibly commit that they will allow access to the well, and the non-elites will veto the offer. An elite whose θ_e is such that the elite would choose outcome 1 in the CP approach will also offer outcome 1 in the RCP approach. An elite whose θ_e is high enough that they would offer outcome 3 in the CP approach will also offer outcome 3 in the RCP approach, regardless of the value of R. If $R < 0$, implying that using the veto is costly to

[16] Assuming that the non-elite household who would exclude others has $\theta_i = 0$ simplifies the notation, but the results are qualitatively identical if we assume a low θ_i such that $0 \leq \theta_{nee} \leq \overline{\theta}_{ne,12}$.

[17] See, e.g., Johansson (1992).

[18] The thresholds that define the ranges of θ_e in which the elite chooses different outcomes depend on parameters a, d and g. The range of θ_e in which the elite chooses outcome 1 exists if the threshold above which the elite prefers outcome 1 to outcome 2, $\overline{\theta}_{e,12} = \frac{g}{2a-2d}$ is less than the threshold above which the elite prefers outcome 3 to outcome 1, $\overline{\theta}_{e,31} = \frac{d-g}{2d-g}$. In this case, elite chooses outcome 2 if $\theta_e \leq \overline{\theta}_{e,12}$, outcome 1 if $\overline{\theta}_{e,12} < \theta_e < \overline{\theta}_{e,31}$, and outcome 3 if $\theta_e > \overline{\theta}_{e,31}$. Note that the threshold above which the household allows others to use the well on their land is different for non-elites than for elites. A non-elite household with the same value of θ_i as an elite-household may allow access even if the elite does not because the sum of distances walked to the well is smaller if the well is on non-elite land than if it is on elite land, resulting in a larger benefit to other households who are using the well. If $\overline{\theta}_{e,12} > \overline{\theta}_{e,31}$, then the elite chooses outcome 2 if $\theta_e \leq \frac{d}{2a-g} = \overline{\theta}_{e,32}$ and outcome 3 if $\theta_e > \overline{\theta}_{e,32}$.

[19] The setting closely resembles the Ultimatum Game, in which players frequently reject unfair offers, suggesting some positive payoff to using veto power in that context (for example see Thaler, 1988).

[20] The assumption rules out the possibility that the non-elite households will veto the welfare-maximizing outcome. In the welfare-maximizing outcome (3), $V_{nee} = a$ and $V_{nea} \geq a$, because the assumption that characterizes the non-elite who allows access, θ_{nea}, is that they prefer to allow access than to exclude others from using the well.

Table 1
Payoff matrix.

Outcome	Land	Accessible	V_e	V_{nee}	V_{nea}	W
1	Elite	Yes	$a-g+\theta_e(2a-2d)$	$a-d$	$a-d+\theta_{nea}(2a-g-d)$	$3a-g-2d$
2	Elite	No	a	0	$\theta_{nea}a$	a
3	**Non-elite, allows access**	**Yes**	$a-d+\theta_e(2a-g)$	a	$a-g+\theta_{nea}(2a-d)$	$3a-g-d$
4	Non-elite, excludes	No	$\theta_e a$	a	$\theta_{nea}a$	a
5	Public	Yes	$a-d+\theta_e(2a-2d)$	$a-d$	$a-d+\theta_{nea}(2a-2d)$	$3a-3d$

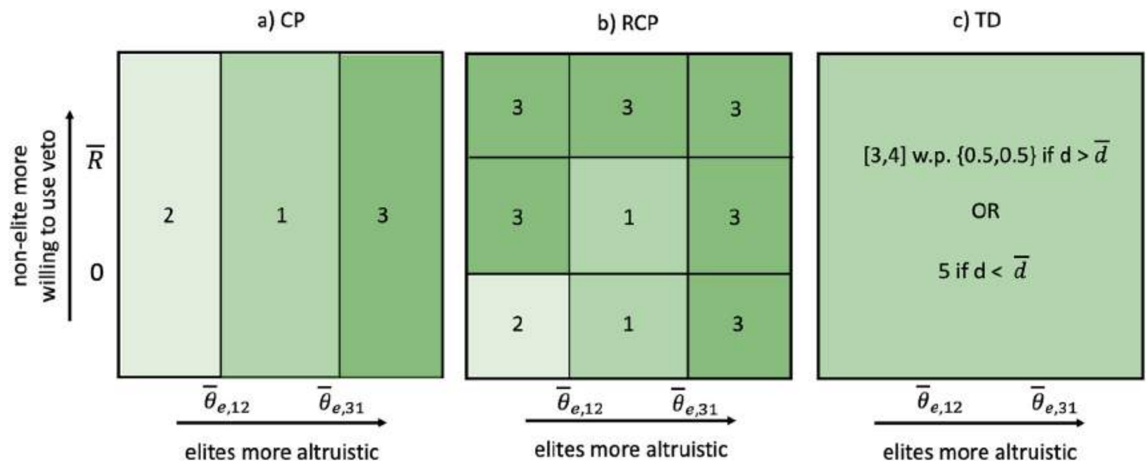


Fig. 2. How outcomes vary with community characteristics under different decision-making processes.

the non-elite household, the outcomes are the same as under the CP approach. Fig. 2b illustrates.

The top-down process If the top-down provider uses the TD process, the top-down provider chooses the location for the well that maximizes social welfare subject to the constraint that, unlike the households, the top-down provider does not know how altruistic any landowner is. The provider knows the geography of the village: where each plot of land is and whether it belongs to an elite, a non-elite, or is public. For simplicity, we assume that the provider believes that each household, elite and non-elite, is sufficiently altruistic that they will allow others to use a well located on their land with probability 0.5. A household whose θ_i is low enough that they will exclude other households from using a well may strategically misrepresent themselves as altruistic to the provider.

The provider can ensure access to the well only by installing the well on public land, which results in the greatest sum of distances to the well. The provider installs the well on public land if the distance to public land is not too large, if d is less than or equal to a threshold value $\bar{d} = \frac{2a+g}{5}$. If $d > \bar{d}$, the provider installs the well on land that belongs to a non-elite household, even though there is a 50% chance that the landowner will not allow access to other households.[21]

Fig. 3 summarizes the differences in welfare between outcomes under the three decision-making approaches in our model.[22] The RCP approach results in greater welfare, because more households use safe drinking water and/or the total distance to the new well is smaller, than the CP approach when elites are self-interested and communities are willing to use their veto rights and yields the same outcomes otherwise. The RCP approach performs better than the TD approach if elites are altruistic and/or communities are willing to veto selfish offers, but worse if elites are self-interested and communities are reluctant to use the veto. For intermediate values of elite altruism and willingness to use the veto, the comparison between the RCP and TD processes depends on the strategy employed by the top-down provider. The CP approach performs worse than the TD approach when elites are self-interested but better when they are altruistic, though the comparison depends on the TD strategy for intermediate values of altruism. When the RCP or the CP approach yields greater welfare than the TD approach, it may also result in greater number of households who use safe water if the TD approach places the well on the land of the non-elite who excludes.

The model illustrates several mechanisms that result in different outcomes under the three approaches to decision-making. Lack of information about landowner types prevents the top-down provider from choosing the welfare-maximizing location. If the top-down provider had the same information as the community, they would select outcome 3. Under the information constraints, the top-down provider is more likely than are the communities to install the well on public land, which is the only location to which all three households have to walk. The location of public land in the model illustrates the fact that public land is scarce in densely inhabited Bangladeshi villages and therefore the well may be far from many households. More generally, the top-down provider may also have less information than households do about community geography, which location is closest to most households who do not have safe water, as well as how far households may be willing to walk.

The outcome that the communities can achieve depends mainly on how altruistic the elites are, illustrating the potential problem of elite capture. Elite capture, which occurs in the model when an elite household installs the well on their own land, occurs in most states of the world in the model under the CP approach. The RCP process can reduce elite capture because communities who are willing to use the veto can constrain a self-interested elite to propose well locations that are more accessible than their own land would be. The TD approach also reduces elite capture, but unlike the RCP approach, it does so at the cost of

[21] The top-down provider prefers option 5 with certainty over a lottery consisting of options [3, 4] with probability {0.5, 0.5} if $d \le \bar{d}$. Under our assumptions, the provider prefers a lottery over options [3, 4] to a lottery with the same probabilities over options [1, 2].

[22] In the comparison of RCP and CP approaches to the TD approach, we compare each outcome under the RCP and CP to expected welfare if the top-down provider installs the well on private land and to welfare if the top-down provider installs the well on public land.

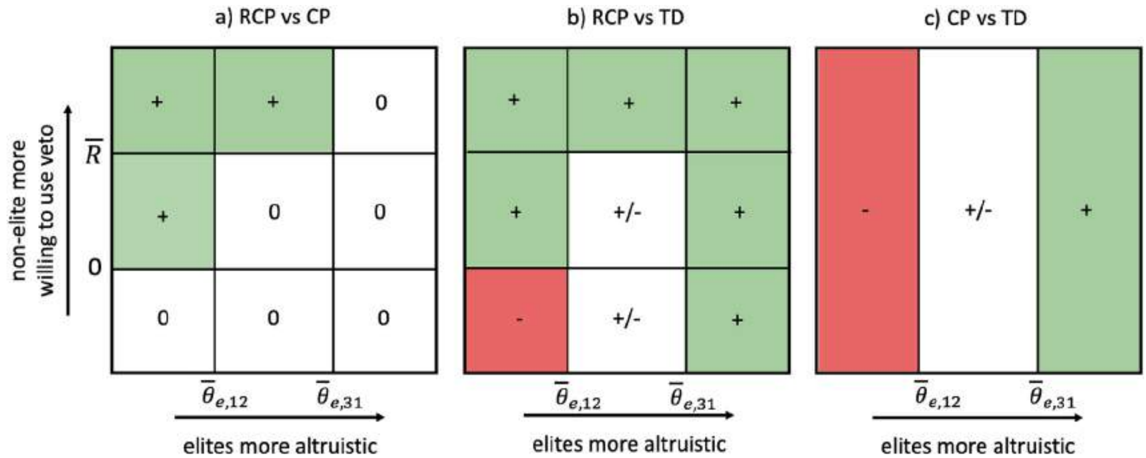


Fig. 3. Summary of differences in welfare between decision-making processes.

placing wells farther away, on public land. The RCP process uses community information to place wells in closer but still accessible locations. The RCP approach does not eliminate elite capture because communities may not be willing to use the veto. The TD process does not eliminate capture of the well because it places wells on private land that may belong to a self-interested household if public land is too far.[23]

The simple model abstracts from a number of features of the context. The results that the welfare maximizing well location is on non-elite land and that the top-down provider installs the well on non-elite land if they install the well on private land are not general for two reasons. First, elite households are likely to be wealthier than non-elites, and they are likely to own more land. A community well requires more space than does a private well because of the traffic to use the well, and a safe well has a larger footprint than does an unsafe one. Non-elite households may be less likely to own sufficient land to install a safe community well. Building a community well on their own land was problematic for some non-elite households during our project. In a simple extension in which the non-elite who allows access may not own sufficient land to install a well, placing the well on elite land or on public land become welfare maximizing locations in some states of the world. Also, the welfare maximizing location may be on elite land for more complex community geographies. The trade-offs between the three approaches to decision-making are not unique to the specific case that we consider.

In general, the problem of elite capture may result both from the landowner's type and the ex post moral hazard problem. Communities may be able to reach and enforce agreements that would secure access to a well even when the landowner has an incentive to restrict access ex post. Such agreements might be based on the repeated transactions in which community members engage such as employment transactions and/or elites needing non-elites' votes in elections. The top-down provider cannot influence the behavior of a landowner once a well has been placed on private land. Such enforceable agreements might help to explain why the RCP approach achieves a greater increase in use of safe water. Also, in general, the outcomes under the CP and RCP approaches will result from bargaining, and the set of community members who participate in bargaining may be different under the two approaches because of the rules in the RCP approach.

A possible extension of the model could include the requirement that communities contribute funding in order to install a well. Such a model might also incorporate a disutility that a household incurs when they use a well on someone else's land, which could decline with the household's contribution of funding to the well. The relationship between the number of contributors and the number of households who use the well would be ambiguous. Households would contribute to a well only if they expect to use it or if they expect others whose welfare they care about to use it. Therefore, a large number of contributors implies that many households feel confident that they can use the well. However, a small number of contributors does not imply that few households expect to use the well. Elite households may pay the full contribution for a well that other households will use, either for altruistic reasons or, if the well is built on non-elite land, to reduce the disutility associated with using a well on someone else's land.

5. Selection of study sites and random assignment

We selected 250 villages randomly, 125 villages in Gopalganj and 125 villages in Matlab upazilas (subdistricts), from a wider population of villages in which at least 65% of wells had unsafe levels of arsenic in Matlab and at least 75% of wells had unsafe levels of arsenic in Gopalganj.[24] Both upazilas had severe arsenic contamination and no other major interventions that were addressing the problem.[25] Fig. 4 shows the two upazilas on a map of arsenic contamination in Bangladesh.

The original plan allocated 150 villages to treatment, defined as being offered safe water sources, and 100 villages to control. However, before we assigned villages to treatment, the cost of water source installation increased. We reduced the number of villages allocated to treatment by a total of 23,[26] resulting in a total of 127 villages assigned to treatment, 57 in Matlab and 70 in Gopalganj, and 100 villages assigned to control, 50 in each upazila.

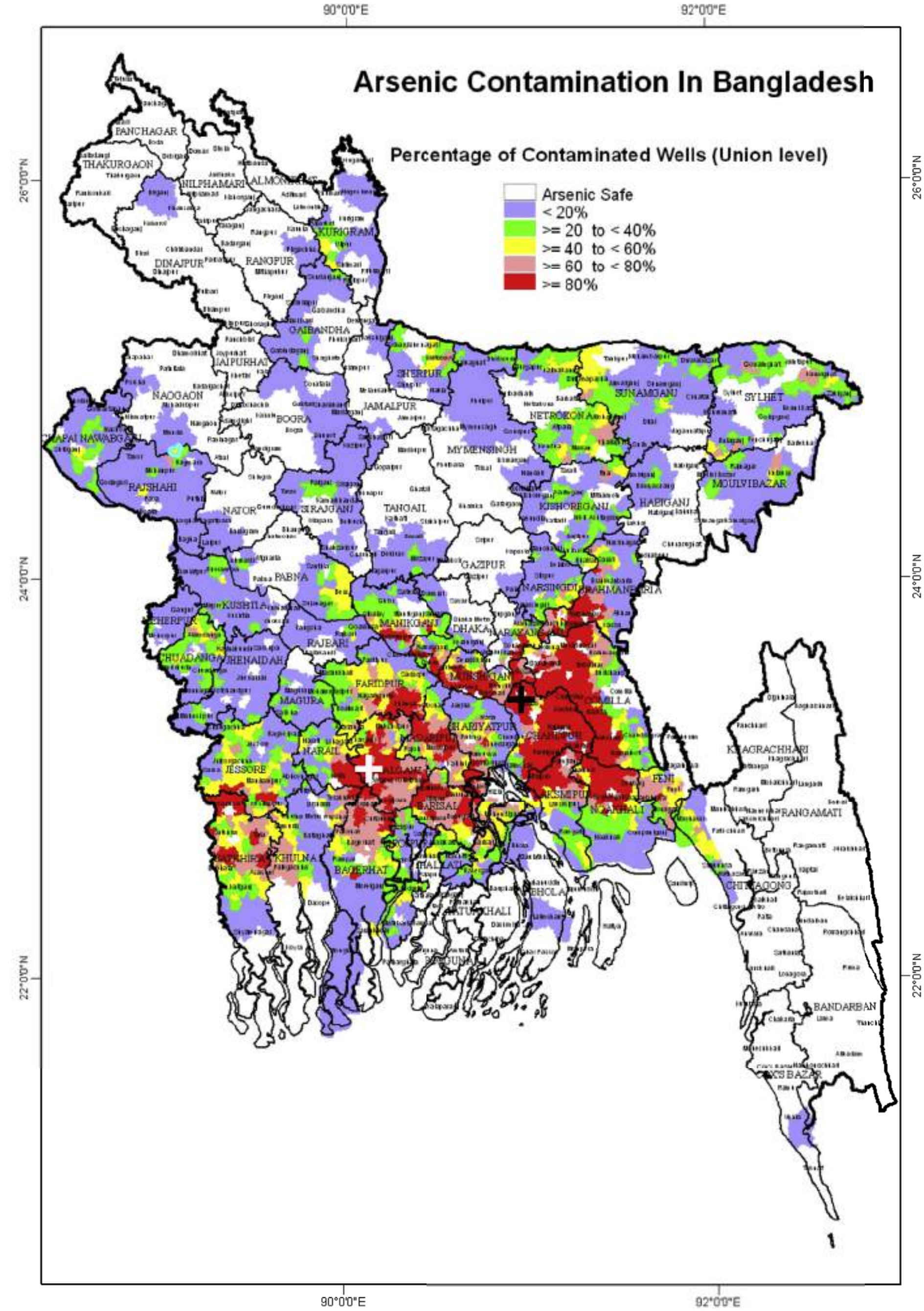
We stratified assignment to treatment and to decision-making processes by upazila. We sorted the original 125 villages in each upazila alphabetically using Anglicized spelling of Bengali names according to the Latin alphabet, not the original Bengali alphabet. We then assigned every nth village from the list in each upazila to treatment, control, and to be excluded from the study in order to reduce costs, where $\frac{1}{n}$ is the fraction of villages assigned to each group. Subsequently, we assigned every third village to each decision-making approach within the sample

[23] In the simple model, the top-down provider does not place a well on elite land, so there is no elite capture per se, but they may place a well on the land of a self-interested non-elite household who will exclude others. Under other parameter values and geographies, the top-down provider may place a well on land that belongs to an elite household who may be self-interested, resulting in elite capture.

[24] We further excluded three unions in which other organizations were working and two unions in which the government had responsibility for wells.

[25] We used data on arsenic contamination of pre-existing tubewells from the Bangladesh Arsenic Mitigation Water Supply Project to identify locations.

[26] Appendix A2 provides details.



White and black crosses mark Gopalganj and Matlab upazilas, respectively. Reproduced with permission from van Geen et al. (2006).

Fig. 4. Arsenic contamination in Bangladesh and study sites (van Geen et al., 2006).

of treated villages in each upazila. This list randomization approach was standard during the early years of randomized control trials, when we were implementing the experiment (see e.g. Miguel and Kremer, 2004). Any concern that other organizations could use similar lists to prioritize other programs should be mitigated by several considerations. As noted above, no other programs were addressing arsenic contamination issues in our study areas. Furthermore, there are several different ways to Anglicize each name, with no standard approach. The likelihood that other programs selected the same set of villages with severe arsenic contamination for reasons other than arsenic contamination, selected the same fraction of villages for treatment as would have to be the case for the chosen villages to be the same, and used the same approach to Anglicizing the names is extremely low.

Random assignment to decision-making approaches was implemented correctly for all treated villages. Random assignment to treatment was also correctly implemented in the majority of study villages, with the exception of one part of the Matlab study area, South Matlab. The project director in Bangladesh at the time mistakenly followed a different plan, which allocated all villages in South Matlab to treatment. The motivation for this plan was to reduce project costs. Well installation in South Matlab was less expensive than elsewhere, because shallower tubewells could provide safe drinking water. The plan followed the procedure described in the previous paragraph to assign villages in North Matlab randomly to treatment, to control and to be excluded from the project for the purpose of cost reduction. As with the rest of the study area, assignment to decision-making processes was correctly randomized after assignment to treatment.

We were unable to install tubewells because of hydro-geological conditions in 19 villages in Gopalganj. We exclude the 19 villages in which deep tubewells are not feasible because all but a few communities reject all other safe water technologies regardless of the approach to decision-making, meaning that the experiment is uninformative about differences in project impact under different approaches to decision-making.[27] The reason why village residents reject alternative technologies seems to be the performance of those technologies.[28] The three decision-making approaches are equally represented in the 19 villages: 7 under the TD process, 6 under the CP process, and 6 under the RCP process. Excluding these villages leaves a total of 108 villages in the treated group.

The hydro-geological condition which prevents tubewell installation is a rock layer that overlies the deep arsenic-safe aquifer and cannot be penetrated by local well-drilling technology. The presence of the rock layer and other village characteristics are spatially correlated, although villages assigned to treatment in which tubewells are feasible and those in which tubewells are not feasible are only marginally more different from control villages with respect to baseline characteristics than are both of these groups combined. In our main analysis, we use a spatially-matched control group in Gopalganj.[29] Using the spatially-matched control group is conservative. The point estimates are almost identical but yield slightly smaller p values if we use the full control group instead, as we show in Table 5.

In addition, we lost baseline data for one control village and one village treated under the CP process. The final treatment sample of villages in which tubewells are feasible and for which we have both baseline and follow-up data consists of 107 villages, 56 villages in Matlab and 51 in Gopalganj, with 36 villages assigned to the TD approach, 36 to the RCP approach, and 35 villages assigned to the CP approach. The final number of villages in the matched control group sample for which we have both baseline and follow-up data are 84, 49 villages in Matlab and 35 villages in Gopalganj. Fig. 5a and b map the study villages in the final sample. Fig. 6 illustrates the process of sample selection.

With this final sample, our study is powered to detect differences between each treatment arm and the control group of 0.23 standard deviations at the 10% level with 80% power and differences between any two treatment arms of 0.28 standard deviations. These effects correspond to, respectively, a 12 percentage point and a 15 percentage point difference in change in use of safe drinking water.[30] We did not pre-register the study nor did we pre-specify the analysis. Neither of these practices was common before 2007, when we began this study. We post-registered the study with the AEA RCT registry at a later date.

6. Description of data

We carried out a baseline survey in 2007 in all 250 original villages, after the information campaign about arsenic but before any other project activities began. We surveyed 40 households in each of the study villages except in a small number of villages that had fewer than 40 residents.[31] The baseline questionnaire included detailed information about awareness of the arsenic problem, the water sources used by the household, household characteristics, including proxy measures of a household's socio-economic status such as assets owned, materials with which the house was built, access to electricity, and ownership of a sanitary latrine, and the household's social networks and relationship to the village community.[32]

The follow-up survey, carried out after the intervention was completed in all villages, in 2010 and 2011, surveyed the same households that were included in the baseline survey in all villages that received treatment and in all control villages. We successfully re-surveyed 97% of households. The differences between attrition rates in any of the treated groups and between any treated groups and control are not statistically significant, and there is no correlation between baseline use of safe drinking water and attrition. In the main sample, we have data from 7,427 households at baseline and 7,341 households at follow-up.[33] Throughout, we apply survey weights so that each village counts equally in sample statistics, consistent with the original study design.

We documented the numbers and types of safe drinking water sources installed, attendance at meetings, and the number of contributors in each community. After the interventions and before the follow-up survey, we conducted focus group discussions (FGDs), to understand how the decision-making proceeded under each process. We carried out FGDs in 12 treatment villages, 4 for each of the decision-making processes, 6 in Gopalganj and 6 in Matlab, separately with men and women.

7. Verifying random assignment

7.1. Assignment to treatment and control

We implement randomization checks using a simple Ordinary Least Squares (OLS) regression on an indicator of treatment and an upazila control, which tests whether the difference between villages assigned to treatment and to control is statistically significant. Throughout the

[27] We discuss results that include all villages in Section 10.

[28] In 16 villages in which we knew tubewells were not feasible at the time of installation, we did not install any water sources in 4 out of 6 CP villages, 3 out of 4 RCP villages, and 5 out of 6 TD villages. In 8 of the villages in which tubewells are not feasible, we initially believed we could install tubewells, and the residents raised contributions. The residents withdrew their contributions after they learned that the tubewells were not feasible. Also, the rejection of alternative technologies is not related to price. In 10 villages, we could install only a more expensive type of deep tubewell, for which we required the same community contribution as for the alternative technologies. For the more expensive wells, we installed a higher percentage of offered wells than we did for the standard, cheaper deep tubewells. See further discussion in Appendix A1.

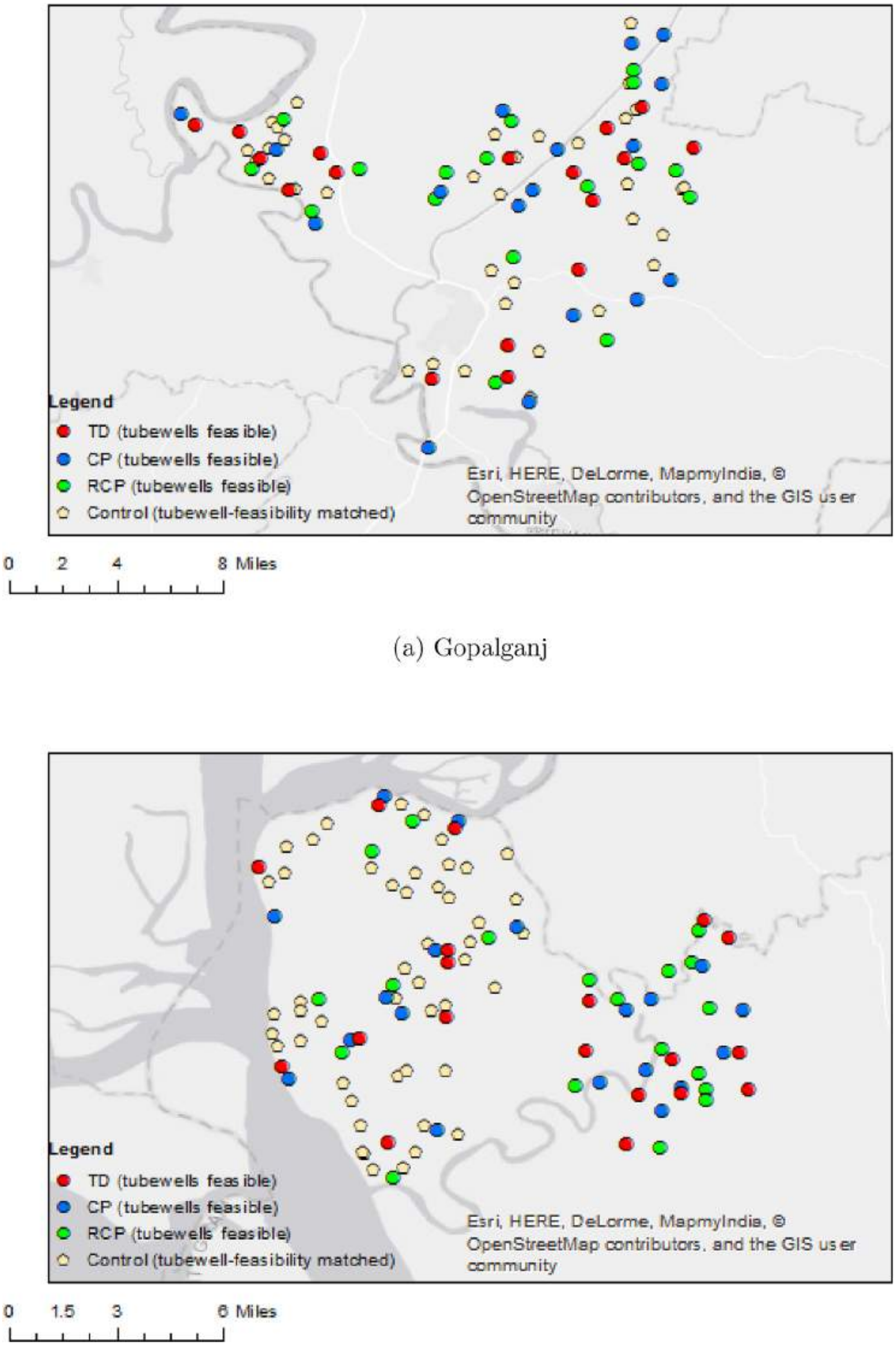
[29] Appendix Figs. C1a and C1b show the original 250 villages and their assignment to treatment and control, whether tubewells are feasible in treated villages, and whether the village is assigned to the matched control group or not for control villages. Appendix A3 provides further details regarding the comparison between villages in which tubewells are feasible and not feasible and the construction of the matched control group.

[30] We base these calculations on the observed intra-cluster correlation in changes in use of safe drinking water, equal to 0.19.

[31] We obtained lists of households in each village from district offices. We then selected every *nth* household from the list, where *n* is the number of households in the village divided by 40. We then used the same method to select a sample from the remaining households who served as replacements for any households that we could not locate.

[32] We did not have the resources to do a full income or expenditure survey.

[33] The total number of study households in our main sample is 7, 557. In this main sample, we are missing baseline data for 130 households because of data entry problems, including all data from one CP village. The process of data loss was random—termites destroyed some of the paper questionnaires during the process of data entry and checking—and households with missing baseline data are statistically indistinguishable at follow-up from other households in the same villages. The remaining baseline data thus represent a randomly selected sample within each village. In the control village in which we lost baseline data, we did not collect follow-up data, so this village is excluded from the main sample.



(a) Gopalganj

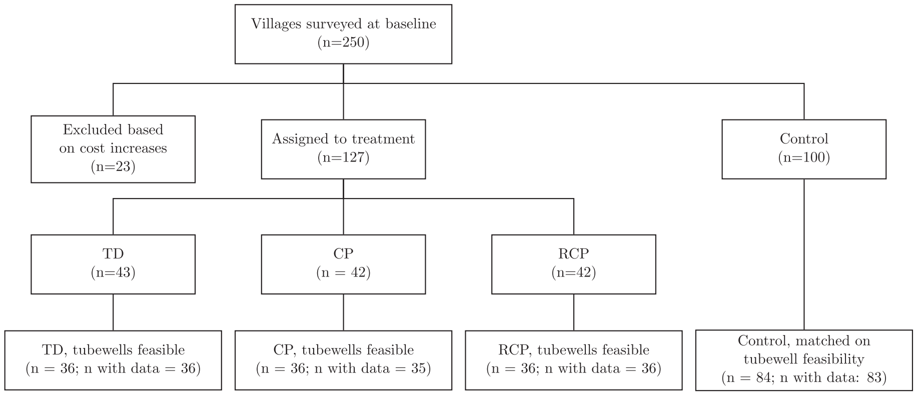
(b) Matlab

Fig. 5. Study villages.

paper, we define treatment as a village being offered safe sources of drinking water. The household-level specification is:

$$Y_i = \alpha + \beta_t I_{treated,v} + \boldsymbol{Z_{vu}}\boldsymbol{\gamma} + \epsilon_{iv} \quad (3)$$

where Y_i is a characteristic measured at baseline in household i; $I_{treated,v}$ is an indicator which is one if village v received treatment and zero otherwise; and $\boldsymbol{Z_{vu}}$ is a vector of controls for stratification by upazila u, which consists of a demeaned upazila dummy variable and the interaction term between this variable and the treatment dummy. We construct the vector of controls $\boldsymbol{Z_{vu}}$ to ensure that β_t consistently esti-



Notes: TD: Top-down. CP: Community Participation. RCP: Regulated Community Participation.

Fig. 6. Experimental design and sample selection.

mates the average difference between treated and control villages.[34] We include the upazila controls because (1) we stratified the treatment at the upazila level, and (2) the fraction of treatment villages is different in Gopalganj and Matlab. We cluster standard errors at the village level throughout. For the village-level outcomes, we estimate an equivalent regression at the village level.

In Table 2, we show baseline summary statistics and the randomization checks for the sample of villages in which tubewells are feasible.[35] Column 1 reports the sample means and standard errors for a selection of variables, which measure use of safe drinking water at baseline, factors that might influence the ease of providing safe drinking water, and community-level variables that might influence the likelihood of successful collective action.

The results in column 2 show that households in treatment villages are less likely to use safe water at baseline and to have changed to an arsenic-free source of water recently than are households in control villages, and they undertake slightly more collective actions at baseline. These differences arise because fewer sources of safe water are available in South Matlab than in North Matlab. Since the variables we test are not independent, we also carried out a Hotelling's T-Square test for joint significance of differences in village means for all 12 variables. This test rejects the null hypothesis that the means of all 12 variables are jointly equal in treatment and control groups.

The departure from the project protocol is limited to the specific problem in South Matlab. Random assignment to treatment and control was correctly implemented in Gopalganj and in North Matlab (see Appendix A2). We report the difference in means between treated and control villages in a sample which excludes South Matlab in column 3 of Table 2. In this sample, the differences between treatment and control are not statistically significant for any of the variables and a Hotelling's T-squared test does not reject the hypothesis that the means of the 12 variables are jointly equal in treatment and control villages.

7.2. Assignment to decision-making approaches

The decision-making approaches were randomly assigned within the group of treated villages. In Table 3, we compare the baseline values of 15 variables across villages assigned to each of the 3 decision-making processes in which tubewells are feasible, resulting in a total of 45 tests.[36] We fail to reject the null hypothesis that the means are equal in villages treated under one decision-making process and the other treated villages at the 10% level in 44 of these tests. This is consistent with what we would expect due to chance if the variables were independent. We confirm that a Hotelling's T-Square test fails to reject the null hypothesis for each comparison.[37]

We compare villages assigned to different approaches to decision-making, based on data from households in treated villages in which tubewells are feasible, with the following estimating equation:

$$Y_i = \alpha + \beta_p I_{p,v} + \boldsymbol{Z_{vu}}\boldsymbol{\gamma} + \epsilon_{iv} \quad (4)$$

where notation is as in Equation (3), except for the indicator variable $I_{p,v}$, which is one if village v received treatment under decision-making process p, and zero otherwise.[38] We estimate Equation (4) separately for each characteristic Y and each process p. As in Equation (3), we construct the vector of stratification controls $\boldsymbol{Z_{vu}}$ to ensure that the coefficient β_p reflects the average difference between villages treated under process p and other treated villages in the regression sample.[39]

8. Methodology

We estimate the effect of treatment, defined as a village being offered safe sources of drinking water, under each of the three approaches to decision-making. Every village that was assigned to treatment was offered safe sources of drinking water, but not all villages chose to install tubewells under the program. We then test whether the treatment effects differ under the three approaches to decision-making. The outcome variable is whether or not a household uses safe water, discussed further below.

Our main estimating equation is the following difference-in-difference specification:

$$Y_{it} = \theta_v + \beta_0 POST_t + \sum_{p \in P} \beta_p (I_{p,v} \times POST_t) + \boldsymbol{Z_{vu}}\boldsymbol{\gamma} + \epsilon_{ivt} \quad (5)$$

[34] We follow Lin (2013), Imbens and Rubin (2015) and Gibbons et al. (2019). In Equation (3), we construct these controls as follows. Let G_u be a dummy variable which takes the value one if the village is in Gopalganj and zero otherwise, and let $\overline{G}$ be the fraction of observations in Gopalganj. The demeaned upazila dummy variable is $G_u - \overline{G}$. The vector of controls here includes $G_u - \overline{G}$ and its interaction with treatment status, $I_{treated,v} \times \left(G_u - \overline{G}\right)$.

[35] We report the same results for the full sample in Appendix A2.

[36] In Appendix A4, we show that excluding the villages in which tubewells are not feasible does not affect the baseline comparison between villages assigned to different decision-making approaches.

[37] In those cases in which we do not reject the null hypotheses, we also do not reject the hypotheses that the means are the same in pairwise comparisons between the processes.

[38] When we make pairwise comparisons between villages assigned to different approaches to decision-making, we estimate a version of Equation (4) which includes dummies for all three approaches to decision-making and omits the constant.

[39] When we estimate Equation (4), the vector of controls $\boldsymbol{Z_{vu}}$ includes the demeaned upazila control $G_u - \overline{G}$ and its interaction with the relevant process dummy, $I_{p,v} \times \left(G_u - \overline{G}\right)$ (notation as in footnote 34.).

Table 2
Baseline summary statistics and verification of random assignment to treatment.

	Sample Mean	Treatment − Control	
	(1)	(2)	(3)
No of households in village	222	−43	−46
	(14)	(28)	(30)
% of water sources arsenic contaminated (BAMWSP)	0.951	−0.004	0.007
	(0.005)	(0.009)	(0.009)
Reports using arsenic safe water	0.51	−0.15***	−0.03
	(0.01)	(0.04)	(0.04)
Changed water source due to arsenic, last 5 years?	0.45	−0.15***	−0.02
	(0.01)	(0.04)	(0.04)
Symptoms of arsenic poisoning, anyone in hh?	0.009	0.001	0.000
	(0.001)	(0.003)	(0.003)
Total value of household assets (in thousand BDT)	555	−35	−25
	(13)	(39)	(45)
Access to electricity?	0.39	−0.06	−0.04
	(0.01)	(0.05)	(0.05)
Household head literate	0.61	0.00	0.02
	(0.01)	(0.03)	(0.03)
Household head Muslim	0.72	0.01	0.03
	(0.01)	(0.05)	(0.06)
Household head farmer	0.43	0.02	0.02
	(0.01)	(0.02)	(0.02)
Number of associations in community	6.23	−0.02	−0.24
	(0.03)	(0.19)	(0.22)
Number of collective actions in community	1.06	0.15**	0.03
	(0.02)	(0.06)	(0.06)
p value from Hotelling's T-squared		0.020	0.418
Number of villages		192	163
Number of households		7566	6431
Includes South Matlab?		Yes	No

Note: Column 1 shows the mean value. Columns 2 and 3 show the regression-estimated difference between treatment and matched control villages, controlling for upazila-level stratification. Treatment is defined as being offered safe water sources under one of the three approaches to decision-making. Data in rows 1 and 2 come from the Bangladesh Arsenic Mitigation Water Supply Project and are measured at the village level. All other data are from baseline household surveys. Standard errors are robust or clustered at the village level and are shown in parentheses. Hotelling's T-squared tests equality of means of all listed variables between treated and matched control groups. Asterisks reflect regression-estimated significance of differences between groups. $^{***}p < 0.01$, $^{**}p < 0.05$.

where notation is as in Equations (3) and (4) except for the subscript t, which denotes the time period, either baseline or follow-up; $POST_t$, which is a dummy variable that is zero at baseline and one at follow-up; and θ_v, which is a village fixed effect that absorbs baseline differences across villages. We construct controls for upazila-level stratification of assignment to treatment so that each β_p estimates the average treatment effect in the regression sample.[40]

We estimate Equation (5) by OLS in four samples: treated villages in which tubewells are feasible, including and excluding South Matlab, and treated villages in which tubewells are feasible and matched control villages, including and excluding South Matlab. When we estimate Equation (5) in treated villages only, the coefficients β_p estimate the mean change in Y between baseline and follow-up in villages treated under decision-making process p. When we include control villages, the coefficients β_p estimate the difference-in-difference in Y compared to the control villages. We test, pairwise, the equality of the coefficients β_p, in order to evaluate whether the treatment effects are equal for each pair of decision-making processes.[41] We also estimate similar regressions which test equality between the coefficient under a given decision-making process and the pooled coefficients under the other decision-making processes.[42]

Random assignment of villages to approaches to decision-making ensures that the differences between the coefficients β_p reflect the differences between the causal effects of the approaches to decision-making in all four samples. When we include the control villages, without excluding South Matlab, the coefficients β_p are consistent and unbiased estimators of the treatment effects under each process p as long as two assumptions hold: 1) any differences between treatment and control villages that are due to the lack of randomization in South Matlab affect use of safe drinking water additively; and 2) these differences are at least approximately constant over the two years between baseline and follow-up. These assumptions seem very reasonable for the three observable differences between treatment and control villages: baseline

[40] In Equation (5), the vector of controls $\boldsymbol{Z_{vu}}$ consists of the demeaned upazila control $G_u - \overline{G}$ interacted with all time-varying variables, specifically, the dummy $POST_t$ and its interactions with the three indicators for treatment under decision-making processes p, $I_{p,v} \times POST_t$ (notation as in footnote 34.).

[41] The sequential nature of assignment to treatment first and then to decision-making processes means that there is no correlation in South Matlab between the final assignments and the assignments that would have been implemented had the project director correctly followed the original protocol. Therefore, an intent-to-treat regression would not add value relative to the regression that excludes South Matlab. The effect of assignment to treatment in the intent-to-treat regression would be driven only by villages in Gopalganj and North Matlab, and we can consistently estimate the causal effects in this subsample by simply excluding South Matlab from the analysis.

[42] These regressions have similar specifications as Equation (5), substituting $\beta_p I_{p,v} \times POST_t + \beta_T I_{treated,v} \times POST_t$ for the terms inside the summation across decision-making processes.

Table 3
Verification of random assignment to decision-making process.

	TD (1)	CP (2)	RCP (3)
Proportion of villages in Gopalganj	0.47	0.47	0.47
	(0.08)	(0.08)	(0.08)
Proportion of villages in South Matlab	0.28	0.25	0.28
	(0.07)	(0.07)	(0.07)
No of households in village	244	198	173
	(37)	(20)	(27)
% of water sources arsenic contaminated (BAMWSP)	0.95	0.95	0.96
	(0.01)	(0.01)	(0.01)
Reports using arsenic safe water	0.48	0.44	0.37
	(0.06)	(0.06)	(0.06)
Changed water source due to arsenic, last 5 years?	0.40	0.37	0.33
	(0.05)	(0.05)	(0.05)
Symptoms of arsenic poisoning, anyone in hh?	0.012	0.010	0.005**
	(0.003)	(0.003)	(0.002)
Total value of household assets (in thousand BDT)	521	548	538
	(33)	(48)	(45)
Access to electricity?	0.39	0.36	0.33
	(0.06)	(0.05)	(0.05)
Household head literate	0.61	0.61	0.61
	(0.02)	(0.03)	(0.02)
Household head Muslim	0.73	0.74	0.68
	(0.07)	(0.06)	(0.07)
Household head farmer	0.43	0.45	0.45
	(0.03)	(0.02)	(0.03)
Number of associations in community	6.46	5.97	6.32
	(0.35)	(0.20)	(0.26)
Number of collective actions in community	1.13	1.13	0.99
	(0.17)	(0.17)	(0.15)
p value from Hotelling's T-squared	0.962	0.998	0.787
Number of villages	36	36	36
Number of households	1424	1417	1396

Note: Table shows baseline means of variables in villages treated, defined as being offered safe water sources, under each approach to decision-making. Data are from household surveys, except rows 1 and 2 (from village-level project records), and 3 and 4 (from village-level BAMWSP data). Standard errors, robust or clustered by village, are shown in parentheses. Hotelling's T-squared tests equality of means of all listed variables between villages treated under one approach and the remaining treated villages. *p* values from pairwise Hotelling's T-squared tests are: RCP = TD 0.780; CP = RCP 0.877; TD = CP 0.997. Asterisks reflect regression-estimated significance of differences between villages treated under one process and the remaining treated villages. $^{**}p < 0.05$.

access to safe water, whether or not household changed to a different water source because of arsenic in the last 5 years, and number of collective actions, which are few in all communities, as well as possible unobservable differences that may affect use of safe water. When we exclude South Matlab, random assignment of villages to treatment and control ensures unbiased and consistent estimates of β_p, although, in the presence of heterogeneous treatment effects, we may estimate different average treatment effects. Excluding South Matlab sacrifices precision if assumptions 1 and 2 in fact hold.

The main outcome variable uses information reported by the household. The reported measure takes the value one if the respondent reports that the household's primary source of water for drinking and/or cooking is safe from both bacterial and arsenic contamination, and zero if s/he reports that the source is unsafe, if s/he does not know whether the source is safe or not, or if the source is vulnerable to bacterial contamination, for example a dug well or surface water.[43] Households who know the status of the well only know whether a well is safe or not, according to the Bangladeshi standard, but not the level of arsenic in the well. Unsafe wells are painted red if they have been tested.[44]

Enumerators verified the safety of the source that the household reported using whenever possible, which was the case for the large majority of households in the sample.[45] The verified information matched household reports in 97% of cases at baseline, and in more than 99% of cases at follow-up.[46] Furthermore, the fraction of wells that are safe is similar among verified wells (50% at baseline and 63% at follow-up) as it is according to household reports (51% at baseline and 61% at follow-up). In Table 5, we show that the coefficients are similar, with smaller *p* values, when we use an outcome variable that combines the verified status for those wells for which it could be verified with household reports for the remaining sources. Nevertheless, we use the reported measure in our main specifications because the village means of the combined measure differ between the 3 approaches to decision-making at baseline.[47]

[43] Further details regarding the construction of this variable are in Appendix B1.
[44] We did not have sufficient funds to test water quality or arsenic biomarkers.

[45] We could verify household reports when the well was less than 5 min walk away and either marked green (safe) or red (unsafe). We were able to verify the status for 65% of households at baseline and 88% of households at follow-up. The baseline fraction is lower primarily because we did not ask enumerators to verify well status in an early version of the questionnaire.
[46] At baseline, households were somewhat less likely to correctly report the status of safe wells (94%) than unsafe wells (more than 99%). At followup, households were slightly more likely to correctly report safe wells (99.6% correct) than unsafe wells (99.0% correct).
[47] The baseline differences are caused by two outlier villages treated under the RCP approach, in which many residents reported that their sources were safe, but project staff verified that the sources were not safe. Two villages in the control group show a similar pattern.

An outstanding concern is that households may report that they use safe sources installed by the program even when they do not. However, in a very similar context, Cocciolo et al. (2020) report that exposure to a comparable program to increase use of safe drinking water does not influence the correlation between arsenic contamination of the drinking water that the household uses at home and arsenic contamination of the water source that the household reports using, both measured objectively by water quality tests. If treated households report that they use safe sources even when they do not, we would expect that treatment would weaken the correlation between arsenic contamination measured at the source and arsenic contamination measured in household drinking water. Since exposure to safe drinking water programs does not appear to lead to mis-reporting on average, it seems unlikely that mis-reporting should vary by approach to decision-making.

We use household data, which allow us to estimate heterogeneous effects by baseline characteristics when we discuss explanations for the results in Section 11. However, treatment is assigned at the village level; therefore we cluster standard errors at the village level (e.g. Bertrand et al., 2004). We include survey weights, which allow each village to count equally in summary statistics, consistent with our original study design.[48]

The outcome variable is binary. Estimating by OLS has the advantage of simplicity and transparency but may yield inconsistent estimates if regression specifications are not fully saturated. We also report results from a fully saturated model in Section 10. The results are almost identical to those obtained with the main specification.[49]

9. Impacts of the three approaches to decision-making on the use of safe drinking water

The proportion of households who use safe drinking water increases about 80% more between baseline and follow-up in villages that use the RCP process than under the other two approaches to decision-making. The proportion increases by 27 percentage points in RCP villages, by 15 percentage points in CP villages and by 14 percentage points in TD villages when we estimate Equation (5) using OLS in the sample of treated villages only, as we show in Column 1 in Table 4. The difference between the RCP approach and the other two decision-making processes combined as well as the pairwise differences between the RCP and each of the other approaches are statistically significant at the 5% level.

Column 2 shows estimates when we drop South Matlab from the treated sample, meaning that we compare outcomes only within the group of villages that were randomly assigned both to treatment and to approach to decision-making. The comparison between decision-making processes remains similar when we exclude South Matlab.

Columns 3 and 4 show estimates when we include the control villages in the analysis, first excluding South Matlab and then including South Matlab. The average change in use of safe drinking water in the control group is close to zero; therefore the estimated treatment effects reported in columns 3 and 4 are very similar to the changes over time in use of safe drinking water reported in columns 1 and 2. The treatment effect is statistically significant under each approach.[50] The comparisons between decision-making processes are very similar when we exclude South Matlab, though the pairwise comparison between the RCP and CP approach is not statistically significant at the 10% level ($p = 0.103$) when we exclude South Matlab and include the control villages. The similarity of the estimates between columns 3 and 4 suggests that the assumptions required in order for the OLS estimation of Equation (5) to yield unbiased estimates in the sample that includes South Matlab and control villages are satisfied.

The RCP approach stochastically dominates the other two approaches to decision-making. The cumulative density function (cdf) of the mean change in use of safe water sources in each village under the RCP approach lies to the right of the cdf for the TD and CP approaches along the entire support of the distribution (Fig. 7).

While baseline differences between villages allocated to the three different decision-making processes are not statistically significant, a somewhat smaller proportion of households use safe water at baseline in villages assigned to the RCP process than in villages assigned to the other two processes and the villages assigned to the RCP process are somewhat smaller on average. Larger increases in the proportion of households who use safe water are possible when fewer households use safe water at baseline. Also, collective action may be easier in smaller villages and, more importantly in our case, the maximum number of wells remains constant as village size grows. However, these differences do not drive the results. A larger fraction of households change to a safe well under the RCP approach over almost the entire range of safe water use and village size at baseline.[51]

10. Robustness

The results remain consistent across a range of alternative specifications. Table 5 illustrates the stability of the estimated treatment effects across different specifications and the *p* values associated with the comparisons between the three approaches to decision making. In the interest of brevity, we focus on the comparison with results shown in column 4 of Table 4. Appendix A6 describes the same set of robustness tests for all four samples shown in Table 4 and confirms that the results are similarly robust in all four samples.

Column 1 of Table 5 repeats the results from column 4 of Table 4 for comparison. The first set of robustness checks conducts the analysis on data collapsed to village-level means. The second set uses household fixed effects, instead of village effects. The third set estimates the treatment effects using a fully saturated model, which substitutes indicators for each decision-making process for the village fixed effects. This approach both ensures consistency in the presence of sampling weights and further that all predicted values lie within the unit interval. The fourth set of robustness checks conducts the analysis without survey weights. In the fifth set, the dependent variable uses the status of the household's drinking water verified by the project staff for those households for which the project staff were able to verify the status and the status reported by the household otherwise, as discussed in Section 8. The sixth set uses the full control group instead of the matched control group. In all cases, the comparison across decision-making processes remains almost identical.

In addition, while the full analysis of heterogeneity of impacts across the two upazilas is beyond the scope of the paper, we have estimated Equation (5) in each upazila separately, without the upazila controls. The differences between the impacts of the RCP approach and each of

[48] These regressions yield results that are almost identical to those obtained when we collapse the household-level observations to village-level means. In practice, they are also very similar to results obtained without including survey weights, although these regressions place slightly less weight on smaller villages, in which effects are both stronger and more precisely measured. While weighted regressions only guarantee consistent estimates of population parameters in fully saturated regressions (e.g. Deaton, 1997), we verify that the results are almost identical in a similar, fully saturated specification. See Section 10.

[49] Our main specifications are very close to fully saturated. In addition, the extent of inconsistency increases with the fraction of predicted values that lie outside the unit interval (Horrace and Oaxaca, 2006), and in our case, all predicted values of the outcome variable lie in the interval $(-0.05, 1.08)$ and only 6.4% of predicted values lie outside the interval $[0, 1]$.

[50] Appendix A5 describes estimates of the average effect of the program.

[51] Appendix Fig. C2 plots the fraction of households who change to a safe well at different levels of safe water use at baseline, and Appendix Fig. C3 does the same for village size. The baseline distributions of the fraction of households who use safe drinking water and village size are in Appendix Figs. C4 and C5.

Table 4
Impact on use of safe drinking water by approach to decision-making.

	Reported use of safe drinking water (1)	(2)	(3)	(4)
TD	0.14***	0.12***	0.12**	0.15***
	(0.04)	(0.05)	(0.05)	(0.04)
CP	0.15***	0.14***	0.15***	0.15***
	(0.04)	(0.04)	(0.04)	(0.04)
RCP	0.27***	0.27***	0.25***	0.27***
	(0.04)	(0.05)	(0.05)	(0.05)
Average change in control group			−0.01	−0.01
			(0.02)	(0.02)
RCP vs CP	0.032**	0.039**	0.103	0.038**
CP vs TD	0.941	0.743	0.583	0.926
TD vs RCP	0.028**	0.026**	0.041**	0.032**
TD vs pooled	0.179	0.136	0.136	0.185
CP vs pooled	0.216	0.297	0.519	0.239
RCP vs pooled	0.014**	0.016**	0.037**	0.017**
N	8206	6022	12551	14735
Includes South Matlab	Yes	No	No	Yes
Includes control group	No	No	Yes	Yes

Note: Table shows estimated change in reported use of safe drinking water. Data are at household level with two periods, weighted so that each village counts equally in summary statistics. All estimates absorb village fixed effects and control for upazila-level stratification. Standard errors, clustered by village, are shown in parentheses. Reported p values test: i) significance of the difference between the estimated effects in each decision-making process pair; and ii) significance of the difference between the estimated effect under one decision-making process and the remainder of the treated villages. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 5
Robustness tests.

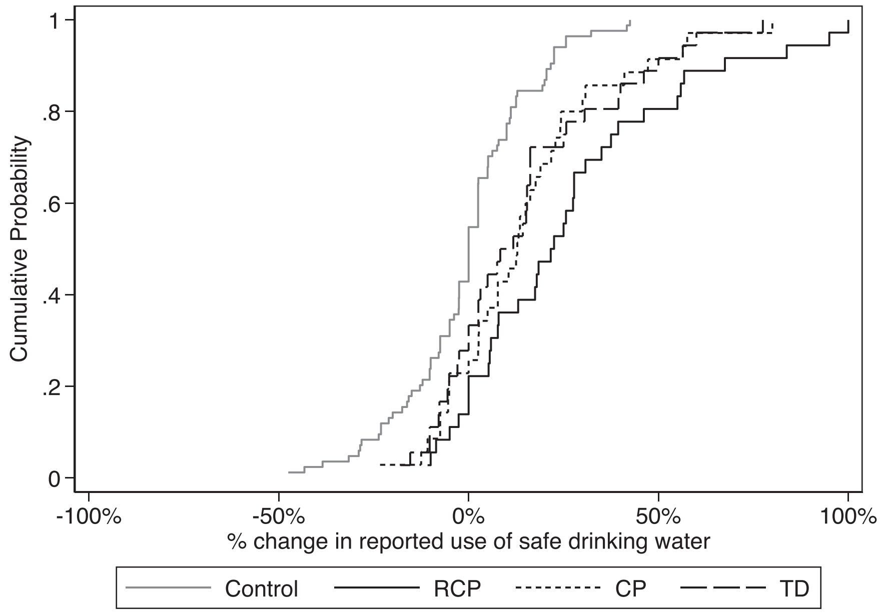
	Use of safe drinking water (1)	(2)	(3)	(4)	(5)	(6)	(7)
TD	0.15***	0.15***	0.15***	0.15***	0.15***	0.13***	0.16***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
CP	0.15***	0.15***	0.16***	0.16***	0.15***	0.14***	0.16***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
RCP	0.27***	0.27***	0.26***	0.27***	0.26***	0.30***	0.28***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)
Average change in control group	−0.01	−0.01	−0.01	−0.01	−0.01	0.01	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
RCP vs CP	0.038**	0.037**	0.056*	0.056*	0.052*	0.008***	0.028**
CP vs TD	0.926	0.930	0.909	0.831	0.976	0.937	0.949
TD vs RCP	0.032**	0.031**	0.045**	0.035**	0.053*	0.007***	0.027**
TD vs pooled	0.185	0.182	0.214	0.169	0.260	0.084*	0.176
CP vs pooled	0.239	0.231	0.286	0.309	0.273	0.112	0.204
RCP vs pooled	0.017**	0.016**	0.027**	0.022**	0.027**	0.003***	0.013**
N	14735	382	14360	14735	14737	14735	15882
Unit of analysis	Household	Village	Household	Household	Household	Household	Household
Unit of fixed effects	Village	Village	Household	None	Village	Village	Village
Weights	Yes	No	Yes	Yes	No	Yes	Yes
Use of safe drinking water	Reported	Reported	Reported	Reported	Reported	Verified	Reported
Control group	Matched	Matched	Matched	Matched	Matched	Matched	Full

Note: Table shows robustness tests corresponding to the specification shown in column 4 of Table 4, repeated in column 1 here for convenience. The unit of analysis is as specified, with two periods. Household data are weighted so that each village counts equally in the analysis. Estimates absorb fixed effects as specified, except in column 4 which shows results from a fully saturated specification controlling for decision-making process dummies. The outcome variable is use of safe drinking water, measured as specified. The control group is the matched control group or the full control group as specified. Reported p values test: i) significance of the difference between the estimated effects in each decision-making process pair; and ii) significance of the difference between the estimated effect under one decision-making process and the remainder of the treated villages. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

the other two approaches are larger and more statistically significant in Gopalganj than in Matlab, indicating that the non-random assignment to treatment and control in Matlab is not driving the results.[52]

In villages in which tubewells are not feasible, the average treatment effect is close to zero (Appendix A5) as a result of the rejection of alternative technologies. If we include villages in which tubewells are not feasible in the comparison between approaches to decision-making, the average treatment effects fall and the variance of the effects increases (Appendix A7). Despite these attenuating effects, the difference between the RCP process and the other processes pooled remains significant at the 10% level, as does the pairwise difference between the RCP process and the TD process, in the specifications in columns 1 and 4 of Table 4.

[52] Results available upon request.



CDF corresponds to mean change in reported use of safe drinking water in each village in the main sample.

Fig. 7. Empirical cumulative distribution functions (CDF) Change in reported use of safe drinking water.

11. Explaining the results

In this section, we investigate why the RCP approach increases use of safe drinking water more than do the TD and the CP approaches, and why the CP and TD approaches perform similarly. Our evidence is consistent with three possible mechanisms that contribute to the differences: communities have more information about their characteristics and needs than the top-down provider has; communities can influence access to a well, positively or negatively, more than the top-down provider can; and/or community interactions may motivate participants to use safe water. We identify the potential effect of information through differences in distances between households and project wells, as well as more generally distance to the nearest safe well, under the three different approaches. We characterize the extent of negative community influence in the form of elite capture—self-interested elites controlling location of the well and/or restricting use of the well—using several pieces of evidence: the number of households who contribute to funding the project wells, evidence from focus group discussions and the household survey about who made decisions, and assessment by respondents whether decision-making unfairly favored influential people and whether owners of land on which well is located are restricting access. We analyze connections to community leaders among households who contribute to funding wells and households who use project wells, though the connections are not simple indicators of elite capture.

11.1. Methodology

We estimate the following equation in the sample of treated villages, because many of the variables that we examine are only observed in treated villages:

$$Y_i = \sum_{p \in P} \beta_p I_{p,v} + \boldsymbol{Z_{vu}} \boldsymbol{\gamma} + \epsilon_{iv} \tag{6}$$

with notation as in Equation (5). As in the main analysis, we account for stratification in assignment to treatment, apply weights that allow each village to count equally in the analysis, and we cluster standard errors by village. For village-level outcomes, we estimate an equivalent regression at village level. The coefficients β_p capture the sample means of each outcome variable in villages treated under decision-making process p.[53] We test the equality of the coefficients β_p in each pair of decision-making approaches.

We report results both for the full sample and subsamples with different characteristics. The subsamples for which we report results are endogenously defined, such as households who report using sources installed by the project. Outcomes in these subsamples reflect both a selection effect and a causal effect. Also, the variables that define the subsamples are not necessarily causing any heterogeneity in outcomes. However, reporting outcomes for these groups separately helps to understand the aggregate treatment effects.

Our analysis is exploratory. We report 21 different combinations of outcome variables and subsamples in 3 different decision-making approaches. We report only the "naive," per comparison, p values (Kling et al., 2007). This approach minimizes the risk of false negatives with the caveat that some of the comparisons may be statistically significant due to chance.[54] We reduce the likelihood that we draw erroneous conclusions from the tests that we report and from additional tests that we carried out but do not report in the main paper by focusing the exploratory analysis on explanations that arise from the reasoning presented in Section 4, which informed the design of the experiment. Also, we aggregate individual variables into measures of a particular dimension of influence, such as when we combine answers to questions about elite influence on the decision-making process. Further, we look for consistency between several different indicators relevant to each mechanism, and we compare evidence from the survey data to information from the FGDs.

[53] We describe outcome variables briefly in the main text. See Appendices B3–B7 for more details. The vector of controls $\boldsymbol{Z_{vu}}$ consists of the demeaned upazila control $G_u - \overline{G}$ interacted with all three indicators for treatment under decision-making processes p, $I_{p,v}$ (notation as in footnote 34).

[54] See also Casey et al. (2012).

11.2. Comparing the RCP approach to the TD and CP approaches

The RCP approach increases use of safe water relative to the other two approaches despite the fact communities install similar numbers of wells under all three decision-making processes, as we show in Table 6, Panel A. The greater increase in use of safe water seems to occur in one of three possible ways. Regulated communities (1) place the wells that they install through the project closer to more households than do the other two approaches; (2) they negotiate broader access to the community wells installed by the project as well as to existing and new privately-owned safe wells; and/or (3) they may motivate more households to switch to safe water.

Unlike under the other two approaches, households in RCP villages switch to safe water not just by using the community wells installed by the project but also by increasing their use of both existing and new private safe wells. Households who have their own wells both at baseline and at follow-up report an increased number of users under the RCP approach but a decline in the number of users under the TD and the CP approaches, as we show in the last row of Panel E of Table 6.[55] At the same time, households who do not use wells installed by the project switch to other safe wells at higher rates in RCP villages than in TD and CP villages, as we show in Table 6, fifth row of Panel E.[56]

The increase in use of private wells in RCP villages suggests that households in RCP villages switch to safe water not only because project wells are placed more conveniently or are more accessible, but also because communities in RCP villages may renegotiate access to existing and new, private safe wells in order to facilitate agreements about the new project wells. Supporting evidence comes from a FGD in an RCP village in which the village chairman committed to installing two new wells, and did install one, in one cluster of households in order to win agreement that the project should provide a well in another cluster. Participants in another FGD also discuss sharing existing safe wells. In addition, the RCP approach may motivate participants to switch to safe wells through deliberations in meetings or through a common knowledge effect, whereby some switch because they are ashamed to continue using unsafe water when they know that other participants know that the household is aware which sources are safe and which are not.[57] Our evidence does not address this last possibility directly.

A reason why the RCP process places project wells more conveniently and broadens access relative to the TD process may be the difference in information that the top-down provider and the communities have.[58] We know from direct communication with NGOF that the project staff placed wells on public land because they could not identify benevolent landowners or influence the behavior of landowners to ensure access to wells after installation. The communities did not follow this strategy even though it was available to them. The top-down process installed a much larger percentage of wells on public land than did either of the participatory approaches, as we show in Table 6, first row of Panel B. At the same time, communities selected more convenient well locations under the RCP process than the top-down provider did. They placed wells about 25% closer to households, on average, as we show in Table 6, second row of Panel B, and they reduced the distance to the nearest safe well twice as much, as we show in the third row of panel B.[59] Locating wells on public land appears to result in less convenient placement, which is consistent with the scarcity of public land in the study villages. An example from a FGD in a TD village illustrates the role of information. Participants report that the project staff located a well on land belonging to a selfish person who would not have been chosen by the community, and he was allowing only his relatives to use the well.

The similar change in distance to the main well that households use across the three approaches may seem puzzling, given that the RCP approach places wells in more convenient locations. The similarity results from the fact that households who switch to safe wells increase the distance they walk to collect water on average. The increase in distance is smaller under the RCP process than under the CP and TD processes, but a greater share of the study population switch to safe wells in RCP villages than in CP and TD villages.[60] This pattern of results confirms that households in RCP villages had more convenient wells available to them, whether installed by the project or because of renegotiated rights to use non-project wells. Households report that distance is one of the most important considerations when they choose a water source.[61]

Differences in information may not fully explain the differences in well placement. Communities may be able to ensure access to wells placed in more convenient locations by influencing the behavior of even a self-interested landowner through enforceable agreements that the top-down provider would not be able to enforce. Broad participation and veto power under the RCP process may result in agreements enforced through other interactions between community members, such as elites needing votes in an election or the effort of workers in their houses or fields.

A difference between the RCP and the CP approaches appears to be that community elites may be less likely to decide well locations under the RCP approach than under the CP approach, and/or, as our model suggests, that the RCP process may constrain self-interested elites to make more benevolent choices.[62] One indication that a smaller number of people control location and access to wells in CP villages, on average, is that the mean number of contributors per well installed by the project is smallest in the CP villages. We show this and the other results in this paragraph in Panel C of Table 6.[63] Also, a single household paid the entire contribution for each of the wells installed by the project in a larger fraction of CP villages than in RCP or TD villages.[64] A small number of contributors may be efficient if benevolent elites pay the contribution and allow access to the well, but paying the contribution may allow self-interested elites to influence the location of the well and/or to legitimize restricting access to the well. Characteristics of contributors are consistent with at least some having elite status and more so in CP villages than in RCP or TD villages. Contributing households are relatively wealthier and more likely to list local leaders in their social network than are other households in their communities, especially in

[55] The number of users grows at privately owned safe wells in RCP villages, and at the same time the proportion of households who own and use a private safe well in RCP villages increases relative to other approaches, as we show in second row of Appendix Table C1.

[56] The pairwise differences between the RCP and CP and RCP and TD approaches are marginally insignificant, but the difference between the RCP villages and the pooled TD and CP villages is statistically significant.

[57] An alternative explanation may be a selection effect, in which village residents who were more likely to switch to safe water in any case are relatively less likely to use project wells in the RCP villages, which does not seem very probable.

[58] Lack of technical expertise does not hamper the community approaches in our study, as it does for example in Khwaja (2004), because the project provides all necessary technical information under all three approaches.

[59] The measure of distance throughout is walking time, as reported by the household. Appendix Table C2 replicates the analysis using the log of this measure.

[60] See Appendix Tables C4 and C5.

[61] See Appendix Figs. C6, C7, and C8.

[62] Others also find evidence of elite capture of safe water sources in Bangladesh e.g. van Geen et al. (2015).

[63] We code the number of contributors as equal to zero in the 5 villages in which we did not install any wells.

[64] The data in rows 1 and 2 of Panel C, Table 6 are from project records. Household survey data are also consistent with a smaller number of contributors and higher average contribution per contributing household in CP villages. Appendix A8 provides additional details regarding the results described in this paragraph.

Table 6
Explaining differences between impacts of the three approaches to decision-making.

	TD	CP	RCP		*p* values
Panel A: Safe water sources installed					
Number of water sources installed per village	2.36	2.53	2.47	RCP = CP	0.769
	(0.16)	(0.14)	(0.12)	CP = TD	0.432
		N = 108		TD = RCP	0.581
Proportion of offered water sources installed per village	0.81	0.87	0.85	RCP = CP	0.765
	(0.05)	(0.05)	(0.04)	CP = TD	0.432
		N = 108		TD = RCP	0.575
Panel B: Location of installed water sources					
Fraction of sources built in public places per village	0.58	0.29	0.39	RCP = CP	0.174
	(0.06)	(0.05)	(0.06)	CP = TD	<0.001***
		N = 96		TD = RCP	0.032**
Distance between household and nearest project source (minutes)	8.62	10.12	6.54	RCP = CP	<0.001***
	(1.12)	(0.92)	(0.48)	CP = TD	0.305
		N = 3832		TD = RCP	0.091*
Change in distance to household's nearest safe source (minutes)	−3.35	−5.48	−6.79	RCP = CP	0.389
	(0.78)	(1.01)	(1.14)	CP = TD	0.098*
		N = 3630		TD = RCP	0.014**
Change in distance to household's main source (minutes)	−0.33	−0.25	−0.08	RCP = CP	0.610
	(0.20)	(0.26)	(0.19)	CP = TD	0.793
		N = 3972		TD = RCP	0.366
Panel C: Contributions					
Number of contributing households per village	10.31	6.10	10.85	RCP = CP	0.023**
	(1.80)	(1.02)	(1.78)	CP = TD	0.045**
		N = 107		TD = RCP	0.833
Fraction of villages with one household paying contribution per well	0.45	0.52	0.33	RCP = CP	0.088*
	(0.07)	(0.08)	(0.08)	CP = TD	0.491
		N = 102		TD = RCP	0.258
Relative log total assets (contributing households)	0.09	0.08	0.20	RCP = CP	0.276
	(0.08)	(0.06)	(0.09)	CP = TD	0.973
		N = 305		TD = RCP	0.349
Relative connectedness to local leaders (contributing households)	−0.04	0.10	0.05	RCP = CP	0.495
	(0.04)	(0.06)	(0.05)	CP = TD	0.049**
		N = 308		TD = RCP	0.184
Relative kin connectedness to local leaders (contributing households)	−0.04	0.09	0.01	RCP = CP	0.288
	(0.04)	(0.06)	(0.04)	CP = TD	0.080*
		N = 308		TD = RCP	0.405
Panel D: Self-reported project evaluation					
Household agreed with decisions taken	0.78	0.70	0.75	RCP = CP	0.221
	(0.03)	(0.03)	(0.02)	CP = TD	0.079*
		N = 3815		TD = RCP	0.493
Household felt that decision-making process was fair	0.89	0.84	0.86	RCP = CP	0.329
	(0.01)	(0.02)	(0.01)	CP = TD	0.013**
		N = 3776		TD = RCP	0.108
Household reported that decision-making process favored influential individuals	0.07	0.14	0.12	RCP = CP	0.272
	(0.01)	(0.02)	(0.01)	CP = TD	<0.001***
		N = 3830		TD = RCP	0.004***
Household reported safe sources to be hard to access due to installation on private land	0.08	0.09	0.08	RCP = CP	0.794
	(0.01)	(0.01)	(0.01)	CP = TD	0.496
		N = 4098		TD = RCP	0.645
Household reported access to project sources to be restricted by landowner	0.01	0.02	0.02	RCP = CP	0.846
	(0.003)	(0.008)	(0.005)	CP = TD	0.268
		N = 4092		TD = RCP	0.170
Household reported safe sources too far from house	0.60	0.61	0.53	RCP = CP	0.127
	(0.04)	(0.04)	(0.04)	CP = TD	0.823
		N = 4075		TD = RCP	0.203
Panel E: Use of wells installed by the project and other sources					
Fraction of households using project source	0.27	0.24	0.29	RCP = CP	0.306
	(0.04)	(0.04)	(0.04)	CP = TD	0.591
		N = 4057		TD = RCP	0.654
Change in reported use of safe drinking water, households using project source	0.49	0.54	0.58	RCP = CP	0.735
	(0.07)	(0.07)	(0.06)	CP = TD	0.613
		N = 1041		TD = RCP	0.360

(*continued on next page*)

Table 6 *(continued)*

	TD	CP	RCP		*p* values
Change in reported use of safe drinking water, households not using project source	0.03	0.03	0.10	RCP = CP	0.104
	(0.03)	(0.02)	(0.04)	CP = TD	0.927
		N = 2900		TD = RCP	0.117
Change in no. of households using well owned by reporting household (well owners only)	−0.74	−1.11	0.64	RCP = CP	0.038**
	(0.54)	(0.75)	(0.35)	CP = TD	0.691
		N = 439		TD = RCP	0.035**

Note: Outcome variables as listed. Reported coefficients reflect regression-estimated mean values in villages treated under the listed decision-making process. Data are from project records (Panel A; row 1 of Panel B; and Panel C) or household surveys. When the household is the unit of analysis, weights are applied so that each village counts equally in the analysis. Regressions control for upazila-level stratification. Number of observations enumerates non-missing observations in each analysis. Standard errors, robust or clustered by village, are shown in parentheses. In Panel C, "relative" means that variables are constructed by first demeaning with respect to village-level averages. Reported *p* values test significance of the pairwise difference between mean outcomes in each decision-making process pair. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

CP villages.[65]

Contribution by a single household might reflect a belief among other households that the landowning household will not allow access to the well. Households who do not expect to be able to use the well are less likely to contribute funding. Participants in all FGDs confirm the important role that contributions of funding play in influencing the use of the well. Households who contribute funding feel that they have the right to control the use of the well and are perceived to have this right by others, while those who have not contributed tend to think that they need permission to use the well.[66]

Also, the CP approach places wells less conveniently than does the RCP approach, as shown in Table 6, Panel B, further suggesting that more well locations in CP villages may satisfy selfish preferences of elites.

While evidence from FGDs is descriptive, the differences between discussions in FGDs in CP and RCP villages are remarkably consistent across the FGDs in both upazilas. Participants in FGDs in CP villages report that a small group of influential people, usually men or village leaders, made the decisions about installing wells and contributing funding. FGDs in RCP villages report that participants in a big meeting engaged in active negotiations in order to win agreement needed to satisfy the unanimity rule. FGD participants in RCP villages praise the role that project staff played in enforcing the rules.[67] The FGDs in CP villages report that influential people installed the wells on their own land and are restricting the use of the source by others. One person installed a fence around the well.[68] The FGDs in RCP villages do not report restrictions on access to installed wells, and participants report that they took care to install wells on land that belongs to individuals whom everyone trusts to allow broad access. A substantial fraction of respondents in the household surveys also report that decisions were taken in small or male-only meetings under the CP process but not under the other processes.[69]

11.3. Comparing the TD approach to the CP approach

The TD and the CP approaches result in similar impacts on safe water use but for different reasons. Communities in CP villages seem to have better information about safe water needs than does the top-down provider by the same argument as made above for the RCP approach. The difference in distance to project wells and nearest safe wells is less pronounced between the CP and the TD approaches than is the difference between TD and RCP villages perhaps because locations are more likely to satisfy selfish preferences of elites in CP villages than in RCP villages.

While worse information and reliance on the strategy of placing wells on public land may cause the TD approach to place wells less conveniently, the TD approach does appear to reduce elite capture of wells relative to the CP approach, thereby resulting in similar impacts on safe water use. More people contribute funding to wells under the TD approach than under the CP approach. In addition, fewer people report that the decision-making process favored influential individuals under the TD approach, or that safe sources were difficult to access because of installation on private land or because of landowner restrictions, as shown in Table 6, Panel D.[70] The caveat applies that these self-reported assessments may reflect other dimensions of satisfaction with the project as well as elite capture.

A potential explanation that does not seem to account for the differences in outcomes is village residents' approval of each approach. Communities could be more willing to fund and use wells when they are more satisfied with the decision-making process. However, communities are least satisfied with the CP approach despite the similar outcomes under the CP and TD processes, as we show in Table 6, Panel D. The TD and RCP processes receive comparable approval ratings even though the RCP villages experience much better outcomes.

12. Conclusion

The field experiment shows that delegating decisions about providing safe drinking water to communities increases the percentage of households who use safe drinking water relative to a top-down approach but only if the participatory process limits the influence of

[65] Well users have slightly lower assets and are slightly less likely to be connected to local leaders than other households in the same villages, and these patterns do not differ across treatment arms. See Appendix Table C3.

[66] Households who contribute to project wells are more likely to live near project wells and to report using them. However, some households who live far away from a project well also report contributing and they report that they do not use the well, suggesting that households contribute to wells for altruistic reasons in at least some cases. The relationship between the number of contributors and increase in use of safe water is also not uniform across decision-making processes. A single household paying the cash contribution for each well is associated with a smaller increase in use of safe water under the CP process but a larger increase under the RCP and TD processes.

[67] We also collected evidence on participation in meetings. However, meetings serve different purposes under the different decision-making processes, so comparing participation in meetings across approaches is not informative about participation in decision-making. In the interest of brevity, we discuss this evidence only in Appendix A9.

[68] One FGD in a CP village describes an exception, in which a person changed the location of the installed well from his own land to a more accessible place.

[69] See Appendix Fig. C9.

[70] The comparison between TD and the other two approaches is statistically significant for the first of these variables. All three variables are constructed by pooling answers to several different questions. For example, the variable "Household reported that decision-making process favored influential individuals" is coded as one if the respondent household either reported that the decision-making process was unfair because it favored influential individuals or that they disagreed with the decisions taken because they favored influential individuals.

community elites. The direct comparison of impacts achieved by the same intervention undertaken with a participatory approach and the historically conventional and still very common top-down approach is rare in the literature. The regulated participation approach improves outcomes relative to the top-down approach even though the latter is designed to be more focused on the objective of increasing the use of safe water than a typical top-down provider, such as a local government, may be. A novel set of decision-making rules that address several ways in which elites often exert influence successfully increases use of safe water relative to an unregulated community approach.

The likely reasons why the regulated community approach increases the use of safe drinking water more than do the other two approaches are because: (1) it places wells more conveniently; (2) it seems to produce agreements that broaden access to community wells installed by the project as well as existing and new, private, safe wells; and/or (3) it may motivate households to switch to safe water. The top-down provider trades off distance between installed wells and households against placing wells on scarce public land to limit elite capture. The top-down and the community approaches have similar impacts on use of safe drinking water but for different reasons: less local information and limited means of securing broad access to the wells in the case of the top-down approach, and restrictions on access to water sources in the case of the community approach. In other contexts, one of these two approaches may dominate the other. For example, if community elites pursue the common good, the community approach could dominate.

The welfare gain from the RCP approach is likely to exceed the gain from the other two approaches. We estimate the gain over a ten-year expected lifetime of a tubewell to be $527 per household who switches to safe water under the RCP approach, $478 under the CP approach, and $448 under the TD approach based on average income gains from improved health due to switching from a contaminated well to a safe well, estimated by Pitt et al. (2020), and changes in distance walked to wells from our data.[71] The gains are greater under the RCP approach because RCP communities place wells more conveniently, resulting in smaller travel costs. The increase in use of safe water is much larger under the RCP approach than under the other two approaches, while the differences in implementation costs are small. The costs of installing wells, which are constant across the three approaches, constitute the bulk of the expense of the intervention. Data on use of time by field staff suggest that the regulated approach and the top-down approach require similar amounts of staff time while the community participation approach requires at most one fewer day of staff time (around a 20% decrease).[72] The participatory approaches may also require additional hours of time spent by community members on making decisions. These are relatively inexpensive differences. A precise analysis of the impacts that each approach has on welfare would need to consider the incidence both of the benefits and costs of participation in the well construction program and is beyond the scope of this paper.

There are a number of issues that this study leaves to future research. First, the performance of the approaches to decision-making likely varies under different conditions, including the influence of elites in community decision-making, to what extent elites pursue the common good, how willing communities are to use the veto rights nominally assigned to them, how effectively communities can enforce agreements, what strategies an external organization can pursue in the absence of community information, and other social characteristics (see, e.g., Cruz et al., 2020). Further research is needed to understand how and why the performance of the approaches to decision-making varies under different conditions in order to guide the engagement of communities in other contexts.

Second, we examine the short-term changes in use of safe drinking water that take place within months of the intervention. These effects may change over time if the agreements that shape the initial use of the wells evolve over time, and as communities and landowners on whose land the wells sit decide whether or not to maintain the wells. In a follow-up study, we are collecting data on use of the wells installed by this project up to 10 years after installation.

Third, the experiment compares two community participation processes to a top-down process that includes the requirement that communities contribute funding. This requirement may reduce the number of water sources installed under our top-down approach relative to the number that can be installed when the community is not required to contribute. On the other hand, this requirement may result in more people using the installed water sources under our top-down approach than would use them if the top-down provider paid the entire cost. An important research question is how the relative performance of the top-down approach would differ in the absence of the requirement that communities contribute funding to the sources of water.

Fourth, the implementing NGO in our study has the necessary technical expertise with respect to safe drinking water and provided this expertise to the communities. More generally, the question remains whether communities can benefit if the implementing organization delegates the responsibility for collecting technical information, and if so, then under what conditions.

Finally, a remaining research challenge is to develop a more fully articulated and comprehensive theoretical framework that describes how community participation influences access to public services and development outcomes more broadly, and as part of this effort, how elites influence outcomes when projects delegate decision-making to communities. A theory of elite influence would help to identify optimal rules to limit elite capture of benefits. Further interaction between theory building and empirical research is needed to construct such a framework.

Declaration of competing interest

Malgosia Madajewicz declares that she has no relevant or material financial interests that relate to the research described in this paper.

Anna Tompsett declares that she has no relevant or material financial interests that relate to the research described in this paper.

Md. Ahasan Habib declares that he is employed by the NGO Forum for Public Health, which is the Bangladeshi partner NGO that participated in implementing the described research project. He has no other relevant or material financial interests that relate to the research described in this paper.

The work was funded by the National Science Foundation Grant 0624256 DHB: Decentralization and Local Public Goods: How Does Allocation of Decision-making Authority Affect Provision?

The research was covered by Columbia University IRB protocol AAAA6176.

Data availability

Anonymized replication data and code are provided online with the supplementary materials.

Appendix. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jdeveco.2020.102609.

[71] The income gains are a lower bound, because the analysis in Pitt et al. (2020) does not include health impacts of arsenic that occur later in life, such as cancers. The gains are for a household with one productive adult male and one productive adult female, with the female's time valued at half the male's time, consistent with women primarily working within the household. The details of the analysis are in Appendix A10.

[72] See Appendix A11 for details.

References

Alatas, V., Banerjee, A., Hanna, R., Olken, B.A., Tobias, J., 2012. Targeting the poor: evidence from a field experiment in Indonesia. Am. Econ. Rev. 102 (4).

Alatas, V., Banerjee, A., Hanna, R., Olken, B.A., Purnamasari, R., Wai-Poi, M., 2019. Does elite capture matter? Local elites and targeted welfare programs in Indonesia. AEA Pap. Proc. 109.

Avdeenko, A., Gilligan, M.J., 2015. International interventions to build social capital: evidence from a field experiment in Sudan. Am. Polit. Sci. Rev. 109 (3).

Banerjee, A., Banerji, R., Duflo, E., Glennerster, R., Khemani, S., 2010. Pitfalls of participatory programs: evidence from a randomized evaluation in education in India. Am. Econ. J. Econ. Pol. 2 (1).

Beath, A., Christia, F., Enikolopov, R., 2017. Direct democracy and resource allocation: experimental evidence from Afghanistan. J. Dev. Econ. 124.

Beath, A., Christia, F., Enikolopov, R., 2018. Do Elected Councils Improve Governance? Experimental Evidence on Local Institutions in Afghanistan. CEPR Discussion Paper No. DP13053.

Bertrand, M., Duflo, E., Mullainathan, S., 2004. How much should we trust differences-in-differences estimates? Q. J. Econ. 119 (1), 249275.

Beuermann, D.W., Amelina, M., 2018. Does participatory budgeting improve decentralized public service delivery? Experimental evidence from rural Russia. Econ. Govern. 19 (4).

Björkman, M., de Walque, D., Svensson, J., 2017. Information is power: experimental evidence on the long-run impact of community-based monitoring. Am. Econ. J. Appl. Econ. 9 (1).

Björkman, M., Svensson, J., 2009. Power to the people: evidence from a randomized field experiment on community-based monitoring in Uganda. Q. J. Econ. 124 (2).

Casey, K., 2018. Radical decentralization: does community-driven development work? Ann. Rev. Econ. 10 (1).

Casey, K., Glennerster, R., Miguel, E., 2012. Reshaping institutions: evidence on aid impacts using a preanalysis plan. Q. J. Econ. 127 (4).

Cocciolo, S., Ghisolfi, S., Habib, A., Rashid, S., Tompsett, A., 2020. Do Community Water Sources Provide Safe Drinking Water? Evidence from a Randomized Experiment in Rural Bangladesh. Working paper.

Cruz, C., Labonne, J., Querubín, P., 2020. Social network structures and the politics of public goods provision: evidence from the Philippines. Am. Polit. Sci. Rev. 114 (2).

Deaton, A., 1997. The Analysis of Household Surveys. Published for the World Bank. Johns Hopkins University Press, Baltimore.

Duflo, E., Dupas, P., Kremer, M., 2015. School governance, teacher incentives, and pupil teacher ratios: experimental evidence from Kenyan primary schools. J. Publ. Econ. 123.

Fearon, J.D., Humphreys, M., Weinstein, J.M., 2009. Can development aid contribute to social cohesion after civil war? Evidence from a field experiment in post-conflict Liberia. Am. Econ. Rev.: Pap. Proc. 99 (2).

Fearon, J.D., Humphreys, M., Weinstein, J.M., 2015. How does development assistance affect collective action capacity? Results from a field experiment in post-conflict Liberia. Am. Polit. Sci. Rev. 109 (3).

Gibbons, C.E., Serrato, J.C.S., Urbancic, M.B., 2019. Broken or fixed effects? J. Econom. Methods 8 (1).

Gugerty, M.K., Kremer, M., 2008. Outside funding and the dynamics of participation in community associations. Am. J. Polit. Sci. 52 (3).

Horrace, W.C., Oaxaca, R.L., 2006. Results on the bias and inconsistency of ordinary least squares for the linear probability model. Econ. Lett. 90.

Humphreys, M., de la Sierra, R.S., van der Windt, P., 2019. Exporting democratic practices: evidence from a village governance intervention in Eastern Congo. J. Dev. Econ. 140.

Imbens, G.W., Rubin, D.B., 2015. Causal Inference for Statistics, Social, and Biomedical Sciences: an Introduction. Cambridge University Press.

Johansson, P.-O., 1992. Altruism in cost-benefit analysis. Environ. Resour. Econ. 2.

Khwaja, A.I., 2004. Is increasing community participation always a good thing? J. Eur. Econ. Assoc. 2 (2/3), 427436 Papers and Proceedings of the Eighteenth Annual Congress of the European Economic Association.

King, E., Samii, C., 2014. Fast-track Institution Building in Conflict-Affected Countries? Insights from Recent Field Experiments. World Development, p. 64.

Kling, J.R., Lieberman, J.B., Katz, L.F., 2007. Experimental analysis of neighborhood effects. Econometrica 75 (1).

Lewis, D., Hossain, A., 2008. Beyond 'the net'? Institutions, elites and the changing power structure in rural Bangladesh. In: Gellner, D., Hachhethu, K. (Eds.), Local Democracy in South Asia: Microprocesses of Democratization in Nepal and its Neighbours. Sage Publications, New Delhi.

Lin, W., 2013. Agnostic notes on regression adjustments to experimental data: reexamining Freedman's critique. Ann. Appl. Stat. 7 (1).

Mansuri, G., Rao, V., 2013. Localizing Development: Does Participation Work? World Bank, Washington, DC.

Miguel, E., Kremer, M., 2004. Worms: identifying impacts on education and health in the presence of treatment externalities. Econometrica 72 (1), 159217.

Olken, B.A., 2007. Monitoring corruption: evidence from a field experiment in Indonesia. J. Polit. Econ. 115 (2).

Olken, B.A., 2010. Direct democracy and local public goods: evidence from a field experiment in Indonesia. Am. Polit. Sci. Rev. 104 (2).

Pandey, P., Goyal, S., Sundararaman, V., 2009. Community participation in public schools: impact of information campaigns in three Indian states. Educ. Econ. 17 (3).

Pitt, M., Rosenzweig, M.R., Hassan, N., 2020. Identifying the Hidden Costs of a Public Health Success: Arsenic Well Water Contamination and Productivity in Bangladesh. Review of Economic Studies. forthcoming.

Pradhan, M., Suryadarma, D., Beatty, A., Wong, M., Gaduh, A., Alisjahbana, A., Artha, R.P., 2014. Improving educational quality through enhancing community participation: results from a randomized field experiment in Indonesia. Am. Econ. J. Appl. Econ. 6 (2).

Sheely, R., 2015. Mobilization, Participatory Planning Institutions, and Elite Capture: Evidence from a Field Experiment in Rural Kenya, vol. 67. World Development.

Smith, A., Lingas, E., Rahman, M., 2000. Contamination of drinking water by arsenic in Bangladesh: a public health emergency. Bull. World Health Organ. 78, 10931103.

Thaler, R.H., 1988. Anomalies: the ultimatum game. J. Econ. Perspect. 2 (4).

van Geen, A., Ahmed, K.M., Ahmed, E.B., Choudhury, I., Mozumder, M.R., Bostick, B.C., Mailloux, B.J., 2015. Inequitable Allocation of Deep Community Wells for Reducing Arsenic Exposure in Bangladesh. Journal of Water, Sanitation and Hygiene for Development.

van Geen, A., Ahsan, H., Horneman, A.H., Dhar, R.K., Zheng, Y., Hussain, I., … Graziano, J.H., 2002. Promotion of well-switching to mitigate the current arsenic crisis in Bangladesh. Bull. World Health Organ. 80 (9).

van Geen, A., Trevisani, M., Immel, J., Jakariya, M., Osman, N., Cheng, Z., … Ahmed, K., 2006. Targeting low-arsenic groundwater with mobile-phone technology in Araihazar, Bangladesh. J. Health Popul. Nutr. 24 (3).

van Geen, A., Zheng, Y., Versteeg, R., Stute, M., Horneman, A., Dhar, R., … Ahmed, K.M., 2003. Spatial variability of arsenic in 6000 tube wells in a 25 km2 area of Bangladesh. Water Resour. Res. 39 (5).

White, H., Menon, R., Waddington, 2018. Community-driven Development: Does it Build Social Cohesion or Infrastructure? A Mixed-Method Evidence Synthesis. 3ie Working Paper 30.

Wong, S., 2012. What Have Been the Impacts of World Bank Community-Driven Development Programs? CDD Impact Evaluation Review and Operational and Research Implications. The World Bank Social Development.

Wong, S., Guggenheim, S., 2018. Community-driven Development: Myths and Realities. World Bank Policy Research Working Paper 8435.

World Bank, 2003. World Development Report 2004: Making Services Work for Poor People. The World Bank, Washington, DC.