The Importance of 'Exit and Voice' in the Provision of Clean Water: Evidence from India and Sri Lanka

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I. Introduction[1]

Over one billion people--most of the world's poor--do not have affordable access to clean water and sanitation facilities. This increases sickness and morbidity, decreases available time and resources for productive activity and thereby reduces well-being. Since these services have certain technological and economic characteristics that lead to underprovision in markets, they are often viewed as a government responsibility. However, public delivery has often been inadequate because of lack of knowledge of users' preferences, fiscal failures, and shirking and corruption by civil servants -- in democratic and undemocratic regimes alike.

In response to these failures, staff and clients of international development agencies and Non-Governmental Organizations (NGOs) now advocate a decentralized approach to the provision of water and sanitation services that relies on 'coproduction' by community members and civil servants (Briscoe and Garn 1995). This approach is based on lessons-learned from erstwhile projects (Garn 1987) and from emerging evidence on the role of institutions,

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[1] This first part of this chapter is a substantial reworking of Isham and Kähkönen (1996). We thank Hans Binswanger, Keith McLean, Suzanne Piriou-Sall and Louis Poulequin for comments on a preliminary draft; and Elinor Ostrom, Norm Uphoff, Ron Oakerson, Andrew Steer and participants at the Southern Economic Association (1996) and the World Bank's *International Workshop on Rural Infrastructure* (1997) for encouraging us to pursue this work. The empirical material in this chapter paper, initially prepared for two impact evaluation studies by the Operations Evaluation Department (OED) at the World Bank, is detailed in Isham and Kähkönen (1999). We thank Mike Garn for guidance on this research; Robert Picciotto and Roger Slade for the opportunity to participate in these studies; Tauno Skytta and Ron Parker for their guidance and critiques of the impact evaluation studies; the staffs of ORG-MARG SMART in Sri Lanka and of ORG-MARG in India for implementing the surveys and providing the material for the case studies; and Jeremy Highsmith for research assistance. We also thank Madhur Gautam (OED peer reviewer), Warren Van Wicklin (OED peer reviewer), Omar Azfar, Christiaan Grootaert, Mike Garn, Shahrukh Khan, Margaret Madajewicz, Timi Mayer, Meghan O'Sullivan, Lant Pritchett, T.N. Srinivasan, Thierry van Bastelaer, Michael Woolcock, and participants at the *Conference on Democracy and Development* at Middlebury College for their comments and criticisms on this material. Finally, we fondly remember Mancur Olson for his leadership and friendship.

participation, and social capital in water service delivery (Ostrom, Schroeder, and Wynne 1993; Isham, Narayan, and Pritchett 1995; Narayan and Pritchett 1996; Sara and Katz 1998; Isham and Kähkönen 2002). Coproduced water and sanitation services call for open and transparent participation by villagers and civil servants. In doing so, this approach recognizes the importance of incentives faced by these stakeholders and the role of institutions -- including community-level social capital -- in affecting these incentives.

This chapter explores the determinants of coproduced water services in Sri Lanka and India, two ostensibly democratic regimes. Building on the previous analysis of quantitative and qualitative data from 1,088 rural households and 50 water committees in Sri Lanka and India (Isham and Kähkönen 1999), the paper explores how service rules and practices that permit 'exit and voice' by households affect the impact and performance of coproduced water services. Accordingly, in contrast to the country-level studies found elsewhere in this volume, this chapter asks how democratic institutions affect the standard of living at the household level. The motivation for this investigation can be found in previous studies on the relationship between democratic institutions at the national and local levels. Sen (1984), for example, argues that India, with its much vaunted democracy, has been able to prevent major catastrophes like famines – but has been unable to guarantee a better and more dignified existence for its people[2].

The paper proceeds as follows. Section II discusses market, collective action, and government failures associated with provision of water and sanitation services. Section III discusses

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[2] For an analysis of the interaction of democratic (and non-democratic) national and local institutions in the developing world, see Narayan (2002).

the promise and challenges of coproduction. Section IV presents the econometric results of the determinants of performance, and Section V concludes.

II. Market, Collective Action and Government Failures In Water and Sanitation Provision

In much of the developing world, water and sanitation services either do not exist or function poorly because of inherent characteristics that complicate their provision. Whether the provision of a service is most efficiently coordinated through markets, collective action (defined as voluntary action by community members as a group), or government depends partly on its economic and technological characteristics, particularly the degree of rivalry and excludability and the presence of scale economies (Kessides 1993; Ostrom, Gardner and Walker 1994)[3].

Water and sanitation services are often non-rival and excludable--and are thus classified as toll goods.[4] Non-rival services can be consumed jointly by several people since "one man's consumption does not reduce some other man's consumption" (Samuelson 1954). Excludable services can exclude consumption by others at a relatively low cost. Water and sanitation services also often involve significant scale economies, which further complicates their delivery.

The next three subsections illustrate why markets, collective action, and government may

[3] Based on the presence or absence of rivalry and excludability, goods and services can be classified into four categories: private, public, toll, and common pool. See World Bank (1994) and Picciotto (1995) for a discussion of the importance of these characteristics in the provision of development projects.

[4] Some water and sanitation services are public goods--non-excludable and non-rival. This paper focuses only on services that are toll goods. The analysis of toll goods applies, however, also to local public goods which have a spatial dimension.

fail to provide water and sanitation services at the optimal level.

A. Market Failure

Markets may fail to provide water and sanitation services at all because of scale economies related to production. These systems may require large, indivisible investments in networks which attach multiple nodes: where these indivisibilities are large and property rights are underdeveloped, private investors can not earn an adequate return and thus may fail to provide them. Furthermore, market prices cannot be used to ration non-rival services: if the service is non-rival, the marginal cost of additional users--and thus the market price of the service--is zero (Oakland 1987). When markets do provide water and sanitation services, they may not be provided at optimal levels in an unregulated market because of natural monopolies created by network provision or because of externalities.

B. Collective Action Failure

Although a non-rival and excludable service can be optimally provided by the formation of a club (Buchanan 1965; Sandler and Tschirhart 1980), the provision of water and sanitation services through collective action may fail[5]. The reasons for failure often include high fixed costs or lack of technical knowledge and skills: community members in many regions may lack the required physical and human capital resources.

Since certain infrastructure services are non-rival and non-excludable, it is worth comparing these two cases. In the case of a pure public service, collective action may fail

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[5] This club result holds assuming that exclusion costs do not exceed gains from allocating the service in a club arrangement.

because of the free-rider problem. When a service is non-excludable, many community members will fail to contribute to its provision. The relative success of collective action in optimally providing the service depends on the size of the group, homogeneity of group members in terms of tastes and endowments, and the available communication technology. According to theory, collective action is likely to succeed when the group size is small (Chamberlin 1974; McGuire 1974) and when group members interact frequently, communicate easily, and share common values and beliefs. The larger is the group of beneficiaries, the less likely the service will be provided optimally through collective action (Dixit and Olson 1996)[6]. In general, collective action for non-rival and non-excludable goods will yield suboptimal provisions (Olson 1965; Hardin 1982; Sandler 1992).

C. Government Failure

Because of market and collective action failures, government intervention in the provision of infrastructure services is often justified. In theory, government can provide the pareto-optimal level of the service by using lump-sum taxation from community members as a selective incentive to coerce collective action. In practice, governments often fail to provide water and sanitation services optimally because of: non-availability of lump sum taxes; fiscal constraints due to a limited tax base; lack of knowledge of users' needs; and shirking and corruption by civil servants.

[6] Sandler (1992) points out that this outcome depends on the technology of supply.

First, a government may fail to provide these services optimally because it must use distortionary taxes. Unlike lump sum taxes, distortionary taxes lead to a sub-optimal solution (Auerbach and Feldstein 1987). Second, a government may have a limited tax base. In particular in developing countries, governments are often unable to collect tax revenues needed to satisfy demand for water and sanitation services. Third, a government may not know community members' preferences. The traditional lump sum tax analysis assumes that the government has full knowledge of preferences. But in fact, the government does not have at its disposal all the requisite information[7]. As a result, government provision may not be optimal.

Finally, government may fail to provide these services optimally because of opportunistic behavior of civil servants. Shirking and corruption by civil servants is likely unless they work under well-designed incentive mechanisms (Wade 1988, 1994; Uphoff 1994). Civil servants may embezzle portions of tax revenues or other funds intended to finance the service (IRIS 1996): case studies from around the world indicate that illegal payoffs can increase the cost or lower the quality of public works projects by as much as 30 to 50 percent (Rose-Ackerman 1996).

Overall, these results raise a question: what can be done when markets, collective action, and governments fail to provide services at efficient levels?

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[7] As recognized by Samuelson (1954), an individual may have an incentive to understate demand for the service if the amount he has to pay for the service--under any payment scheme--is related to its "revealed preference".

III. The Promise of Coproduction

Recently, a decentralized approach to the provision of water and sanitation services has emerged (Briscoe and Garn 1995) that relies on coproduction, defined as “a process through which inputs from individuals who are not in the same organization are transformed into goods and services” (Ostrom 1996). Coproduction in this paper refers to the production of water and sanitation services through a joint effort of community members and civil servants. Members of both groups contribute inputs into the production process: community members devote time to the design, operation, and maintenance of parts of the system; and civil servants oversee inputs provided by the government. Note that the government is not contracting community members to produce the service: they voluntarily participate by contributing inputs to the production process.

Previous work on coproduction (Whitaker 1980; Parks *et al.* 1982; Ostrom and Ostrom 1987; Lam 1996; and Ostrom 1996) and case studies of decentralized water and sanitation services (Watson 1995; Watson and Jaggannathan 1995; Sara, Gross, and van den Berg 1995; Tavares 1995) document the promise--and the challenge--of this approach. Coproduction of water and sanitation services may alleviate government failure by: alleviating fiscal pressures on the government; providing a means of revealing community members' preferences; and increasing transparency and accountability within the government.

First, coproduction may relieve fiscal pressures. In general (as discussed below), inputs supplied by community members complement inputs supplied by civil servants. However, some tasks may be carried out equally well by members of either group. For inputs that are substitutable, the most efficient service production uses the least-cost producer[8]. The division of labor depends in that case on the government wage rate and the opportunity cost of a community member. In developing countries, the local reservation wage is likely to be lower than the wage rate of a government worker, so that some tasks should be reallocated.[9] This reallocation of labor would, *ceteris paribus*, both relieve the pressure on the government budget and increase the production of services.

Second, adopting coproduction may help to reveal community preferences and ensure that services match what community members want, are willing to pay for, and will be motivated to maintain. If community members devote time to the design, operation, and maintenance of water and sanitation facilities and thereby reveal their preferences, asymmetric information problems will be alleviated. Since community inputs complement inputs supplied by the government, production will shift towards the optimal level.

Third, coproduction may decrease the opportunities for shirking and corruption among civil servants by increasing transparency and accountability. When community members participate in the design, operation, and maintenance of services, the flow of information and the

[8] Assuming that the producer would be motivated to work up to its capacity.

[9] As Ostrom (1996) has stated: "many poor regions and neighborhoods are characterized by severe underutilization of the knowledge, skills, and time of residents--which means the opportunity costs of devoting these inputs to the creation of valued public outputs are low."

interaction among stakeholders reduces the opportunities for civil servants to embezzle tax revenues or other funds allocated for public works.

Fourth, social capital can influence the existence and effectiveness of service rules and practices in coproduced services. Social capital refers to the norms and networks that facilitate collective action (Woolcock 1998). Community-level social capital is likely to help community members to craft and enforce the service rules that govern the design, construction, and O&M. The collective demand for the type and level of services is more likely to be clearly expressed when community members are accustomed to working together, where leaders are accountable, and where all stakeholders have a voice. Water users groups are more likely to succeed in communities with cohesive community groups and regular civic activities. Formal and informal social ties deter community members from free riding and constrain community leaders from shirking and expropriating funds.

IV. The Determinants of Coproduced Water Services in Sri Lanka and India.[10]

To analyze the impact and performance of coproduced water services in Sri Lanka and India, data were collected in 1997 from 50 communities with services partially financed by three World Bank projects: Community Water Supply and Sanitation Project in Sri Lanka; Maharashtra Rural Water Supply and Environmental Sanitation Project in India; and Karnataka Rural Water Supply and Environmental Sanitation Project in India. The Sri Lankan project supported 18

[10] Much of the material in this section is further detailed in Isham and Kähkönen (1999).

communities through out the country: the other projects supported 12 and 20 communities, respectively, in the Indian provinces of Maharashtra and Karnataka.[11] Quantitative data were collected through a survey of 1088 households and 50 water committees.[12] Qualitative data were gathered through focus group interviews with community members and interviews with local government officials.

Analysis of these data indicates that the impact and performance of these water services have been mixed. The projects in India have had a greater positive impact on health than the project in Sri Lanka. Fifty-four percent of households in Maharashtra reported that their family's health has improved, as opposed to 45 percent in Karnataka and 36 percent in Sri Lanka. The reduction in the incidence of diarrhea was highest in Karnataka, and about the same in Sri Lanka and Maharashtra.[13]

Also, projects in India have resulted in large time-savings. In Karnataka and

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[11] Because the Sri Lankan project supported communities through out the country while the other projects supported communities in two different Indian provinces, the first project is referred to as the 'Sri Lankan' project in the text below, while the Indian projects are referred to as 'Maharashtra' and 'Karnataka.'

[12] Communities were selected randomly from a list of all communities that had had access to potable water through the project for at least a year. The survey was carried out in 68 communities, but 18 of these had to be dropped from the analysis in this paper because of incomplete answers or absence of water committees. All these communities were in India. Neighborhoods and households to be polled were selected randomly. The interviews were conducted at times that were convenient to the villagers to ensure maximum participation of both women and men. In some communities the water committee was part of the local government.

[13] To verify the impact of the new service on household health, households in Karnataka and Maharashtra that did not use the new water service were also surveyed as a control group. The results show marked differences in the incidence of diarrhea among the users and non-users of project-financed water services. At the time of the survey, five percent of households using new water systems in Karnataka and 15 percent using new water systems in Maharashtra had suffered diarrhea in the past two weeks, while the incidence of diarrhea among non-users was 13 percent in Karnataka and 23 percent in

Maharashtra, households reduced daily collection time by 62.6 and 53.9 minutes, respectively. The respective reduction in Sri Lanka was 40.6 minutes. The within-project differences were also large. For example, in the two Indian projects, 10 percent of households report that they still spend two hours or more collecting water after the project has been implemented.

Many performance indicators , however, suggest that the performance of the Sri Lankan project has been superior. For example, 86 percent of households in Sri Lanka were satisfied with service design, as opposed to 71 percent and 45 percent, respectively, in the Indian projects. The average quality of water delivered was highest in Sri Lanka. (although the average quality of construction was highest in Karnataka.)

How can improved health be higher among households in Maharashtra if the project has worse performance? Likewise, how can improved health and time savings be lower among the Sri Lankan households compared to the Indian households, despite generally better performance? The health impact results may be explained by lower initial health conditions in Maharashtra than in Karnataka and Sri Lanka: households that did not use a project-financed water system had significantly higher incidence of diarrhea in Maharashtra (23%) than in Karnataka (13%) and much lower incidence and medical treatment of diarrhea in Sri Lanka. Accordingly, these results are consistent with decreasing returns to health interventions: as a result of the same intervention, households with better initial health experiencing smaller health improvements than households with worse initial health. Likewise, the absolute time savings in Sri Lanka project were lower because the pre-project collection times were significantly lower than in the Indian projects: 76

Maharashtra.

minutes as opposed to 147 and 129 minutes, respectively

A. Proximate determinants of impact

This section provides empirical evidence of the linkage between service performance and service impact, using data from the household and water committee surveys. To estimate the proximate determinants of health impacts, begin with an econometric model based on the following relationship:

$$H_{ij}^* = \beta_0 + D_j\beta_1 + C_j\beta_2 + \mathbf{X_{ij}\beta_3} + \varepsilon_{ij}, \qquad (1)$$

where H_{ij}^* is a latent random variable for household *i* in community *j* which is some measure of the changed health of the household since the implementation of a community-based water service. Assume that H_{ij}^* is a linear function of a set of non-stochastic independent variables and an error term (ε_{ij}). These covariates include (as discussed in the previous sections): D_j, design performance of the water service in community *j;* C_j, construction performance of the water service in community *j*; and $\mathbf{X_{ij}}$, a vector of household-specific characteristics.

The dichotomous variable 'improved health,' is used as the dependent variable (with Probit estimation) to test the relationship presented in equation (1), because the available data do not include continuous measures of the change of household health.[14] The community-level independent variables used to test these relationships[15] are 'community design satisfaction', the share of households in each community that were satisfied with project design; and 'good quality

[14] Using the notation in equation (1), let 'improved health' be relabeled H_{ij}, so that $H_{ij} = 1$ if $H_{ij}^* > 0$ and $H_{ij} = 0$ if $H_{ij}^* \leq 0$. Probit estimation is used here: in no case does using other techniques for analyzing dichotomous dependent variables, including linear probability or logit analysis, alter the fundamental results reported below.

construction', a dummy variable for well-built water systems. The household-level independent variables are 'hygiene training', a dummy variable for households that have attended a hygiene class; 'household size', the number of residents in the household; and 'household assets', a composite index of household durable goods.[16]

The results of testing the linkage between performance and health impacts (equation 1), are listed in Table 1 and summarized as follows:[17]

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[15] See Appendix Table 1 in Isham and Kähkönen (1999) for the summary statistics of these variables.

[16] As in Narayan and Pritchett (1999), we build a composite index of household wealth from a weighted sum of household durable goods such as radios, refrigerators, and sewing machines. It is also possible to use self-reported consumption expenditures as a proxy for long-run household economic status; Filmer and Pritchett (1998); argue that an asset index works better than consumption expenditures as this proxy.

[17] The econometric procedures in this section use the following guidelines, except where noted in the text. First, because of the differences in project design (and the likelihood of region-specific omitted variables), all econometric results are reported by project. Second, all results use household-level dependent variables. Third, since heteroskedasticity (non-constant variance of the error term) is likely in the underlying econometric equations, all results are reported with Huber-adjusted standard errors. We thank Chris Grootaert for his suggestions in this regard.

Table 1: Determinants of improved health

	Sri Lanka	Karnataka	Maharashtra
<u>Community-level</u>			
Community design satisfaction	0.72 ***	0.84 ***	0.38 ***
	(0.26)	(0.20)	(0.09)
Good quality construction	0.13 **	0.10	0.18 ***
	(0.05)	(0.07)	(0.06)
<u>Household-level</u>			
Hygiene class	0.13 **	0.01	0.20 ***
	(0.05)	(0.12)	(0.05)
Household size	0.01	-0.01	0.01
	(0.014)	(0.006)	(0.006)
Household assets	0.00	0.00	0.00
	(0.003)	(0.003)	(0.002)
Number of households	377	290	421
Number of communities	18	12	20

Notes:
Source: (Isham and Kähkönen 1999)
Dependent variable is household-level improved health.
Probit estimation, with Huber-adjusted standard errors (in parentheses).
Estimates are marginal changes in probability of independent variable.
Significance levels are: *** (.99%); ** (.95%); * (.90%)
See text for descriptions of variables.

- Improving community satisfaction with service design enhances the service's health impact. 'Community design satisfaction' is a significant and positive determinant of improved health in all three projects. A one-standard deviation increase in 'community design satisfaction' is associated with an increase in the probability of improved health of 0.09 in Sri Lanka, 0.13 in Karnataka, and 0.11 in Maharashtra..[18]

[18] These results on 'community design satisfaction' could be biased upward due to reverse causality if improved household health leads the household to report that they are satisfied with project design. To test for this possibility, 'community design satisfaction' was replaced with "neighbors' design

- Ensuring that water services are well constructed enhances the service's health impact. 'Good quality construction' is a significant and positive determinant of improved health in Sri Lanka and Maharashtra (and positive in Karnataka).[19] A change from bad quality (the presence of serious construction defects) to good quality (the absence of serious construction defects) construction is associated with an increase in the probability of improved health of 0.13 in Sri Lanka and 0.18 in Maharashtra.[20]
- Providing hygiene training (or ensuring that hygiene training is provided by other sources) enhances the service's health impact. Enrollment in a hygiene class is associated with an increase in the probability of improved health of 0.13 in Sri Lanka and 0.20 in Maharashtra.[21]
- Non-institutional household variables (household size and assets) are not significant determinants of improved health in any of the three projects. This is true also of indicators (not reported here) such as household demographics and wealth[22] and the

satisfaction", the share of all other community members that were satisfied with the project design. In similar specifications, the respective coefficients for this variable are 0.67, 0.77, and 0.37, all at significance levels greater than 0.99%.

[19] In Karnataka, the magnitude of the coefficient is similar to that of the other projects, but the significance level is much lower. Evaluation of the data gathering in Karnataka suggests that there is large measurement error, another justification for separating the results by project.

[20] Similar results can generally be shown using a set of alternative measures of construction quality based on more detailed questions (for example, 'leakage in networks' and 'frequent system failures').

[21] The latter result may be subject to reporting bias. It is possible that households who have taken a class will report 'improved health', even when an objective analysis would show no measurable improvements.

[22] For example, number of children in the household and self-reported household income and

type of previous drinking water source used by the household (for example, hand-dug well or spring).[23]

Overall, the results in this section suggest that well-designed and well-constructed coproduced water services are likely to improve household health. They also underline the importance of providing hygiene classes in conjunction with a water project for improving household health. While these conclusions are certainly not ground breaking, these results allow one to establish the statistical significance and relative magnitudes of the importance of well-designed and well-constructed water services across three different projects.[24]

B. Institutional determinants of performance

Do community participation and decision-making lead to higher satisfaction with service design? To answer this question, three household-level dummy variables were created from survey questions about the service design process. First, 'local initiation' indicates that community members, as opposed to government officials or other outsiders, had the *original idea* to build the water system. Second, 'design participation' indicates that the household

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expenditures.

[23] One possible objection to these results is that the self-reported 'improved health' variable is not an accurate indicator of the project impact. Within each project, self-reported 'improved health' is positively correlated (at the 10 percent significance level or better) with most of the other impact and performance indicators in Table 1, including the performance indicators from the technical assessments. The exceptions are 'change of collection time' in Sri Lanka, 'no construction defects' in Karnataka, and 'non-colored water' in Sri Lanka and Karnataka. In addition, Isham and Kähkönen (1999) present similar results in a comparable econometric model of the determinants of time-saving impacts.

[24] While many case studies support these overall findings, there is a surprising lack of empirical studies that test the basic determinants of performance of community-based water services. The approach used here does build on the survey instruments and some of the findings of Sara and Katz (1998), Narayan (1999) and Isham and Kähkönen (2002).

participated in service design. Third, 'local decision-making' reflects that community members, as opposed to government officials or other outsiders, made the *final decision* about what type of system to build.[25]

Table 2 reports results from probit estimates of the household-level determinants of 'satisfaction with service design', with community fixed effects.

Table 2: Institutional determinants of satisfaction with service design

	Sri Lanka	Karnataka	Maharashtra
Local initiation	0.063	0.049	-0.126
	(0.040)	(0.087)	(0.100)
Design participation	0.196 ***	0.253 **	0.419 ***
	(0.094)	(0.069)	(0.096)
Local decision-making	0.191 ***	0.322 ***	0.540 ***
	(0.055)	(0.086)	(0.128)
Community fixed effects	Yes	Yes	Yes
Number of households	336	265	381
Number of communities	16	11	18

Notes:
Source: (Isham and Kähkönen 1999)
Dependent variable is household satisfaction with the design of the water system.
Multivariate probit estimation, with Huber-adjusted standard errors (in parentheses).
Estimates are for discrete changes of independent dummy variables.
Significance levels are: *** (.99%); ** (.95%); * (.90%)
See text for descriptions of variables.

The results can be summarized as follows[26]:

[25] The summary statistics for these variables underline the different approaches to service design across each project, as discussed in Section II. In particular, the means for 'design participation' (0.84, 0.11, 0.21, respectively) and 'local decision-making' (0.72, 0.56, 0.30, respectively) confirm that the Sri Lanka project was the most participatory in terms of soliciting local opinions and giving community members a voice in the design process.

[26] Note that the sample sizes in these specifications are smaller than in Table 1 because they use community fixed effects and in two communities in Sri Lanka, one community in Karnataka and two

- Households are no more satisfied with service design when the original idea to build a system comes from community leaders rather than from outsiders.
- User participation in design leads to greater satisfaction with service design. A discrete change from not participating to participating leads to an increase in the probability of being satisfied with service design of 0.196, 0.253, and 0.419 in Sri Lanka, Karnataka, and Maharashtra, respectively.[27]
- Letting locals make the decision about the system type leads to greater satisfaction with service design. A discrete change from stating that local decision-making did not prevail to stating that it did leads to an increase in the respective probabilities of 0.191, 0.322, and 0.540.

These results show that households are more likely to be satisfied with service design when they have participated in the design process and when the community makes the final decision about service type. This is true within each project and within each community (given the use of community fixed effects), despite different approaches to service design among the projects. In addition, these results indicate that the initiation of well-designed services can begin from outside *or* inside of the community, as long as local participation in design and decision-making is ensured.

What are the institutional determinants of good construction? Is construction better when

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communities in Maharashtra, there is no household that that reported satisfaction with project design.

[27] In this context, it would have been helpful to know whether households fully understood the financial obligations that they incurred by the choice of one system over another. However, data to analyze this were not available.

household contributions are monitored and sanctions against misconduct are imposed, as suggested by the framework? Since 'good quality construction' is a community-level variable, the sample size for addressing these questions econometrically must be 50, the number of communities in the sample. Table 3 lists the within-project associations between 'good quality construction' and two indicators of service rules and practices. 'Construction monitoring' is the community share of households that said that the required construction contributions (cash or labor) were monitored by other community members. 'Construction sanctions' is the community share of households that said that households that did not contribute their share were charged a financial penalty.[28]

Table 3: Institutional determinants of good quality construction

	Specifications	
	(1)	(2)
Construction monitoring	1.02 ***	-
	(0.37)	
Construction sanctions	-	-0.07
		(0.27)
Karnataka dummy	0.40 *	0.08
	(0.17)	(0.20)
Maharashtra dummy	0.33	-0.39 **
	(0.26)	(0.17)

Notes:
Source: (Isham and Kähkönen 1999)
Dependent variable is 'good quality construction'. Sample size is 50.
Probit estimation, with Huber-adjusted standard errors (in parentheses).
Estimates are marginal changes in probability of independent variable.
Significance levels are: *** (.99%); ** (.95%); * (.90%)
See text for descriptions of variables.

[28] The means and (standard deviations) for 'construction monitoring' and 'construction sanctions' are 0.43 (0.37) and 0.20 (0.29), respectively. Even though not required by project design, some households in India--particularly in Karnataka--reported contributing cash or labor to service construction and noted the existence of monitoring and sanctioning of these contributions.

The analysis yields the following results about the determinants of ‘good quality construction’:

- Existence of monitoring mechanisms leads to better quality construction. A one-standard deviation increase in ‘construction monitoring’ increases the probability of ‘good quality construction’ by 0.38.
- Existence of construction sanctions does not measurably improve construction quality.[29]

Overall, the results in this sub-section show that community participation and decision-making in service design lead to well-designed services, and monitoring of household contributions to construction lead to better-constructed services.

C. Social capital and service rules

This section tests if social capital is a significant determinant of ‘design participation’ and ‘construction monitoring’. An econometric model based on the following relationship is used to assess the influence of social capital on service rules:

$$P_{ij}* = \theta_0 + S_{ij}\theta_1 + \mathbf{X_{ij}}\theta_2 + \mathbf{X_j}\theta_3 + \mu_{ij}\ , \qquad (3)$$

where $P_{ij}*$ is a latent random variable for of household *i* in community *j* which is some

[29] This may reflect the fact that only a small share of households in each community reported that sanctions were imposed on non-contributors. Most households stated that even though there may have been rules about sanctions, nothing in practice happened to non-contributors. The rules about sanctions were never enforced. Another possibility is that informal social sanctions, in the presence of effective monitoring, are a constraint against household free riding.

measure of the intensity[30] of design participation; S_{ij} is a measure of household-level social capital; $\mathbf{X_{ij}}$ and $\mathbf{X_j}$ are vectors of household and community characteristics that could affect the participation decision, and μ_{ij} is an error term. The dichotomous variable ‘design participation’ is used as the dependent variable (with Probit estimation) to test the relationship presented in equation (3), because the available data do not include continuous measures of the intensity of design participation (for example, number of hours spent at a community meeting).

The primary indicator of social capital used is the ‘social capital index’, a composite index of the quantity *and* quality of local groups (based on the ‘Putnam index’ in Narayan and Pritchett 1999), that attempts to capture the underlying behavior of interest: that a household has established a pattern of working cooperatively with other households and community leaders. As summarized in the second part of Appendix Table 1, this indicator is created as follows. First, ‘number of groups’ is the number of community groups to which a household belongs. This includes economic groups (such as, farmer’s groups and credit/finance groups), religious groups, and social groups (such as, women’s groups and youth groups). Second, ‘group characteristics’ is an additive sub-index of various characteristics of each household’s most important group, including heterogeneity of members by caste and religion, heterogeneity of members by occupation, the nature of decision-making mechanisms, and effectiveness of group functioning. The additive sub-index is increased by one unit if a household’s most important group has: caste groups that are proportionally represented; different religions that are proportionally represented;

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[30] Intensity of design participation would be measured, for example, by hours per household. As pointed out by a peer reviewer, this is to be distinguished from the quality of participation.

members with different occupations; leaders with different occupations; or participatory decision making. In addition, it is increased by one unit with each increment in the five-point functioning rating (from ‘very poor’ to ‘excellent’). For example, a rating of ‘poor’ adds two units, where a rating of ‘very good’ adds four units.[31] The ‘social capital index’ is the product of ‘number of groups’ and ‘group characteristics.’[32] For example, a household that belongs to two groups (‘number of groups’ = 2) and whose most important group has a proportional representation of castes, members with different occupations, and is rated as functioning poorly (‘group characteristics’ = 4) would have a social capital index of 8.[33]

Summary statistics for ‘number of groups’, ‘group characteristics’, and the social capital index reveal a dramatic difference in the quantity of associational activity in Sri Lanka and India.[34] On average, households in Sri Lanka belong to 2.4 groups. In Karnataka and Maharashtra, this figure is 0.19 and 0.49, respectively. The means of group characteristics and

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[31] As discussed below, a household that reports no group affiliation receives a value of 0 for this sub-index.

[32] Notwithstanding the obvious difficulties in trying to capture in a common metric the very different phenomena of group heterogeneity, participation, and functioning, this type of index (as in Narayan and Pritchett) attempts to identify, from microeconomic data, characteristics of social capital that have been shown to be important elsewhere, including Esman and Norman (1984) and Putnam (1993). See the discussions in Narayan and Pritchett (1999) and Grootaert (1999) on the pros and cons of using an index of social capital. In particular, Grootaert makes the point that using this kind of multiplicative index means that the group characteristics act like a productivity shifter for the number of groups

[33] The use of an additive sub-index based solely on the survey questions assigns, by default, a relative weight to the value of each question. As in Narayan and Pritchett (1999), we experimented with different weights for the questions that comprise ‘group characteristics’, including weights generated from factor analysis. Since the use of different weights did not dramatically change the overall results, we retain these ‘default’ weights.

[34] See Appendix Table 1 in Isham and Kähkönen (1999).

the social capital index are: 7.48 and 25.38; 1.10 and 1.55; and 1.81 and 3.14, respectively.[35]

An alternative social capital indicator is 'help from outsiders', a dummy variable that indicates that a household could get help from non-family members in difficult times. Community members that can do so are likely to have established productive norms and networks with neighboring households. The project-level means for this indicator are 0.61, 0.62, and 0.60, respectively.

Table 4: Determinants of participation in service design

	(1)	(2)	(3)	(4)	(5)	(6)
	Sri Lanka		Karnataka		Maharashtra	
Household indicators						
Social capital index	0.0040 ***	0.0053 ***	0.0182 ***	0.0148 ***	0.0181 ***	0.0142 ***
	(0.0016)	(0.0017)	(0.0049)	(0.0043)	(0.0035)	(0.0044)
Household assets		-0.0022		0.0038 **		0.0022
		(0.0019)		(0.0013)		(0.0023)
Household size		0.0005		0.0132		0.0000
		(0.0098)		(0.0025)		(0.0055)
Community fixed effects	No	Yes	No	Yes	No	Yes
Number of households	367	367	290	264	421	315
Number of communities	18	18	12	11	20	15

Notes:
Source: (Isham and Kähkönen 1999)
Dependent variable is household participation in the design of water system.
Probit estimation, with Huber-adjusted standard errors (in parentheses).
Estimates are marginal changes in probability of independent variable.
Significance levels are: *** (.99%); ** (.95%); * (.90%)
See text for descriptions of variables.

[35] These village-level means are much lower in Karnataka and Maharashtra since both group characteristics and the social capital index take on the value of 0 when a household has no group membership. As noted in Appendix Table 1, the means of group characteristics among households that belonged to groups are 7.56, 7.23 and 6.47, respectively; the means of the social capital index among households that belonged to groups are 25.65, 10.47 and 11.41, respectively. These differences show that groups in Sri Lanka and Karnataka are slightly more heterogeneous, participatory, and effective than those in Maharashtra; and that the index of social capital is more than twice as large among households that belonged to groups in Sri Lanka compared to India

- The results summarized in Table 4 reveal that social capital and design participation are associated. Higher household-level social capital is positively associated with participation in the service design. Specifications (1), (3) and (5) shows a statistically significant relationship between the 'social capital index' and 'design participation'. A one-standard deviation increase in the 'social capital index is associated with increases of 0.06, 0.08 and 0.13, respectively, in the probability of design participation (compared to project means for design participation of 0.84, 0.11 and 0.21).

- The statistically significant relationship between social capital and design participation survives the inclusion of other potential covariates. Specifications (2), (4) and (6) reveal that the inclusion of 'household assets' and 'family size', with community fixed effects, does not change the basic relationship between the 'social capital index' and 'design participation'.[36, 37]

The robustness of these results is confirmed in two ways. First, in all six specifications, replacing the 'social capital index' with either of its the sub-indices or 'help from outsiders' yields

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[36] Using community-level fixed effects means that these specifications are capturing the household-level effect of social capital on design participation, controlling for the possible effect of a vector of community-level variables $\mathbf{X}_j$ that could affect the participation decision. Note that the sample sizes in specifications 4 and 6 are smaller because in one community in Karnataka and five communities in Maharashtra, there is no household that that reported participating in project design.

[37] It is important to verify that the results reported in this table are not overly biased by the way that the social capital index is constructed--with a 0 assigned to all households without any group membership. Sets of alternative specifications with only households that report group membership (not reported here) show very similar results. The one exception is an alternative specification (6) among 94 households in Maharashtra, where the coefficient is positive (0.0029) but insignificant.

the same statistically significant relationship between a measure of social capital and design participation.[38] Second, in the two specifications for Sri Lanka, the only project that required household participation in construction, replacing the 'design participation' with the equivalent 'construction participation' yields a statistically significant relationship (not reported here). A one-standard deviation increase in the social capital index is associated with a 0.09 increase in the probability of construction participation. Two of the three alternative social capital indicators ('number of groups' and 'help from outsiders') also yield statistically significant relationships.

Also, community-level social capital is a positive and significant determinant of construction monitoring. Table 5 lists results from community-level specifications--in India and Sri Lanka, respectively--of the determinants of construction monitoring: in addition to the community-level social capital indicator, each specification includes (not shown) community-level averages of assets, household size and (in the case of India), a dummy variable for Karnataka. With two of the four indicators in Sri Lanka and three of the four indicators in India, community-level social capital is a positive and significant determinant of construction monitoring.

[38] These supplementary results are not reported here. The notable exception is 'help from outsiders' in Maharashtra, with a negative marginal effect and a p-value of 0.06.

Table 5.5: Determinants of construction monitoring

Social capital indicator				
Sri Lanka (n=18)	(1) Social capital index	(2) Number of groups	(3) Group characteristics	(4) Help from outsiders
	0.014	0.095	0.283***	1.006***
	(0.011)	(0.094)	(0.111)	(0.312)
India (n=32)	(5) Social capital index	(6) Number of groups	(7) Group characteristics	(8) Help from outsiders
	0.031***	0.164***	0.063***	0.0401
	(0.008)	(0.050)	(0.016)	(0.144)

Notes:
Source: (Isham and Kähkönen 1999)
OLS estimation, with standard errors (in parentheses).
Results from other independent variables not reported.
Estimates are marginal changes in probability of independent variable.
Significance levels are: *** (.99%); ** (.95%); * (.90%)
See text for descriptions of variables.

The results in this sub-section show that household-level social capital leads to participation in service design: in communities with effective community groups, participation in service design is likely to be higher. The results from Sri Lanka show that social capital also tends to increase participation in construction design. Finally, social capital is positively associated with construction monitoring.

What are the implied magnitudes of the effect of social capital on project impact. Isham and Kähkönen (1999) present evidence from two-stage reduced form equations that, in the Sri Lankan project and in Maharashtra, more social capital leads to improved household health for about 26 to 34 households in a community of 200 households (the average size of the communities that were surveyed.)

V. Conclusion

This chapter has analyzed the promise and challenges of coproduced water and sanitation. Using data from Sri Lanka and India, this paper has shown that that certain failures of collective action and government are reduced--but not eliminated--by the adaptation of coproduction. Well-designed and well-constructed coproduced water services do lead to improved household health. Democratic institutions -- rules that enable exit and voice -- increase user satisfaction with service design by involving community members in the design process and by letting community members, not outsiders, make the final decision about the service type. Ensuring that communities have effective mechanisms to monitor household contributions to construction is in turn an effective way to promote well-constructed services.

However, household participation in service design and ability to craft and enforce monitoring mechanisms are not automatic, even in ostensibly democratic countries such as Sri Lanka and India. The empirical results presented here suggest that in communities with high levels of social capital--in particular, with active community groups and associations--design participation is more likely to be high and monitoring mechanisms are more likely to be in place. In those communities, households are accustomed to working together and social ties deter free riding. This suggests a way to place an economic value on community-level social capital in the context of water projects: as the net present value of the marginal increase in health associated with active civic associations.[39]

What do these results, in particular the results about social capital, imply for designers of coproduced water projects in democratic and non-democratic countries alike? They do not necessarily suggest that projects should avoid investing in coproduced water systems in communities with low levels of social capital. Indeed, while many poor communities with the most urgent need for improved water systems are likely to have low levels of social capital[40], people in many of these communities are likely to reliably report a willingness to pay and maintain a water system. Instead, these results suggest that designers of coproduced water projects need to pay attention to the prevailing levels of social capital, as one of the factors that will influence the performance of the project, in communities to be served by the project. When targeting these communities, the allocation of investment resources for water services programs may need to be adjusted to take into account the lack of social capital. Possible adjustments include increased investments in social mobilization efforts (for example, through the strengthening of local organizations) and in more direct supervision by project personnel working in these communities to oversee system performance.[41]

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[39] See Collier (2002) for a general discussion of this point.

[40] For empirical evidence of this general result, see Narayan and Pritchett (1999) and Grootaert (1999).

[41] For more on this last point, see Isham (2002),

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