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Policy Lessons from Implementing India's Total Sanitation Campaign

Dean Spears
Princeton University
NCAER

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www.ncaer.org

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Abstract

Ending widespread open defecation and pursuing feasible methods of safe excreta disposal must be top policy priorities for India. This paper draws policy lessons from the first ten years of latrine construction under India's Total Sanitation Campaign (TSC), a flagship program of the Indian government. So far, the TSC has been able to improve average health and human capital among Indian children where it has been implemented, but sanitation coverage remains substantially incomplete. Indeed, the first ten years of the TSC will have, on average, prevented an infant death for a few thousand dollars, a comparatively very inexpensive average cost. This initial success is in part due to the Clean Village Prize or Nirmal Gram Puraskar (NGP), an incentive for village governments. Heterogeneity in the intensity and effectiveness of TSC implementation suggests that the additional benefits of extending effective TSC implementation to the many remaining Indian children would probably substantially exceed the additional costs. Therefore, as the TSC becomes the Nirmal Bharat Abhiyan, India should not miss the opportunity to invest in successful principles of total sanitation: quality data, effective monitoring, and motivational *ex post* incentives.

Keywords: *Total Sanitation Campaign, open defecation, Nirmal Gram Puraskar, Nirmal Bharat Abhiyan, latrine, infant death, India.*

JEL Classification:

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**Email: dspears@princeton.edu

1. Introduction

Open defecation is a large global problem, but it is substantially and importantly an Indian problem. About 60 percent of the approximately 1 billion people worldwide who defecate openly live in India.[1] Although open defecation may seem remote in some parts of India's modern cities, 600 million people in India – over half of the population – defecate openly. Without a toilet or latrine, they simply go outside. Widespread open defecation has major consequences for health and human capital in India.

This paper draws policy lessons from the first ten years of latrine construction under India's Total Sanitation Campaign (TSC), from 2001 to 2011. The TSC is a "flagship" program of the central Indian government and represents a large effort to improve rural sanitation: over the approximately ten-year period studied, it reports building one latrine per 10 rural people in India. The TSC was designed to improve upon perceived shortcomings of earlier programs: instead of emphasizing subsidies for building infrastructure, it included an *ex post* monetary incentive[2] for local political leaders to eliminate open defecation and made use of village social structures.

Ending widespread open defecation and pursuing feasible methods of safe excreta disposal must be top policy priorities for India. So far, the TSC has been able to improve health and human capital among Indian children, on average, where it has been implemented, but sanitation coverage remains substantially incomplete. Indeed, the first ten years of India's Total Sanitation Campaign (TSC) will have, on average, prevented an infant death for a few thousand dollars, a comparatively very inexpensive average cost. This initial success is in part due to the Clean Village Prize or Nirmal Gram Puraskar (NGP), the incentive for village governments to eliminate open defecation. Heterogeneity in the intensity and effectiveness of TSC implementation suggests that the additional benefits of extending effective TSC implementation to the many remaining Indian children would probably substantially exceed the additional costs. Therefore, as the TSC becomes the Nirmal Bharat Abhiyan, India should not miss the opportunity to invest in successful principles of total sanitation: quality data, effective monitoring, and motivational *ex post* incentives.

1.1. Policy lessons

This paper will explain and review evidence for seven policy lessons drawn from data about sanitation in India and econometric analysis of the impact of the TSC. These conclusions are presented alongside their evidence throughout the paper, and are summarized here:

Policy Lesson 1. *Improving sanitation – meaning safe excreta disposal – must be a top priority for India. Because open defecation has negative externalities, it is everybody's problem, and requires government action.*

Policy Lesson 2. *By promoting and incentivizing latrine use, the TSC has had positive initial impacts on children's health and human capital.*

[1] According to internationally standardized DHS data, open defecation in India in 2005 occurred at a comparable rate to in Namibia in 1992, and was much more common than in Zimbabwe in 1994 or Zambia in 1992.
[2] Some government TSC documents about the TSC refer to what economists call "subsidies" as "incentives"; this paper will follow standard economics terminology in calling the NGP – a conditional, *ex post* reward – an incentive.

Policy Lesson 3. *The TSC and clean village prize together are a comparatively very inexpensive way to save babies' lives.*

Policy Lesson 4. *Villages are a critical level of governance for sanitation intervention.*

Policy Lesson 5. *Incentives to local leaders for outcomes are useful and should be strengthened by both increasing the monetary incentive and devoting resources to ensure accurate evaluation and adjudication.*

Policy Lesson 6. *The additional benefit of extending effective TSC implementation to remaining Indian children would probably substantially exceed the additional cost.*

Policy Lesson 7. *Achieving total sanitation coverage will require both safeguarding the quality of administrative data – perhaps by providing resources for data sources that bypass bureaucratic interests – and investing in large datasets about health outcomes.*

1.2. Overview

This paper reviews and integrates recent papers by the author about sanitation in rural India and adds several new analyses. Therefore, this paper will cover a wide range of topics important to rural sanitation policy in India. Appendix table A briefly summarizes the prior papers incorporated here.

Section 2 presents evidence on the importance of sanitation for health and human capital, and the costs of open defecation. Section 3 reviews research on the effects of the TSC on health and human capital, and computes that the first ten years of the TSC will have prevented an average infant death for only a few thousand dollars. Section 4 documents that villages are a critical level of governance for the implementation of sanitation improvements. Section 5 studies heterogeneity among Indian states in the effectiveness of TSC latrines, and concludes that there is still much room and need for further effort. Section 6 concludes, reviewing policy opportunities as the TSC becomes the NBA.

2. The primacy of sanitation

When this paper refers to "sanitation," it will mean safe excreta disposal in particular (not, for example, water supply or disposal of household trash). There are many constraints on health and development in rural India; among these, why should open defecation be a priority? First, sanitation coverage is particularly poor in India, relative to other countries at similar levels of development. Second, germs from unsafely disposed of feces cause chronic illness and adverse changes in the lining of the intestines of small children, importantly keeping them from growing and developing at critical early ages. Third, these early life health deficits have life-long consequences for human capital, including for achieving adult cognitive potential.

2.1. Suggestions from aggregate comparisons

Historians have long used height as a measure of well-being (Steckel, 2009). However, a puzzle has recently emerged: modern differences across developing countries in GDP per capita do not very well explain differences in average height (Deaton, 2007). In particular, people in Africa are taller than

their level of economic development would predict, and people in India are much shorter. This puzzle does not appear to be explained by international differences in genetic height potential: although the median Indian child is two standard deviations below the international reference population, the best-off Indian children meet international norms (Bhandari, *et al.*, 2002).

Spears (2012b) observes that international variation in open defecation offers one solution to the puzzle. The analysis collapses each of the 140 DHS survey rounds with height and sanitation data into one observation, so a country-year is an observation. The analysis finds that sanitation coverage alone explains 54% of the cross-country variation in the height of children under three years old. India, with relatively short children and high levels of open defecation, falls squarely on the regression line. Moreover, open defecation may be particularly dangerous in India because – even in rural India – population density is very high.

Across DHS survey-years, each additional percentage point of household sanitation coverage is associated with an increase in height approximately equal to 0.01 standard deviations of height in the international reference population. This result is not driven by time trends, fixed heterogeneity across countries, or any single world region, and is robust to the inclusion of a range of control variables, including for GDP. No similar effect is found of other plausible cross-country differences, such as electrification, water supply, political autocracy, and FAO estimates of average calorie deficits.

Figure 1: Differences in sanitation across Indian states explain children's height

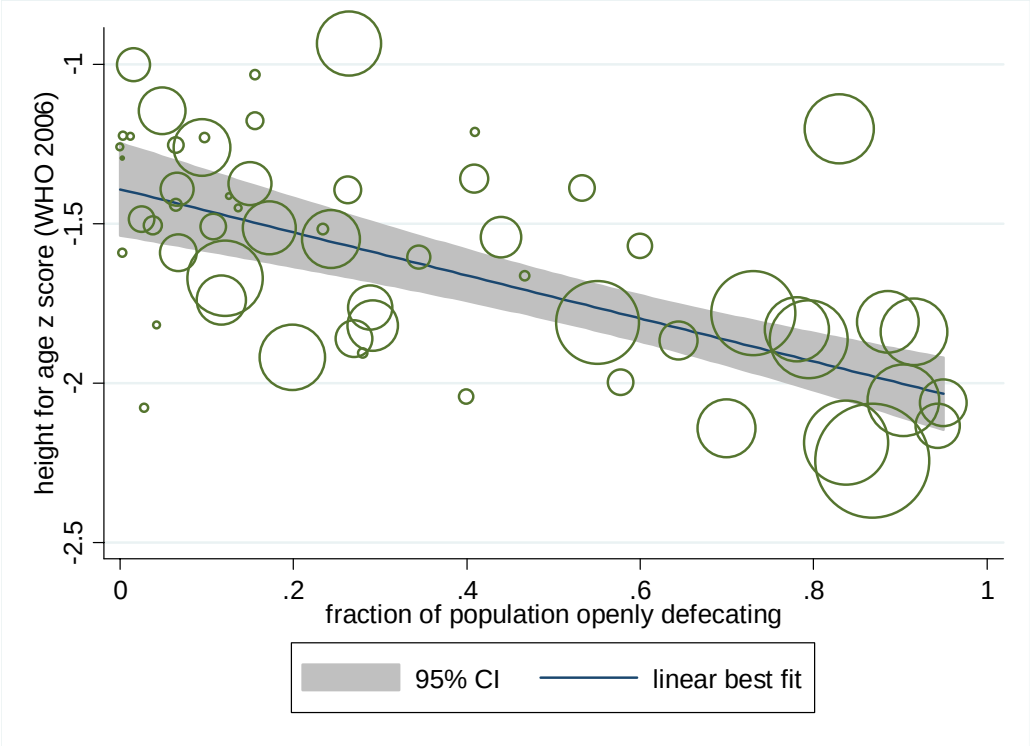


Figure 1 reports a similar analysis, comparing Indian states in a cross-section using the NFHS-3, the 2005-2006 round of India's DHS. Rural and urban parts of states are collapsed separately, so each

circle is either the rural or urban population of a state, with the area of the circle proportional to the size of the population it represents. There is a clear negative slope: within India, in places with more open defecation, children are shorter, on average. The two circles well above the line are urban and rural Tamil Nadu. The largest circle, at the bottom-right, is rural Uttar Pradesh.

Table 1 verifies the statistical significance of this relationship. The association between open defecation and children's height-for-age is essentially unchanged when state fixed effects are added, so the regression is focused on the difference between rural and urban parts of the same state. This suggests that the result is not driven by unobserved state-level heterogeneity in genetic potential, governance, or other differences. Heterogeneity in sanitation coverage appears to be an important determinant of difference in height across Indian states. Of course, this correlation is not itself enough to establish a causal effect of sanitation; that will be the goal of section 3.

Table 1: Height-for-age of children under 3 and sanitation, OLS

height-for-age *z*-score:	(1)	(2)	(3)
open defecation	-0.660***	-0.598***	-0.555***
	(0.164)	(0.110)	(0.0701)
state fixed effects			✓
weights	population	none	population
n (rural/urban state parts)	58	58	58
R^2	0.391	0.326	0.961

Standard errors in parentheses; 29 states; * p<0.05, ** p<0.01, *** p<0.001

2.2. The lasting consequences of early life health

Disease early in life has lasting consequences for human capital (Almond and Currie, 2011). Evidence is accumulating that poor health and inadequate nutrition in early life cause persistent deficits in cognitive development and ability (e.g. Case and Paxson 2010). Cunha, Heckman, and Schennach (2010) advocate that policy invest in very young children's cognitive skills, based on evidence of temporarily high returns on such investment at early ages.

Much of this research has focused on rich countries, but the life-long health and human capital costs of early life disease may be even greater in a developing country such as India. Spears (2012c) considers the correlation between height-for-age and cognitive achievement using NCAER's 2005 IHDS data. Although there is a positive slope between height and cognitive achievement among children in the U.S. – taller eight- to eleven-year-olds are a little more likely to be able to read – this slope is at least twice as steep among Indian children. The analysis then controls for matched household-level data from the 1990s, which suggests that household-level sanitation and hygiene may be an important omitted variable explaining this slope. Because childhood cognitive skills predict adult cognitive skills, these results imply a detrimental effect of widespread open defecation in India on adult labor productivity (Hanushek and Woessmann, 2008).

3. Effects of India's TSC

Has the Total Sanitation Campaign improved children's health and human capital? Many recent accounts of the TSC have focused on *process* evaluations. Such evaluations ask, for example, whether the TSC is actually constructing the latrines it claims to be constructing, or in which states the TSC is better meeting its spending targets. In contrast, this section reports results of *impact* evaluations, which attempt to determine whether the activities of the TSC are achieving the intended final outcomes. Here the question is not so much whether the TSC is spending money or as promised, but whether whatever activities it *is* doing are having an effect on the final outcomes that policy-makers care about. Is the TSC causing children to be healthier?

3.1. Difficulties in documenting effects of sanitation

Estimating the causal effect of a program or policy is always difficult, but sanitation presents its own special challenges. The first difficulty is that one person's open defecation imposes "external" harmful effects on other people. Statistically, this means that it might not be helpful merely to compare health among people who do and do not have latrines, even if the latrines were randomly distributed. The second difficulty is in measuring the right outcome. Recent medical research suggests that fecal germs can importantly harm children's growth and development without necessarily causing diarrhea. However, counts of diarrhea episodes reported in surveys are the most commonly studied outcome by which sanitation is statistically evaluated. Taken together, these challenges suggest that policy-makers should handle research on sanitation with care.

3.1.1. Externalities

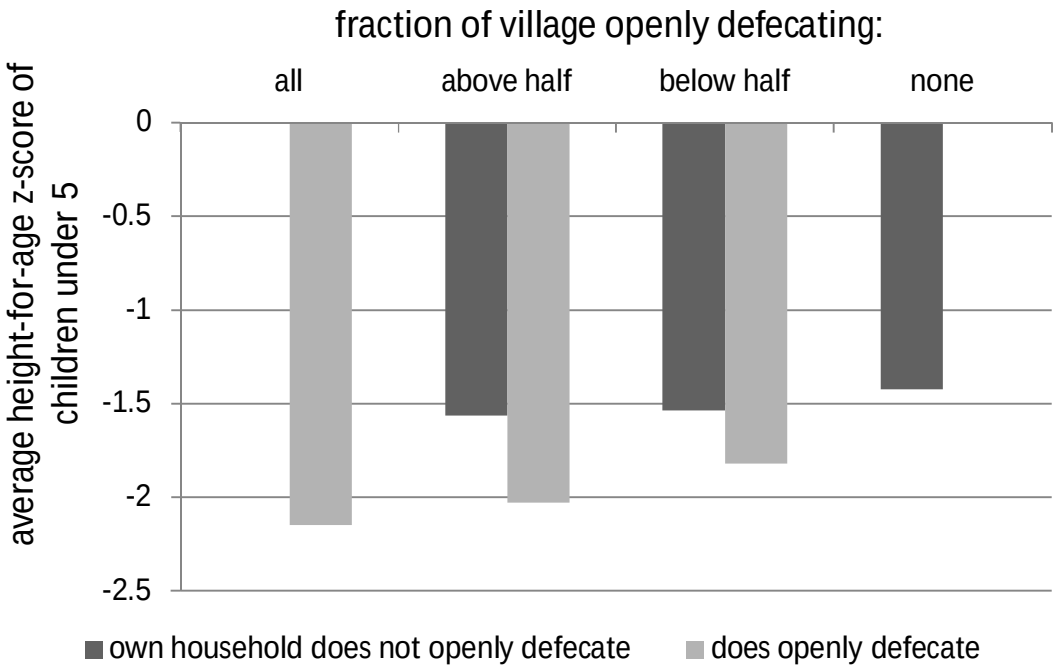
In economics, an activity carries an externality if it has consequences for somebody else, consequences other than those taken into consideration by the person who chose the activity. So, pollution has negative externalities because it harms people other than the people who elect to pollute. Scientific research can have positive externalities because future engineers might use findings to make something helpful that the original researcher did not intend. Externalities are important for two reasons. First, externalities can make effects of a program or policy more difficult to measure. Second, externalities are a central rationale for government intervention.

Figure 3 illustrates the negative externalities associated with open defecation. Health does not only depend on whether one's own household defecates openly; it also matters what others do. Feces from other households can make children sick and stunt their growth. The figure plots average heights-for-age of rural children under five in various categories, using the NFHS-3. The figure splits children into those whose households do (light bars) and do not (dark bars) openly defecate. Unsurprisingly, on average the children whose households do not openly defecate are taller than those whose households do. (All of the bars are negative because the average Indian child is shorter than the international reference population).

The graph further separates children by the fraction of the households in their village included in the survey who openly defecate. This village-level factor adds explanatory power beyond the household's own behavior: within both groups, children who live in villages where fewer households openly defecate are taller, on average. By itself, this figure is only suggestive of a causal relationship: we

cannot rule out that otherwise disadvantaged children also sort into neighborhoods with more open defecation. However, the graph is consistent with other evidence that open defecation has negative externalities. If so, then a household's own open defecation matters, but other households' do, too.

Figure 3: Height-for-age *z*-score of children by own household's and community sanitation



Externalities complicate statistical measurement of causal effects because they require that causes be studied at the appropriate scale. That is, is it household, village, or state open defecation that matters most? Many papers have attempted to estimate the effect of sanitation by comparing health outcomes between households (in the same village, often) that do and do not have latrines. Although those two papers find positive effects of sanitation, this approach is likely to underestimate the effect of latrines: households with latrines make children in households without them healthier, and households without latrines make children in households with them sicker, bringing both groups closer together.[3] Partially because of this problem, our research, reviewed below, studies variation in sanitation coverage at the district level. Identifying the key level of aggregation is an important open research topic.

In addition to complicating measurement, according to public economics, the involvement of negative externalities is exactly what makes open defecation society's problem and the government's problem, rather than merely a private issue for each household. Exactly because the external health effects of open defection on other people are on other people, they are underappreciated (if appreciated at all) by those who openly defecate. Because open defecators fully appreciate their own

[3] Miguel and Kremer (2004) demonstrate that prior studies had missed the effect of deworming medicine on children's academic performance by randomizing at the individual level, allowing treatment and control children to reinfect one another.

benefits, but not other people's costs, they openly defecate "too much" from a socially optimal perspective. Thus, the theory of public economics holds that in the case of externalities, private decision-making will never achieve the optimal outcome. Government action is necessary to reduce open defecation.

Section 2 presented aggregate evidence of the importance of sanitation and reviewed studies documenting the impact of early life health on human capital. That evidence provides the motivation for *somebody* pursuing safe sanitation; it is the involvement of negative externalities that indicates that the responsibility must importantly be the government's.

Policy Lesson 1. *Improving sanitation – meaning safe excreta disposal – must be a top priority for India. Because open defecation has negative externalities, it is everybody's problem, and requires government action.*

3.1.2. What survey-reported diarrhea misses

A second difficulty in statistically measuring effects of sanitation is that the health consequences of open defecation may be difficult to detect in the variables commonly measured in household surveys. In particular, the outcome variable most commonly associated with sanitation in large-scale health surveys is diarrhea morbidity, usually as reported to a surveyor by a child's mother. However, this data could be misleading.

In general, survey-reported disease can be systematically biased when poorer people perceive and report disease differently than richer people do (Das, *et al.* 2012). Moreover, measuring diarrhea with surveys may be particularly difficult (Schmidt, *et al*., 2011). In a field experiment, Zwane *et al*. (2011) show that households who are surveyed more frequently report less child diarrhea. If diarrhea data is very noisy, it might be difficult to detect the signal of an effect of sanitation, creating the false impression that sanitation has no effect.

Perhaps even more importantly, recent medical literature suggests that large and lasting effects of disease caused by poor sanitation can occur without necessarily causing diarrhea. Humphrey (2009) suggests that chronic but subclinical "environmental enteropathy" – a disorder caused by overwhelming fecal contamination which increases the small intestine's permeability to pathogens while reducing nutrient absorption – could cause malnutrition, stunting, and cognitive deficits without manifesting clinically as diarrhea. Mondal, *et al* (2011) document this phenomenon in Bangladesh. Again, therefore, a study only of the effects of sanitation on diarrhea – even if it were perfectly measured – could incorrectly conclude that sanitation has no effect on human capital.

3.2. Effects of the TSC

Two recent papers have documented an important average effect of the TSC, using existing large-scale data sets. This evidence suggests that the TSC has made children healthier, taller, and better able to reach their cognitive potential. Indeed, the first ten years of the TSC will have prevented an average infant death for only a few thousand dollars, a very low cost compared with other interventions in the literature.

Development economists have recently shown that important lessons for policy can be drawn from randomized, controlled experiments evaluating policies and programs (Banerjee and Duflo, 2011). However, the studies of the TSC reviewed here are a reminder of the continuing potential for rigorous and informative program evaluations using large, observational datasets and research strategies grounded in the details of a program's design.

3.2.1. Effects on infant mortality

Perhaps the most important effect of sanitation is on infant mortality. Spears (2012a) documents an average, overall beneficial effect of the TSC on infant mortality using three complementary econometric methods. All three methods give approximately similar answers: given the stock of household latrines produced by the TSC by 2011, at the end of its first 10 operational years, it had caused a large but plausible decline in infant mortality of about 4 infant deaths per 1,000 live births. This effect is slightly smaller than the effect found by Galiani, *et al.* (2005) of a water privatization program in Argentina, and comparable to the effect of a water source improvement program studied by Kremer, *et al* (2011) in Kenya. This section will review the first two econometric methods used to identify this effect; the third will be explained in section 4.2.1.

The first empirical strategy compares infants born in different years within a district with children born in different years and in different districts, using district and year fixed effects. This approach identifies an effect of the TSC on infant mortality in the DLHS-3 data by the differences in the year-to-year profile of TSC implementation across districts. The analysis finds an apparent effect: the more TSC latrines that had been built in a child's district by its first year of life, the more likely it is to survive to its first birthday.

The work of the analysis is to demonstrate that this correlation indeed reflects a causal effect of the TSC, and not simply a spurious correlation of child health improving more quickly in the same district-years where the TSC is becoming better implemented. This is done through a series of falsification tests. First, an effect is seen only on rural children, not urban children, which is what would be expected because the TSC is a purely rural program. Second, there is no "effect" on a child's survival of her first year of life of the stock of TSC latrines existing in her second year of life. This is evidence of a causal effect: if the TSC were indeed *causing* the decline in infant mortality, latrines would not be expected to reach "back in time" to influence infant survival. However, if the result were merely a spurious correlation of good district-level trends with good district-level trends, the exact timing might not have been expected to matter.

Other tests verify that the effect of the TSC works through plausible mechanisms. For example, the effect of the TSC is mainly on post-neonatal mortality (infant mortality after the first month of life) not neonatal mortality, which is what would be expected if the TSC operated by improving the disease environment. Moreover, the effect of the TSC is greatest for children who were given non-breast-milk food earlier in their lives. These children would have been more exposed to fecal pathogens in the absence of the TSC, so a larger effect on them would be expected. Finally, the effect of the TSC is greatest in districts with higher population density, plausibly suggesting that the TSC is more protective in places where people would have been more likely to encounter others' feces.

The second empirical strategy used a long difference-in-differences method, comparing aggregate, district-level census data on infant mortality from 2001 to 2011, the first 10 years of TSC implementation. This strategy asks whether rural infant mortality fell by more in districts where more TSC latrines were built in this period. The results essentially replicate the individual-level results from the first strategy, and again no "effect" is found on urban infant mortality. Importantly, this approach allows the data to pass a test that could have rejected "parallel trends" – the critical assumption that infant mortality would have evolved in similar ways without the program – by showing that TSC intensity in the 2000s is not correlated with changes in infant mortality in the 1990s or the 1980s.

Importantly, these results do not imply that the TSC has worked well throughout India, nor that the TSC has even been implemented throughout India; these are average effects. Indeed, these findings would have been statistically impossible to produce if there were not districts with more and less TSC coverage to compare. Section 5.1 will explore the heterogeneity of the effect of the TSC across Indian states.

3.2.2. Effects on children's height

The TSC reduced infant mortality by improving the disease environment in children's early lives. It is well documented in the literature that this would very likely also improve growth and development, allowing children to reach their height potentials. For example, Coffey (2012) matches survey data on women's height from the 2000s to Sample Registration System mortality data from the years of their births to show that women born in years and states with lower infant mortality grew taller as adults.

Section 2.1 showed that children grow taller in states with less open defecation, but it is difficult to draw a causal conclusion from this correlation alone. Variation in the implementation of the TSC allows a better justified inference of a causal effect of sanitation on children's height. Spears (2012a) applied the same individual-level identification strategy used to show an effect of the TSC on infant mortality to NCAER's IHDS data about the height of children under 5. Heights of Indian children must be studied with care because their height-for-age is falling relative to the international reference population until about age two; this is accounted for with a complete set of age-in-month dummy variable controls by sex.

Indian children born in districts and years in which more TSC latrines had been built grow taller, on average, than children born in other years in the same district, or other districts in the same year. At the mean intensity of the TSC across India, the TSC caused children's height-for-age to increase by about two standard deviations. This is slightly smaller than the size of the effect that Barham (2012) found for a health and family planning program in Bangladesh. This result suggests that widespread open defecation is indeed part of the explanation for the large average height deficit among Indian children.

3.2.3. Effects on children's cognitive achievement

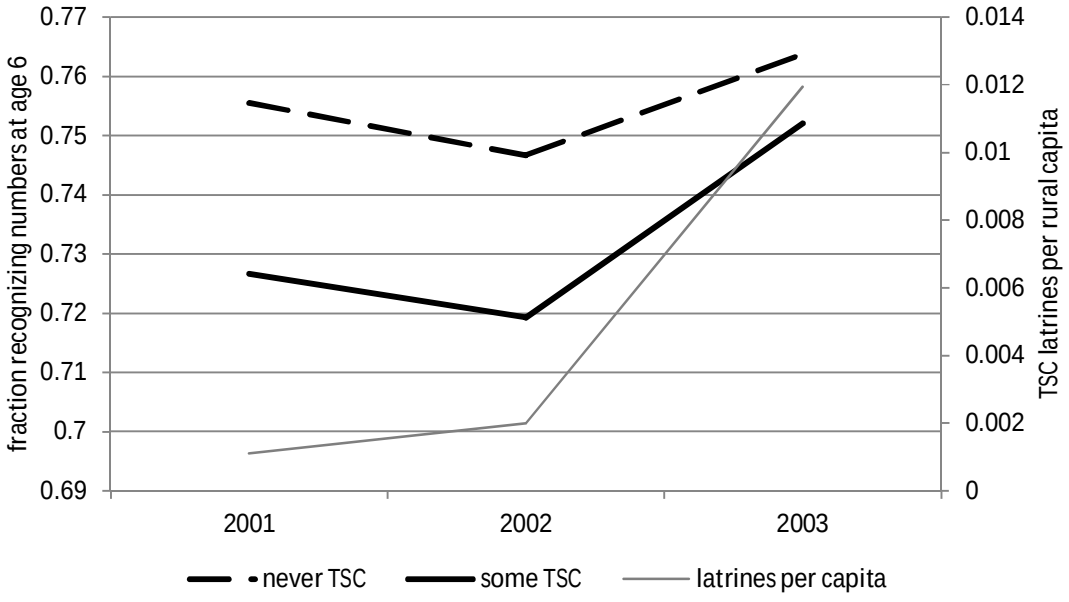
The same early life environmental conditions that encourage children to reach their genetic height potentials also allow them to better reach their genetic cognitive and human capital potentials. Recall from section 2.2 that Spears (2012c) found that the correlation between height and cognitive achievement that had been well-documented in developed countries is even steeper among Indian

children. Because the TSC helped children grow taller, and because taller children are better able to read and perform other cognitive tasks, it is reasonable to ask next whether the TSC has caused an improvement in children's cognitive achievement.

Spears and S. Lamba (2012) investigate this question using Pratham's individual-level Annual Status of Education Report (ASER) data. The ASER data is generated by a large, annual survey in each rural district that gives children academic achievement tests. In particular, the ASER survey tests reading, starting from letter recognition, and math, starting from number recognition.

The analysis follows the same individual-level identification strategy as before: are children born in districts and years in which more TSC latrines had been built better able to subsequently recognize letters and numbers when they are six years old than children born in other districts or years? Because the TSC only started building latrines in 2001, and because ASER test data are not available after 2009, Spears and S. Lamba are able to study six-year-olds in 2007, 2008, and 2009 born in 2001, 2002, 2003.

Figure 4: Difference-in-differences in cognitive achievement due to the TSC



source: Spears and S. Lamba (2012)

As expected, children exposed to better sanitation coverage in their first year of life showed greater cognitive ability at age six. Figure 4 illustrates a simplified form of the analysis. Only some districts received any TSC coverage at all in the first three years of the program. As the figure shows, cognitive achievement moves in parallel for districts that did and did not receive TSC latrines in this period for children born in 2001 and 2002, when the program intensity was very low. However,

cognitive achievement increases by more for children born in districts with TSC latrines in 2003, when some latrines started being built on a wide scale.

As before, details of the analysis suggest that this outcome was, indeed, a causal effect of the TSC. The effect of the TSC remains despite a range of controls in household and village characteristics and parents' education. There is no "effect" of the TSC on children who took the same ASER tests in the same years, but were too old to be exposed to the program, suggesting the finding is not merely a spurious result of district-level trends.

This result importantly indicates that widespread open defecation may not only be a substantial threat to health in India, but also carries a large economic cost in failure to meet human capital potentials.

Policy Lesson 2. *By promoting and incentivizing latrine use, the TSC has had positive initial impacts on children's health and human capital.*

3.3. Cost-effectiveness of the TSC

The effect of the TSC is moderately large, but perhaps more important is that it is purchased cheaply. Accountability Initiative (2011) reports annual TSC expenditure totals, computed from government accounts (George (2010) independently presents similar figures) and divided among central government, state government, and "beneficiary" expenditures. Sometimes cost-benefit analyses of policies only include government expenditures, but household and village spending on latrines is an important part of the full economic cost of the TSC.

Table 2 combines these cost figures with Spears's (2012a) estimates of the effects of the TSC to compute the 2010 U.S. dollar cost of an infant death averted. The computations follow the procedure recommend by Dhaliwal, *et al.* (2011), and therefore are comparable to Abdul Latif Jameel Poverty Action Lab cost effectiveness figures. These computations exclude all benefits of the TSC other than infant survival, such as the health or human capital of the children who live, and any direct utility gained from access to a latrine.

Cost-effectiveness estimates are always based on a set of assumptions; table 3 presents a range of results based on different assumptions. First, the table takes low, medium, and high estimates of the effect of the TSC from various tables in Spears (2012a). Second, the table presents estimates assuming that each latrine lasts 10, 15, and 20 years from the year of its construction before instantly fully depreciating. Franceyes, *et al* (1992) explain that "pits designed to last 25-30 years are not uncommon and a design life of 15-20 years is perfectly reasonable"' (44). The computations include all expenditure and construction through the 2010-11 budget year, and ignore all expenditure and construction beyond this point.

Table 2: Average TSC expenditure per expected infant death averted

		10% discounting		no discounting	
latrine life (yrs)	effect	total	government	total	government
10	low	4334	3666	2551	2188
10	medium	3435	2906	2022	1734
10	high	1853	1568	1091	935
15	low	3555	3007	1701	1458
15	medium	2817	2383	1348	1156
15	high	1520	1286	727	624
20	low	2234	1890	1276	1094
20	medium	1770	1497	1011	867
20	high	955	808	545	468

Costs in 2010 U.S. dollars. Expenditure data from Accountability Initiative for 2001-2011.

Third, because costs and benefits are spread over time, cost-effectiveness depends on the discount rate. Results implement Dhaliwal, *et al.*'s (2011) recommended 10 percent annual discount rate; results are also included without any discounting of costs or benefits as a sensitivity analysis (*cf.* Nordhaus, 2007). Unsurprisingly, the computed cost of saving a life with this capital investment is lower at a zero interest rate; market discount rates likely fall between these two extremes.

Taken together, the results suggest that the TSC prevented an average infant death for a few thousand dollars. Importantly, this is an average cost, not a marginal cost. These estimates average over initialization and fixed costs, returns to scale, and the heterogeneity of a large country. Therefore, they almost certainly do not represent the marginal benefit of a $2,500 donation to the Indian government. The marginal cost of saving the next infant life could be low if fixed, start-up costs were important, or high if latrines were put in the easiest or most effective places first.

The TSC has achieved its effects inexpensively relative to other programs and to some standards for the value of a statistical life. Ignoring, again, any benefits in addition to averting infant death and using the median discounted total cost estimate from table 2, the TSC saved a life year for around $35, a very rough figure that assumes an infant would have otherwise lived 65 to 70 years. Like similarly computed estimates, this one should be used only with extreme care (Hammer, 1997). This figure should not be taken literally; the point is that it is well below common thresholds of $100 or $125 per life year saved. This estimate is comparable to some of the lowest figures in the literature, such as Ahuja, *et al.*'s (2001) estimate of $40 for household water chlorination or $20 for point-of-collection chlorination in Kenya.

Although corruption is a common problem in low capacity governments, many academic impact evaluations study programs implemented by high capacity NGOs or motivated governments, potentially biasing estimates of effectiveness and complicating policy implications (Duflo et al., 2007; Coffey, 2011). As Ravalion (2012) explains, "a small program run by the committed staff of a good NGO may well work

very differently to an ostensibly similar program applied at scale by a government or other NGO for which staff have different preferences and face new and different incentives" (110). Projects in developing countries often suffer from "missing expenditures": discrepancies between official project costs and the actual value of the resources used (Olken, 2007). Unlike some estimates of cost-effectiveness in the literature, this paper's are inclusive of all costs of administration and losses to corruption, under actual implementation at scale.

Policy Lesson 3. *The TSC and clean village prize together are a comparatively very inexpensive way to save babies' lives.*

4. Explaining sanitation coverage and TSC take-up

As section 3 discussed, properly used and constructed pit latrines are a safe way of disposing of excreta. So, why do some rural places in India achieve better sanitation coverage than others? This section reviews evidence that sanitation take-up is importantly determined at the village level.

4.1. A village-level process

In conversations about the TSC, government officials and NGO staff at state, district, and village levels have all emphasized the importance of decisions made by village-level officials: the pradhan or the sarpanch.

I recently met a District Magistrate (DM) in his large office in an old house, far from the commercial center of the district capital. I asked the DM if he had ever heard of the Total Sanitation Campaign, worrying that the answer might be no. "Heard of it?" he leapt out from behind his desk to sit next to me. On the way, he had pulled out from under his desk a stack of booklets in Hindi: these had his picture on the cover with the district official responsible for village councils, and were full of detailed instructions for how a pradhan should implement the TSC, complete with diagrams for latrine construction. He proudly explained that he had written much of it himself. Like many IAS officers, he was originally trained as an engineer, a civil engineer in his case. "Distributed to everybody!" he beamed about the books.

Apparently, this DM had taken a special, personal interest in the TSC. He put together these booklets and summoned the district's pradhans to a series of special meetings to encourage them to comply, enough meetings so that he could interact with them all. (A pradhan whom I later met confirmed the DM's story). The DM explained to them the externalities of infectious disease: if you have a toilet and your neighbors do not, "the germs will not differentiate between them and you." Grinning, he recounted how he attempted to shame them, reminding them that they spend so much money on festivals as a matter of pride, but apparently do not have enough pride to keep their daughters in law from openly defecating.

At least in this district, all pradhans supposedly have special TSC accounts on which they can draw for the subsidy money, to organize construction with contractors of their choice. As the DM told me "everything is there, only the willpower is needed." But, not all of the pradhans had implemented

the program. When I asked, he guessed – now sadly – that maybe 20% in his district were trying. Strikingly, the chief executive of this district of over 4 million people felt ultimately powerless to do much more than advocate and exhort, even for a program so clearly important to him.

This account was echoed by a TSC specialist working in a state headquarters of an international NGO. He was quite familiar with the pitfalls of rural sanitation programs. The office building in which we met had been constructed with an extra bathroom attached to his shared office. The bathroom was being used as a closet. When he went in to find pamphlets detailing the proper construction of latrines, he joked "we are learning from them" – meaning villagers, who sometimes store tools and food in their latrine superstructures.

In his view, a key source of heterogeneity in implementation was "the P factor: the pradhan factor." He elaborated: "where the pradhan was good, the opportunity [to implement the program] was good." He described that it is up to the pradhan to sort out how the latrines will be constructed: for example, will the work for the whole village be contracted out as one job? Often, "pradhan simply finds a mason." In short, "if the person is good he can make a difference. Lots of the program has depended on the pradhan's influence."

This section reviews three sets of econometric evidence that village governance represents a key level of organization in determining sanitation take-up. First, relative to other household goods, latrine use is highly correlated at the village level. Second, randomized village-level political reservations predict TSC take-up. Third, variation in the size of the NGP incentive caused by a discontinuity in the rule linking population to prize size predicts village-level TSC intensity.

Policy Lesson 4. *Villages are a critical level of governance for sanitation intervention.*

4.1.1. A coordination game?

One possibility is that idiosyncratic household preferences or constraints are the primary determinants of take-up of pit latrines, rather than open defecation. If so, one might expect some households within a village to have latrines and others not to; in different villages these household-level determinates would be differently distributed, so a large set of villages would exhibit a wide range of levels of sanitation coverage.

Another possibility is that properties of villages are the primary determinants of sanitation take-up. Perhaps in certain villages local leaders have encouraged safe excreta disposal, or perhaps social or biological complementarities cause people in a village to switch from open defecation to latrine use approximately together. If so, one would expect there to be many villages with full sanitation coverage and many villages where everybody openly defecates, with few villages in between.

Kishore and Spears (2012) formalize this intuition and test whether safe rural sanitation is primarily determined at the household or village level. The analysis uses the 2008 DLHS-3 – a large survey with over 20,000 rural villages – and collapses the data to the village level to produce an estimate for each village of village-level sanitation coverage.

Figure 5: Bimodality in the distribution of village-level sanitation coverage, DLHS-3

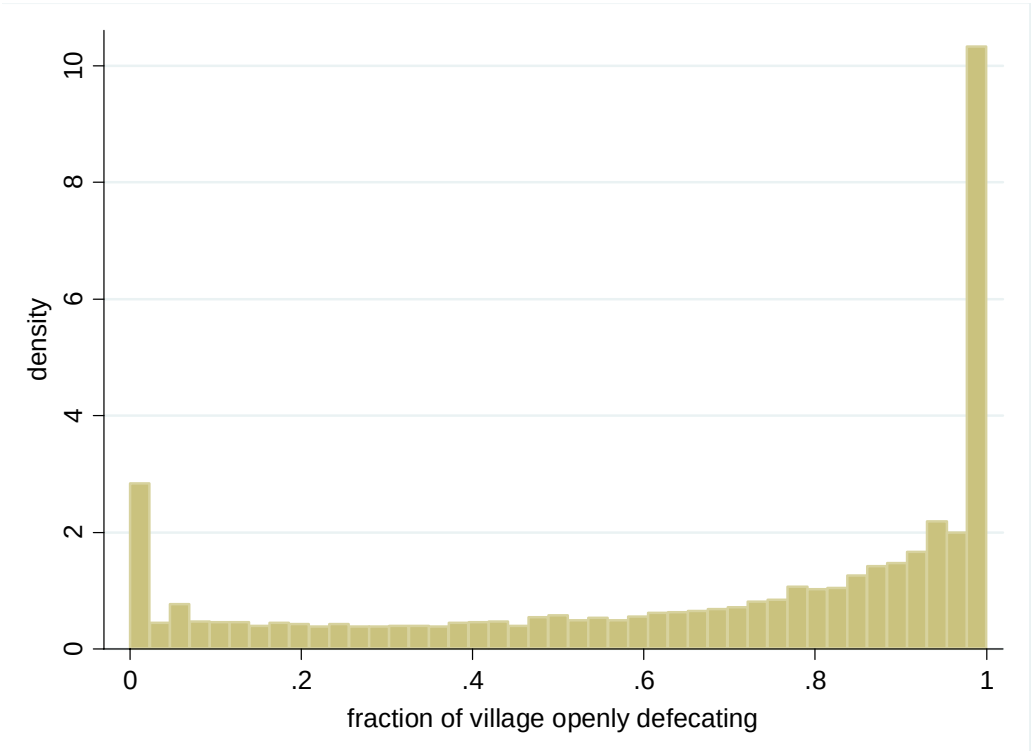


Figure 5 shows the strikingly bimodal distribution of village-level sanitation coverage: 31 percent of villages are at 0% or 100% open defecation among surveyed households. Using a looser standard, 37% are below 5% or above 95%. Visibly fewer villages have sanitation levels below these extremes. Because these are simple pit latrines, not linked sewer systems, the result is not mechanically driven by the natural monopoly of laying pipes (the result is the same if tiny fraction of rural households with piped sanitation is dropped).

Although this appears to be evidence for the importance of village-level determinants of sanitation, another possibility is that household wealth determines latrine take-up, and household wealth just happens to be highly correlated within villages. However, a similar pattern is not seen for other household assets. For example, in 53 percent of villages no surveyed households use clean cooking fuel, and in 72 percent of villages less than 10% do. Similarly, in 28 percent of villages no surveyed households have a "pucca" or well-constructed house, and in half of villages less than one in eight do. In neither of these cases is there a second mode of villages with near-universal take-up of clean cooking fuel or pucca houses.

One explanation that Kishore and Spears explore is that village-level sanitation coverage is the outcome of a coordination game. In this game theoretic situation, the value of an action depends on whether other people are doing it, and there are incentives for doing what everybody else is doing. These incentives could be social – if the value of having a latrine depends on a social reference point, or if the pleasantness of visibly walking to openly defecate depends on whether others are doing so – or

biological, if sanitation coverage is most effective when universal. In either case, extremely high and extremely low sanitation coverage will both be stable equilibria. Coordination from a village leader could change expectations in such a way as to move behavior from the low take-up stable equilibrium to the high take-up stable equilibrium.

4.1.2. Effects of village governance

If village governance were an important determinant of TSC take-up, then the preferences and efficacy of the village chairman would be expected to matter for TSC take-up. Village governance positions are reserved for women and for members of low castes, and these reservations are randomly assigned. Following on Chattopadhyay & Duflo's (2004) investigation of villages in West Bengal and Rajasthan being randomly assigned to have female pradhans, S. Lamba and Spears (2012) study the effect of random reservation of a village to have a scheduled caste (SC) pradhan on TSC implementation.

The results indicate that villages randomly assigned to have an SC pradhan are about two percentage points less likely to have won the NGP for having an open defecation free village, a 25% reduction. In principle, many mechanisms could account for this apparent effect. Strikingly, under SC pradhans, villages construct just as many latrines per capita as under unreserved pradhans. However, conditional on having a latrine for each household, SC pradhans are less than half as likely to win. This could illustrate the gap between latrine *construction* and latrine *use*, if SC pradhans are less able to motivate their villages to use the latrines. Alternatively, latrine use – unobservable in this data – could be just as high in villages with SC pradhans, but they are nevertheless less likely to ultimately receive the prize for other reasons. Whatever the explanation, the existence of this effect highlights the importance of village-level determinants of sanitation coverage.

4.2. Effects of the clean village prize

The NGP, or clean village prize, is an *ex post* cash incentive awarded to villages that have achieved open defecation free status. The prize is large for rural India: one lakh rupees or about $2,000 for the median village, or about $6,800 at purchasing power parity.

In order to give a larger prize to larger villages (in which achieving open defecation free status would presumably be more difficult), the NGP incentive amount was designed as a "step function" of village population (Alok 2010). Table 3 presents the rule behind the prize.

Table 3: Discontinuities on the NGP incentive rules

	village population in the 2001 census:				
	below 1,000	1,000 to 1,999	2,000 to 4,999	5,000 to 9,999	10,000 or more
rupees:	50,000	100,000	200,000	400,000	500,000
dollars (market):	1,000	2,000	4,000	8,000	10,000
dollars (PPP):	3,400	6,800	13,600	27,200	34,000

Presumably it is more difficult to achieve open defecation free status in a larger village, however this difficulty is likely to be continuously increasing in population size: it is not much more difficult to get everybody in a village of 1,001 people to use latrines than to get everybody in a village of 999 people to use latrines. Given the discontinuities in the reward, however, this means that there are large discontinuities in a village leader's motivation to try to win the prize. Two pradhans, one of a village with 999 people and one of a village with 1,001 people, face similar costs in trying to win the NGP, but the one with 1,001 people will receive much greater benefits. Therefore, the simple economics of incentives predicts that the TSC will be implemented more vigorously, on average, in villages with populations just above the incentive discontinuities than in villages with populations just below the incentive discontinuities.

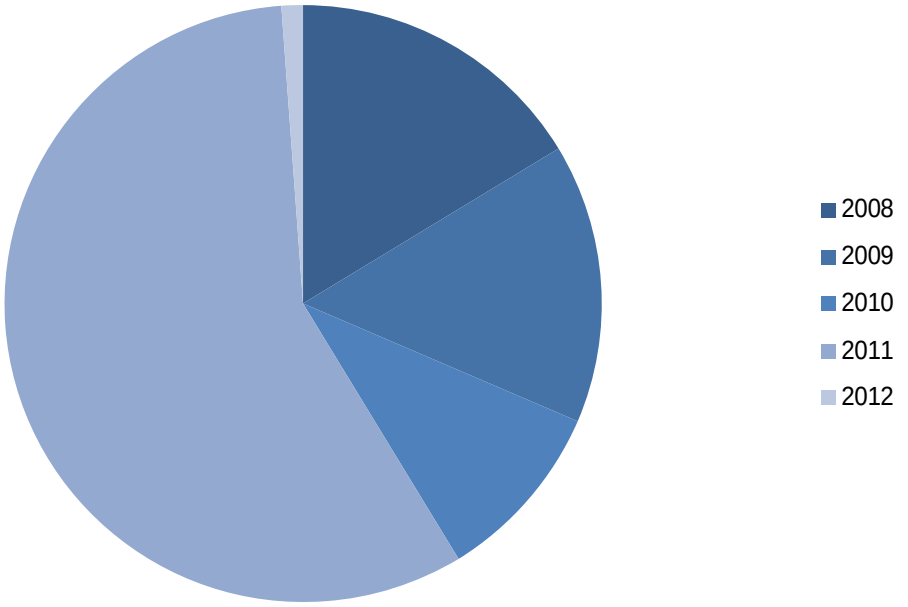
If these discontinuities in local leaders' incentives to try to win the NGP indeed predict TSC implementation, then this would be further evidence of the importance of local governance to sanitation policy. Spears (2012a) offers implicit evidence. In districts with many villages with populations just above the incentive discontinuities, rural infant mortality rates were lower in 2011, on average, than in districts with many villages with populations below the discontinuities. However, the incentives do not predict district-level infant mortality in 2001, before the program. This all indicates that greater incentives motivated village chairmen to put more effort into the TSC, leading to better child health. However, these results at the district level can only *imply* a village-level effect of the program. Section 4.2.1 presents village level evidence.

4.2.1. Village-level effects of discontinuities in the NGP incentives

Is there village-level evidence that the discontinuities in the NGP incentive have impacted TSC intensity? This exercise faces important data constraints. A crucial step is matching the TSC village-level administrative data on latrine construction (the outcome variable) to 2001 census population data. This must be done by hand, using village names, without knowing what block the village is in. Village names are often spelled differently, or are altogether different (for example, perhaps a surveyor accidentally wrote down the name of a hamlet instead, or Hindus and Muslims may use different names for the same place).

Even if it were easy to match 2001 census data to TSC administrative data, it may not have been very valuable. The village construction dataset is not a panel; there is one number recorded per village, which is replaced when a new number is eventually entered. However, the village dataset it is not a cross-section either, because it has been updated irregularly. Village level data is entered locally, and, although the data is required to be current, many villages have not updated their data in some time. Data were updated 2011 for some villages, not since 2008 for others. Figure 6 shows the large fraction of villages with out of date data when the data were accessed in early 2012. An official in the central government unit responsible for the TSC told me about as directly as one could expect not to trust this data much.

Figure 6: Distribution of villages by year TSC administrative data last updated



Accessed February 2012

Despite the important limitations of the data, it would be very important for policy-making to know whether the NGP incentive has motivated TSC latrine construction in villages. Although it will not be possible to estimate *quantitatively* the motivating effect of a marginal rupee of incentive on village effort, it may be possible to indicate *qualitatively* whether a greater incentive has caused better TSC performance.

The analysis in the supplementary appendix of Spears (2012a) approached this question in two complementary ways, constructing two datasets. Constructing the first dataset started with randomly drawing a sample of villages from the 2001 census. This sample was drawn from among villages with populations within 100 people of the discontinuities. 460 of these were able to be matched to TSC data, based on the village name. The advantages of this data are that its sample is focused on the discontinuity; it uses real 2001 census population data; and it is from all states. The disadvantages are that that the dataset is very small; almost no controls are available; and there is no reason to believe that matchability of village names is ignorably "random."

The second dataset was constructed by matching the TSC construction data to the TSC's own baseline survey for 50 districts. Entire blocks (sub-district units) were randomly selected, to be representative of the 280 districts used in the district-level analysis. Unfortunately, the TSC's baseline survey recorded the count of households, not populations, so each village's population is estimated by multiplying the count of households in each village by the average household size for that district in the 2001 census. This estimation would be expected to attenuate the estimated effect of the incentive (some villages will be placed on the wrong side of the discontinuity).

With either dataset, the key econometric test is to regress village level TSC intensity – that is, latrine construction per capita – on that village's NGP incentive per capita, with controls for population and other village level characteristics. In both cases, a higher NGP incentive appears to have encouraged village-level latrine construction. Extrapolating linearly, a 100-rupee increase in the NGP incentive per capita would be associated with an about 20 percentage point increase in household sanitation coverage, although this figure should not be taken literally.

The credibility of interpreting this effect causally depends on the plausibility that villages with similar populations on either side of the NGP cut-points are also similar in other, unobserved ways, on average. Unfortunately, the data are not nearly complete enough to compute a technical regression discontinuity. However, the most densely populated discontinuity in the prize is around 1000 people. Among the 79 randomly-selected villages with populations estimated to be between 1000 and 1200, 7 (or 9%) of them won the "open defecation free" prize; among the 64 villages with populations from 800 to 1000, none of them did.

4.2.2. Could the prize ever be too high?

Based on these results, should the NGP reward amount be increased to encourage more village chairmen to attempt to win prize? Perhaps so, but there is a countervailing consideration: limited government monitoring and evaluation capacity.

R. Lamba and Spears (2012) study the NGP incentive game-theoretically, as a mechanism design problem in which the government aims to incentivize pradhans to implement sanitation, pradhans try to maximize their income and minimize their costs, and only limited resources are devoted to verifying NGP applications. In this situation, increasing the prize amount will increase sanitation and effort to win the prize legitimately, but it will also increase fake applications from pradhans with relatively high costs of achieving open defecation free status but relatively low administrative costs of submitting the application.

What happens next depends on the resources devoted to evaluating NGP applications. If evaluations are accurate, then pradhans will learn not to submit false applications. However, if monitoring resources are limited so some false applications win the prize, then as word of this gets out, even more pradhans will submit false applications. This will further overwhelm limited monitoring resources, further blunting the incentive, leading to even more false applications, and so on as the incentive unravels.

To avoid this possibility, it is important that as the NGP incentive is increased, the quality of monitoring and of evaluating prize applications be increased, as well. At any particular, limited level of monitoring quality, the incentive can be too high.[4] However, sufficiently increasing both the incentive and monitoring quality is likely to improve sanitation outcomes.

[4] I thank Diane Coffey for suggesting another mechanism by which this generically could happen: with a higher prize, a pradhan can better afford to bribe corrupt monitors and still have enough prize money left over to make submitting a false application worth the costs.

Policy Lesson 5. *Incentives to local leaders for outcomes are useful and should be strengthened by both increasing the monetary incentive and devoting resources to ensure accurate evaluation and adjudication.*

5. Reaching the rest

Econometric methods are good at identifying averages. The research in section 3, for example, has answered the question "what has been the average effect of the TSC so far?". However, the policy question now is how much to invest in expanding sanitation coverage to the many places where it has not yet reached. To answer this question, one would like to know not the average effect of the TSC so far but the marginal effect: what would be the benefits of the *next* TSC latrines? Would these benefits be worth the further cost?

This section pursues answers to these policy questions about marginal effects. Determining how much more the Indian government should invest in completing sanitation coverage will require a combination of statistical evidence and basic theory of public economics, and will not be able to provide the precise answers of section 4. First, I will compare the effects of the TSC across different states. Then I will consider whether sanitation coverage so far appears to have responded to social costs and benefits – as economic theory would recommend – or to private costs and benefits – which would indicate a continuing need for government action. The results indicate that the TSC should be intensified to reach the remaining rural population.

5.1. Heterogeneous effects

The effect of the TSC on infant mortality described in section 3.2.1 averaged over all of rural India, using the DLHS-3. This section presents results from estimating the same regression on the same data, but restricting the data to each large enough state in turn. This produces an estimate of the effect of TSC latrines in each state.

This analysis by state is important for policy because it helps answer the question of whether to continue to pursue TSC coverage in states where coverage remains low. If, for example, the places where latrines have already been built are the only places where they have been helpful, it might suggest careful thinking before attempting to build more latrines in places where the latrines that have been built have not helped. On the other hand, if in places with few latrines the ones that have been built have been very helpful, this suggests that there are still high marginal returns to sanitation coverage in these places where coverage is low.

Importantly, these will not be estimates of the total effect of the TSC in each state. This is because each state has implemented the TSC with a different intensity. Here, the question is not "how many latrines haven been built in each state", but "of the latrines that have been built in each state, what has their average effect been?" So, we are asking not about the total effect of the TSC by state, nor about heterogeneity on the *extensive* margin (how many villages have been nominally reached, for example), but about heterogeneity on the *intensive* margin: in each place, what has the average reported TSC latrine accomplished?

Figure 7: Effectiveness of TSC latrines on the intensive margin by state

Figure 7 presents the results: there is a range of variation across states in the effectiveness of reported TSC activity on the intensive margin.[5] It is natural to want to make comparisons: it may be unsurprising that TSC latrines have been effective in Gujarat and Maharashtra, on average, and not in Jharkhand or Uttar Pradesh. However, there needs to be an important caveat: although they are not included in the graph, the standard errors of these estimates would be large because each comes from a small sample. Therefore, precise comparisons between states are probably inappropriate. Instead, what might be helpful would be to consider patterns of effectiveness: with what do differences in effectiveness across states correlate?

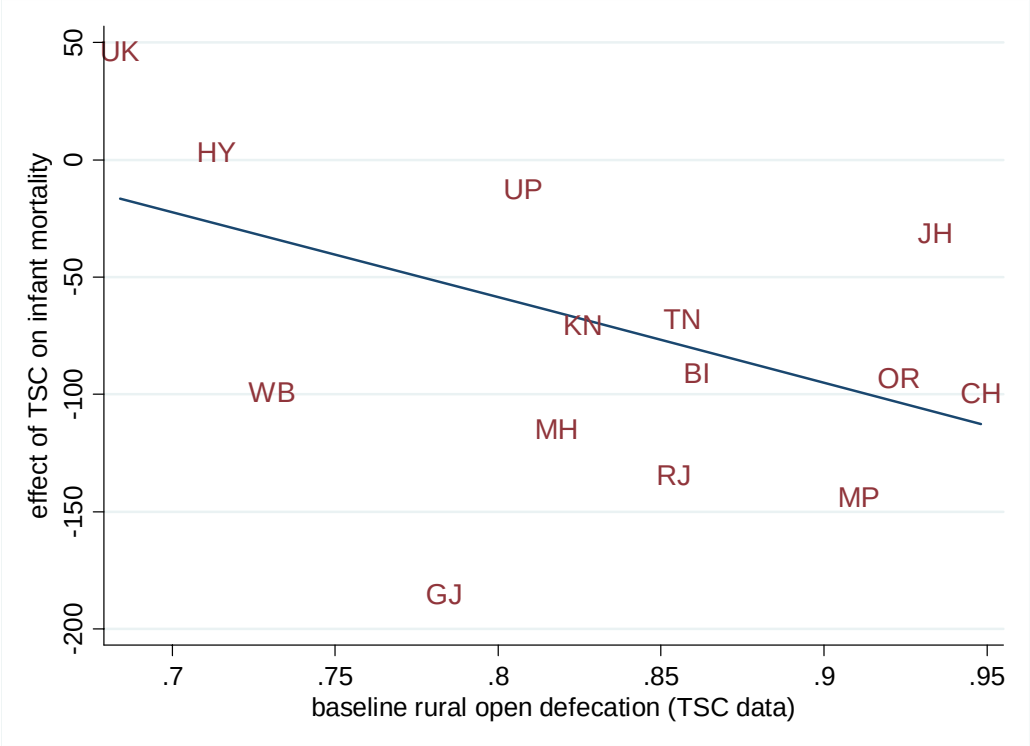
Additionally, it is not necessarily clear what exactly these differences in effectiveness imply. The independent variable here is *reported* TSC latrine construction. There are at least two ways in which reported latrines could have a low effect on infant mortality. First, they could be made but made badly: perhaps given to the wrong people, or not accompanied by motivation to use them. Second, they could be not made at all, and merely reported; in this case reported latrines would surely be expected to have a low effect.

A first question is whether TSC latrines have been more effective on the intensive margin in states with better or worse sanitation coverage. Figure 8 suggests an answer; note that a more negative effect is a better effect, as it represents a larger decline in infant mortality. The negative slope suggests

[5] For clarity and comparability, the regression coefficients (estimated as effects of moving from 0 to 1 latrine per capita) from each state were multiplied by the all-India average TSC intensity. This figure does not necessarily claim, for example, that IMR in Gujarat decreased by 8 deaths per 1,000 due to the TSC.

that the greater open defecation was before the program, the more effective the marginal TSC latrine has been, although the result is only marginally statistically significant (one-sided $p = 0.07$).

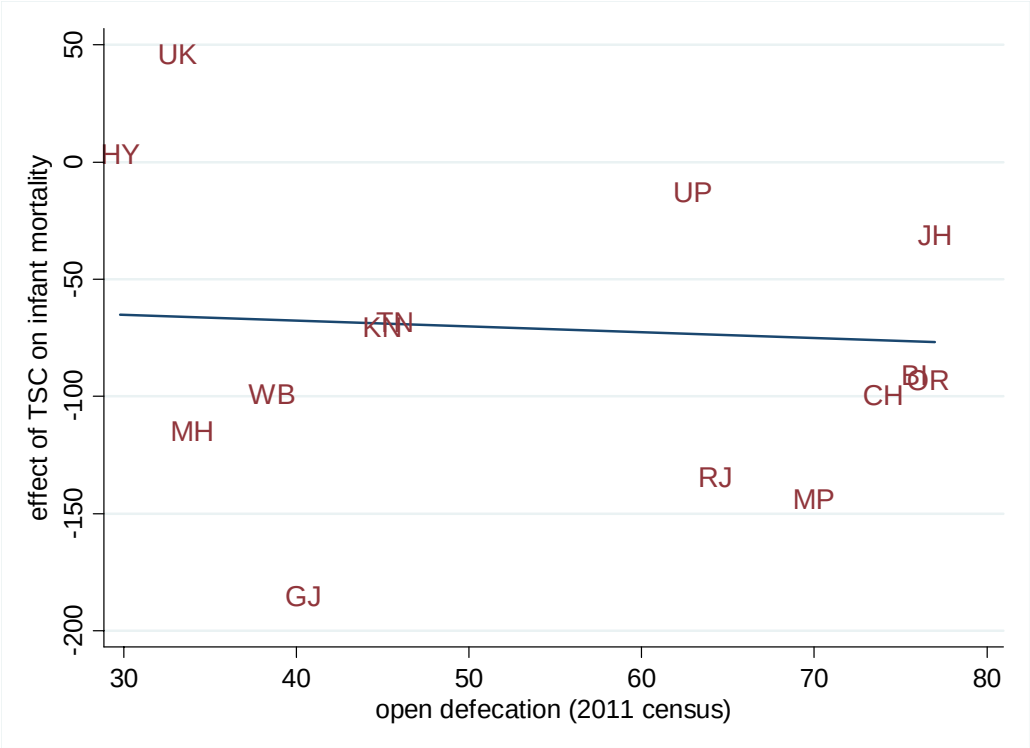
Figure 8: TSC effectiveness and baseline (2001) open defecation



If this correlation is credible, it suggests that effective programs can occur even in places where things are going wrong. From a policy perspective, this result is consistent with economists' law of diminishing marginal returns. Give this law, it may be unsurprising that additional latrines have been more helpful in places where there were fewer of them, and that in Haryana and Uttarakhand, where open defecation was relatively low to begin with, TSC latrines have not caused much of an improvement.

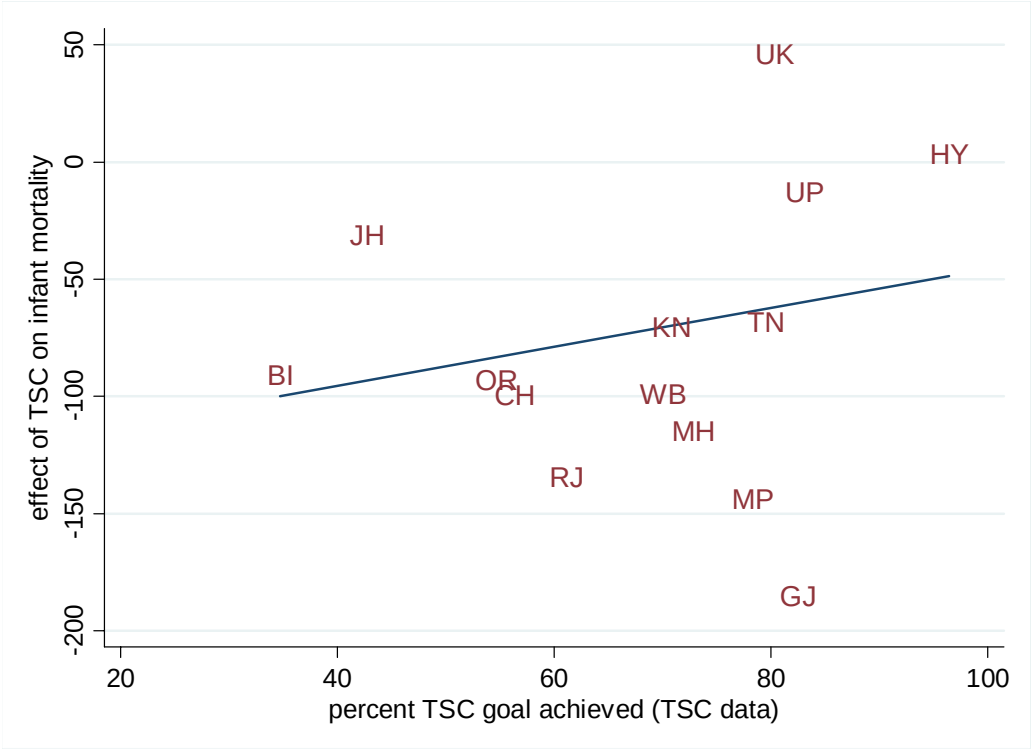
In contrast, as figure 9 shows, there is essentially no correlation between the effect of TSC latrines on infant mortality and levels of open defecation in the 2011 census, after the period studied in this paper. The district level correlation is similarly flat, with a *t*-statistic of -0.02. It is difficult to draw any conclusion from such a null result, but one implication may be that there is no evidence here that TSC latrines will particularly ineffective in the places where more are still needed.

Figure 9: TSC effectiveness and current (2011 census) open defecation



Finally, the TSC administrative data includes a "goal" sanitation coverage that was articulated by the program for each state. Figure 10 compares the effectiveness of TSC latrines with the percent of its goal that each state met. Perhaps surprisingly, the upward slope suggests that TSC latrines were less effective, on average, in states that more nearly met their goal. One possibility is that some states artificially inflated their latrine construction figures more than others, resulting both in appearing to reach their goals and in ineffective "reported" latrines. However, with a *t*-statistic of 1.02 no real inference of any slope can be made.

Figure 10: TSC effectiveness and percent of state "goal" achieved



5.2. Optimal diligence: marginal costs and benefits

Although figure 10 suggests that many states report reaching around 80% of their TSC goals, figure 9 shows that the 2011 Indian census finds over half of Indian household still openly defecating. How much effort should the Indian government put into continuing to expand TSC coverage?

According to economic theory, private actors – such as households and village politicians – will improve sanitation coverage to the level where their private marginal benefits equal their private marginal costs. The government should extend sanitation coverage to the point where its social marginal benefit equals the social marginal cost. Because of the negative externalities of open defecation, the private and social marginal benefits are very different. Therefore, one approach to assessing how much more effort the government should put into the TSC is to ask whether coverage so far appears to have responded to private or social marginal costs and benefits. Is sanitation take-up explained by private or public incentives?

We have seen several pieces of evidence that TSC coverage so far has responded to private incentives. A discontinuity in the NGP incentive that has nothing to do with underlying sanitation requirements predicts village leaders' motivation to pursue sanitation. Random assignment of village governance to members of socially excluded groups decreases the chances of a village being certified as open defecation free, even though the caste of the pradhan is irrelevant to the social marginal benefit of latrine construction.

In contrast, a range of evidence suggests that the marginal social benefits of sanitation coverage still exceed the marginal social costs. First, the marginal benefits are high relative to the costs: properly used sanitation is a cheap and effective way to save infant lives and build human capital. Second, state level evidence suggests that economists' law of diminishing marginal returns applies to sanitation, yet open defecation remains widespread. Finally, it does not appear to be the case that, for example, the TSC has been implemented more thoroughly in districts with higher population density; coverage does not appear to be determined by the social threat of disease.

Policy Lesson 6. *The additional benefit of extending effective TSC implementation to remaining Indian children would probably substantially exceed the additional cost.*

6. Conclusion

6.1. How might the TSC succeed where other programs have failed?

Although earlier sanitation programs in India and elsewhere that focused on latrine construction have failed (Black and Fawcett, 2008), this paper has presented evidence that, on average, the TSC is improving children's health and human capital. Why might the TSC be succeeding -- at least, in those places where it has been well implemented – given the failure of earlier attempts? One answer suggested by Spears (2012a) may be that, in its focus on village-level incentives, the TSC is getting its economics right and getting its sociology right.

The TSC is getting its economics right by offering an *ex post* incentive for achieving the necessary outcome: villages becoming open defecation free. As Holmstrom and Milgrom (1991) describe, incentivizing an agent for performance on one input towards a complex goal could worsen the final product; this is sometimes called the "teaching to the test" problem. Indeed, Glewwe et al. (2003) find that a program that rewarded teachers in Kenya based on students' test scores caused an increase in short-term exam preparation sessions, with little further effect. However, the TSC does not merely reward latrine construction or other inputs, it reward villages where everybody uses latrines.

The program is getting its sociology right by offering this incentive to village leaders, and thereby making use of existing village social hierarchy. Strictly speaking, in government documents the NGP funds are supposed to be used for village improvement projects. However, there is ample evidence from other programs that, money being fungible, local elites can privately capture such funds. Far from a problem, however, this may be exactly why the NGP is helpful: it gives local leaders an incentive to ensure compliance. These local leaders are often accustomed to telling people what to do; villagers are often accustomed to listening. Moreover, village chairmen draw freely on traditional social values in achieving their goal: I have seen villages where the pradhan is trying to win the prize, and has had painted on village walls "do not let your daughters and daughters in law go outside; make a latrine in your house."

However, as R. Lamba and Spears (2012) model and section 4.2.2 discussed, there could be an important limit to what the incentive could accomplish if accurate monitoring and enforcement of the

incentive conditionality is not maintained. A large incentive without accurate verification is a recipe for corruption. Policy-makers should carefully expand and strengthen the NGP incentive. More research is needed about the quantitative response to possible incentive amounts, about how incentive verification is conducted in practice, and about the motivations and activities of village leaders attempting to win the prize.

6.2. Better data could promote better policy

Effective governance requires information, especially for a country as large and diverse as India. As evidence of the lack of information about what is occurring in rural villages, in discussions about the research in this paper, district and top central government officials as well as NGO staff and international funding agencies have all reported wanting to learn *from me* what was going with the TSC on the ground. Achieving an open defecation free India will require more and better data – both administrative data about the implementation of the TSC and survey data for research. It is difficult but necessary to have useful information about hundreds of districts, hundreds of thousands of villages, and a 600 million people's open defecation. There is attainable room for improvement.

First, the attention that the TSC itself has devoted to collecting and making available its own administrative data has been admirable. These monitoring systems should be given the support and resources necessary to improve data quality and preserve what has been achieved.

Already, as figure 6 displayed, the village-level data is largely out of date, whatever the quality of the initial data submissions. It will be important to maintain the quality of the district-level data. Imbert and Papp (2011) study the quality of government administrative data about the National Rural Employment Guarantee Scheme, available from a similar online database. They find substantial inflation of work days relative to household surveys. Part of the explanation may be that officials wish to appear that they are meeting demand for work, in order to fulfill legal requirements. It is important that TSC "goals" not corrupt administrative data. One solution may be providing resources for record-keepers, perhaps even at relatively local levels, who will be independent of any incentives for good performance.

Beyond the administrative data, sanitation research faces sharp data constraints. No large household survey dataset with health data has been collected since the 2008 DLHS, four years ago.[6] Existing datasets sometimes are crucially incomplete. The DLHS did not measure children's height, which reflects long-term health, only weight, which reflects shorter-term health and nutrition. The 2005 NFHS-3, the third round of India's DHS survey, does not include district identifiers, not only making a matching exercise such as the one done here impossible, but further preventing even district fixed effects (or replicating the state-level analysis of section 2.1 at the district level). Apparently, this may be due to confidentiality concerns, despite the fact that average Indian districts are larger than many whole countries where DHS surveys have been conducted. Frequently collected high-quality, multi-purpose datasets, independent of any particular program's or official's bureaucratic interests, are a relatively low cost investment in a public good that is critical for policy making in such a large country.

[6] NCAER is currently collecting a new round of the India Human Development Survey, which will be especially useful as a longitudinal panel. However, even with its 40,000 households it may be difficult to reliably detect effects on low probability events such as infant mortality.

Policy Lesson 7. *Achieving total sanitation coverage will require both safeguarding the quality of TSC administrative data – perhaps by providing resources for data sources that bypass bureaucratic interests – and investing in large datasets about health outcomes.*

6.3. From TSC to NBA: opportunities, but still much to do

Widespread open defecation in India is not only a critical public health concern; it also limits human capital accumulation, and therefore economic potential. Adequately constructed and used pit latrines are well-known to be a safe method of excreta disposal. The data reviewed here suggest that the TSC and NGP can motivate villages to construct and use latrines.

However, coverage is still quite incomplete, and more of the same may not be enough. Increasing and publicizing the prize may be good first steps, but better monitoring of prize applicants will be crucial, especially if a larger prize makes submitting a false application more attractive. If it is true that sanitation is implemented at the village level, then policy-makers in Delhi and state capitals have no alternative but to focus on the details of what motivates local politics and policy. This may require developing alternative channels of information that bypass bureaucratic, financial, and political interests. The difficult part of creating a useful administrative data system is not establishing a modern, online, computerized database; it is ensuring that the people collecting and entering the underlying data have an interest in meaningful and accurate information. The challenge is considerable, but given the deep costs of open defecation and the negative externalities that make latrines a social and government concern, meeting the challenge must be a top priority.

As we meet at the India Policy Forum, the government is in the process of converting the TSC into the Nirmal Bharat Abhiyan, the NBA. The government, Minister Jairam Ramesh, and everyone contributing to this reinvigorated commitment deserve wide applause for this important investment in making India open defecation free.

Increasing the government's investment in sanitation promises important opportunities, but there will be risks as well – risks that more money will attract unwanted attention, and that the so-far successful incentives behind the TSC could be undermined. These risks can be minimized – and the promise of the NBA ensured – by emphasizing those principles that contributed to the successes that the TSC did achieve. Before the TSC, the CRSP emphasized subsidies and latrine construction: incentives for building latrines that nobody will use. If the NBA returns to these principles, it could miss this opportunity to end open defecation. If, instead, the NBA strengthens monitoring systems and incentives for latrine *use*, we can hope for healthier children who become more productive adults.

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Table A: Recent papers reviewed in this article

Citation	Approach	Findings
Spears (2012a)	Econometric evaluation of impact of TSC (2001-2011) on health using large surveys and census data	The TSC reduced infant mortality, on average, by 4 deaths per 1,000 and increased height for age by 0.2.
Spears and S. Lamba (2012)	Econometric evaluation of impact of TSC (2001-2003) on cognitive skills, using ASER data	Children exposed to more TSC latrines in early life recognized more letters and numbers at age six.
Spears (2012b)	International comparisons of sanitation coverage and height, using 140 DHS surveys	Country-years with less open defecation have taller children, a result that is not cause by fixed differences among countries or regions.
Spears (2012c)	Correlation of child height and cognitive achievement using IHDS and HDPI data from NCAER	Taller children score higher on learning tests in India with a much steeper association than in the U.S.; early life sanitation and hygiene matters.
Kishore and Spears (2012)	Modeling village sanitation coverage as a coordination game; comparing open defecation at the village level	Open defecation varies at the village level: in many villages either all or none of the DLHS respondents openly defecate.
S. Lamba and Spears (2012)	Comparison of TSC outcomes with randomized local governance reservations in Rajasthan	Villages in which the chairman's office has been reserved for a member of a low-ranking caste are less likely to win the clean village prize.
R. Lamba and Spears (2012)	Theoretical model of the clean village prize, given corrupt village leaders and limited state capacity	If monitoring resources are limited, increasing the prize amount could perversely worsen compliance, by encouraging false applications that overwhelm the monitoring system.

The most recent versions of these papers are available at www.riceinstitute.org.