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TITLE:- Removing Ropes: Attaching Strings?

Drinking water and institutional arrangements

Arun Agrawal, March 1993

Introduction

Everyone who lives in the Indian desert in Rajasthan dreams of digging a well for his village before he dies. If the well contains sweet water which people can drink the person will go straight to heaven. If not, the altruistic attempt will still weigh heavily in his favor. However, in most villages the water lies so deep and the likelihood of discovering saline water remains so high that few individuals manage to adopt this simple expedient to cancel all their sins. Consequently, more than 25,000 villages in Rajasthan still do not possess water fit for drinking.

The preceding explanation for drinking water scarcity may not strike one as adequate. But nearly fifty years after independence, there are still more than 162,000 Indian villages where safe drinking water is not easily available to villagers (Chakravarty 1990:9). In the drier parts of the country, water scarcity assumes disastrous proportions every summer. For most of the rural population, already close to the abyss, drying wells, dying cattle and failing crops make an uncertain life even harsher.[1] Possibly the worst affected part of the country is the state of Rajasthan where there are no perennial rivers and few freshwater lakes; where rainfall is low and erratic, and where groundwater is often saline and located deep inside the earth. Women

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Newspaper headlines demonstrate the hardships villagers face. "Acute water crisis grips Uttar Pradesh" Indian Express, (New Delhi) May 19, 1984; "Drought in Madhya Pradesh leaves trail of misery" Indian Express (New Delhi) July 19, 1985; "Gujarat in for acute water famine" Times of India December 20, 1986. Quoted in Ecology of Drought and Water Scarcity: need for an ecological water resource policy, Jayanta Bandyopadhyay, (Dehradun: Research Foundation for Science and Ecology) 1987, p.2.

and children trek miles every day to procure meager supplies of potable water for their essential needs. Although the scope and intensity of the daily disaster that villagers confront is recognized in official circles, policies to provide water, I suggest, continue to be founded either in fundamental misperceptions of the issue or in wilful disregard of obvious, available solutions.

This paper, using a case study, examines the institutional dimensions of drinking water provision in Rajasthan. I investigate the thesis that the government treats the provision of drinking water as a technical problem and consequently concocts primarily technical solutions. However, technical solutions while vital, must fail in the absence of attention to institutional arrangements. In the study I detail, lack of attention to appropriate institutions[2] diminished the quality of water provision and increased inefficiency. At the same time, the manner in which government provided water helped those in the village more who owned more assets and who belonged to the upper castes.

I examine government programs with reference to the incentives and opportunities that they present to their clients. Thus much more significantly, I trace inadequacies in government programs to breakdowns in the ability of villagers to solve collective action problems. The explanation I provide, therefore, is relevant to other arguments that suggest development is a top-down process in which villagers have little power to influence what happens; or, programs in the nature of technical "fixes" are bound to fail; or, government projects invariably favor the rich. At the same time, it goes beyond such arguments.

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[2]In the seventies, the phrase "appropriate technology" came to represent the belief that even if a certain technology were successful in the west, it had to be modified to suit the local conditions in developing countries. I use "appropriate institutions" to signify that there must be a match between the technology, institutions chosen to disseminate it, and local conditions.

The Study

The following study examines village Dodopani[3] in the Jodhpur district of Western Rajasthan in India. I first present the salient features of the indigenous water supply system that the villagers had created historically. The depicted situation represents how most villages in Western Rajasthan attempted to fulfill their drinking water needs prior to Indian independence in 1947.[4] I then proceed to describe the changes in the water supply system of the village after the state government introduced piped water supply for the village. The new system, again, represents the method that the state government has chosen to provide drinking water to most water scarce villages in Rajasthan. The next part of the study analyzes the changes in a collective choice framework. In the final part of the paper I tease out the implications that the study holds for attempts by governments to better service their constituents.

Dodopani is located in one of the driest parts of India. Its average annual rainfall is less than twelve inches a year. The rainfall varies tremendously seasonally and from year to year. Most of the rainfall is concentrated in the monsoon months of July to September. At the same time, because of annual variations in rainfall, crops often fail. According to Devraj, the village revenue official (the patwari), rains in Dodopani are sufficient to grow crops only once every five years. Since there are no rivers or lakes near the village, the 180 village households must rely on groundwater to meet their drinking water needs for much of the year. But the village does not possess good groundwater resources either. Villagers have tried to dig several wells

[3]The real name of the village has been disguised. However, the events as described in the study are real. That is, the description is not a composite of events from several different villages.

[4]Many villages in the more remote parts of the desert still follow the same method.

but the water turned out to be saline and brackish in most of them. Therefore, until five years ago, the residents of Dodopani drew their drinking water from a well provided by the local feudal lord nearly a hundred years ago. The villagers did not have to make any contributions for digging the well, but because the water was at a depth of nearly 250 ft. they had to create a viable institutional arrangement to draw the water out of the well.

Surface rainwater tanks (Nadis) used to be important for supplying drinking water needs of the villagers. Using the natural slope of the land, approximately sixty acres of land were used to harvest rainwater during the monsoons. The village council imposed significant sanctions on individuals found dirtying the catchment area (Agor) of the water tank and fined shepherds and pastoralists whose animals wandered into the catchment area. Periodically, the villagers contributed labor to desilt the tanks and clean the catchment area.

There are strong caste divisions in Dodopani. Although there are more than 11 castes, villagers typically see themselves and others as untouchable or upper caste. No upper caste member will accept water from an untouchable. Untouchables can receive water from upper castes, but only in special pots which the upper castes will not use for drinking or cooking.

Villagers employed two to three persons each year to draw water from the well and to distribute it to village families. These persons, who were hired in informal meetings of all the village households, maintained the equipment (rope, barrels, buckets, pulley) needed to draw the water from the well and were responsible for feeding the animals used to provide the draught power to draw the water from the well.

The persons drawing the water out of the well were paid a fixed amount by each household in the village, usually between Rs. 15.00 to Rs. 25.00[5]. The actual amount paid depended upon the number of animals weighted by species that a family owned[6], and the number of persons in the household. Rights to draw water from the well were auctioned each year; the winning bid was to whomever was willing to draw the water for the lowest amount. One to two village families earned their livelihood in this way.

Since there was only one well in the village for nearly 180 households water was scarce, especially before and after the rainy season. Approximately 48% of the households owned personal cisterns (water tanks) in which enough rainwater could be collected to supply the drinking water needs of the household for about two months of the year. But for the rest of the year, all the villagers depended on the well for their drinking water. Very often, water was drawn round the clock to supply village needs and villagers waited in long queues to get their vessels filled.

Villages around Dodopani share its physical characteristics and roughly similar governance systems supplied their drinking water needs. The average size of the villages ranges from 60 to 300 households. None of them possesses good groundwater. They had all set aside a portion of their common land for water harvesting, although currently none of the villagers expend the requisite effort to keep the tanks or the catchment of the tanks clean. The basic

[5]A dollar equals approximately Rs. 28.00 at the current exchange rates. At the time I carried out the field work for this paper (1990), the exchange rate was closer to Rs. 18.00 for a dollar.

[6]The rate for all the animals increased over time. In 1978 villagers paid Rs. 5 for a camel, Rs. 2 for cows/ buffaloes, and Rs. 0.25 for small ruminants. The charge for each family member was Rs. 0.50, but no charge for children.

occupation is farming; milk and sale of animals supplements the family budget. Water reigns as the limiting constraint for all economic activity.

Four years ago the government provided Dodopani with a storage tank filled by water from a tubewell located six kms. away. Water from the tank is available to the villagers free of cost. The same tubewell (sunk by the state government and supposedly maintained and looked after by a government employee) also supplies water to nine other villages the vicinity - each an average distance of five kms from the tubewell. Villagers state that water is now available in more than sufficient quantities for some days in the month. In fact, water overflowing from the tank creates a big puddle for 8 to 10 days in the month. For another 5 to 6 days, water supply is normal, just filling the tank. For approximately fifteen days each month, however, water supply is less, often far less than what is needed.

Three important characteristics of water supply to the villages have changed. Prior to piped water supply, each village was responsible for ensuring that water could be drawn from the local well. Now, however, the supply system involves a total of 10 villages and nearly 2,000 households. The size of the collective action problem, therefore, has changed. Second, the average annual supply of the public good in question, drinking water, has increased enormously. Third, the variation in the supply of water has also escalated immensely. So much so that sometimes during the summer the storage tank in the villages is empty for weeks on end. In an ironical twist, the villagers are then forced to improvise labor gangs to draw water from the old well.

The government program provides drinking water to Dodopani as a public good[7]. Public goods are non-excludable and indivisible. ie. No one can be excluded from using them, nor is their supply diminished through use (See Ostrom (1990) for a refinement of the concept of indivisibility through consideration of stock and flow variables). National defence is a common example. Toll or club goods are excludible but indivisible. Individuals can be excluded from using them, but their quantity does not diminish through use. Bridges or state parks are examples. Private goods are both divisible and excludable. Goods sold in the marketplace are examples. Open pastures in highly populated regions or fish in international waters are examples of non-excludable goods whose supply declines through use. Common goods are imperfectly divisible and excludible. Most community forests and fishing grounds form good examples.

Divisibility (or subtractability) of goods raises problems of overcrowding, collective action and what is popularly referred to as the "tragedy of the commons" - but only in combination with non-excludibility. If the supply of a good does not diminish through use, problems of economic choice do not arise (whether the good is excludible or not) because there is no scarcity of that good. If a good is divisible and excludible the problems that arise are the subject of standard economic analysis.

Non-excludibility and indivisibility depend on the level of technological development, institutional arrangements, and the characteristics of goods. Thus the invention of barbed wire facilitated the conversion of open prairies in the American West into private goods. Demsetz

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describes how in the 18th century, increases in fur prices around Quebec changed institutional arrangements so that hunting territories changed from public goods towards private goods (1967). However, most real life goods are neither perfectly divisible (or indivisible), nor perfectly excludable (or non-excludable). Figure I below provides a visual representation of public, private and common goods on the criteria of excludibility and subtractability.

FIGURE I HERE

Water from the well under the indigenous system was an imperfect public good. So is water from the storage tank under the new system. However, under the new system, when water is available, it resembles a public good more closely than water from the local well. Further, because in the older system, there were well developed rules about who was eligible to receive water (all villagers who paid their dues), drinking water had been "propretyized" (McKean, 1992). In the current system, neither the technology, nor the institutional arrangements exclude anyone from using available water. On this criterion too, water in the new system resembles a public good more closely than water under the older system.

A number of factors explain the variation in water supply under the new system. The most important reason is that the government employee in charge of operating the tubewell is negligent in carrying out his duties. Sometimes he forgets to turn on the valve on the pipeline carrying water to the village. Sometimes he forgets to turn it off. Sometimes he is on leave without arranging a replacement. If the motor doesn't work, he does not get it repaired in time. And indeed, there are occasions when he sells off the diesel fuel supplied by the government to

run the tubewell motor[8]. Another reason is that in the summer, migrant pastoralists often make a hole in pipelines carrying water to the village. This allows their thirsty animals to drink but reduces water supply to the villages or eliminates it entirely.

One way to motivate the government appointee would be for the villagers to select a person from the village who would then regularly remind the tubewell operator to turn on (or off) the valve, complain to higher authorities if the fuel for the motor is sold, and so forth - in short, to lobby. In a meeting, the villagers estimated that if each household in the village paid Rs. 2.50 to 3.00 per month to such a person, they would pay the person Rs. five to six hundred per month and would be able to ensure a more regular and adequate water supply. They also felt that if each village receiving water under the tubewell program was willing to appoint such a person, a force of ten persons will be created which would not only keep the government appointee on his toes, but could also patrol the water pipes and prevent the migrant shepherds from breaking them.

However, as the situation stands, the villagers are unwilling to pay even Rs.3.00 to a person to ensure regular water supply for themselves. In a meeting of thirty villagers, one of the wealthiest persons in the village said, "Why should I pay three rupees for water? It is the responsibility of the government to ensure regular water supply. Not mine". This statement probably echoed the feelings of a number of villagers present in the meeting. At the same time, many villagers also stated that it was a great pity that the informal village institution which earlier enforced and coordinated the water supply at an average cost of Rs. 20.00 per family,

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Standard explanations in development literature cite bureaucratic inefficiencies, top-down planning and implementation, lack of participation by villagers, inherent biases in government projects in favor of the rich, and powerlessness of villagers as factors responsible for failure of government projects. These explanations may capture part of the truth. But we should note that bureaucracies can be efficient - indeed in the study above the solution was efficient; top down planning need not necessarily be a failure; participation is not an unqualified good; and there is nothing predetermined about the power of villagers. At the end of the analysis in this section, we will examine the relative merits of the cited factors. But it is important, however, to first analyze exactly where the well-intentioned, efficient intervention by the government went wrong.

Incentive Problem

The inability of the villagers to appoint a person who can exert some pressure on the tubewell operator to run the tubewell or open/ close the valves is an example of a collective action[9] problem. There are costs associated with coordinating the selection of a person who will perform the ombudsman role suggested in the situation. The benefits to no single individual are greater than the total costs. As Olson (1961) has shown, given the situation prevailing in Dodopani, it is only to be expected that rational[10] villagers will fail to cooperate.

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following Olson, I define a collective action problem as a situation in which for a group G, C> b(i) where C is the total cost for the group of achieving a certain outcome when members of the group act collectively, and b(i) is the maximum benefit associated with the outcome for any individual 'i'.

Nationality in this context implies that an individual will not, without good reason, spend more resources on achieving an objective, than the possible gains from that objective.

But the nature of the collective action problem in Dodopani and the neighboring nine villages changed with the introduction of the tubewell. It is the changed nature of the problem that we must pay attention to. The villagers had been confronted with a collective action problem in the earlier situation also. The earlier problem arose after the feudal lord provided a well to the villagers. They still had to create a mechanism through which water could be drawn from the well for the use of the entire village. One possibility could have been for each family to draw water for itself. However, this would large investments of time and effort every day for each family, long lines in queues and fights over who was entitled to receive water first. Village families could also come together to draw water from the village and reduce costs for each individual by acting collectively. Collective action to draw water from the well required cooperation among a number of villagers to reduce costs of selection, coordination, monitoring and enforcement.

The village assembly chose the cooperative solution. It selected a person every year who would draw water from the well thus taking care of the selection and coordination. The person entrusted with the task of drawing water also monitored by ensuring that no one went undetected if he or she jumped the queue for getting water from the well during periods of short supply. If there were persons who violated rules, the village assembly punished the offenders simply by withdrawing their privilege to secure services of the person who drew water from the well for the village. By creating an effective institution, the villagers converted the water from the well - a public good - into a good with a well defined assignment of enforceable rights over it.

Today, not only are the villagers unable to solve the collective action problem that faces them, even their existing institution has broken down. In brief, the tubewell tank in the village

with its piped water supply is more close to a public[11] good (at least on the days when water is available from it) than the earlier village well from which water could be drawn with ease only using animal draught power. The water is supplied free by the government to all villagers who have an equal claim on it. None of them can be prevented from using the water. Even if villagers are able to appoint a person to ensure a regular water supply and agree to pay him Rs. 3.00 per household, the benefits would be available to all households. Some households can refuse to pay the contribution, reasoning that the water supplied is free, and therefore they need not pay any money at all to ensure its provision. Since non-payers cannot be excluded from getting water, the problem of exclusion is greater than in the situation prevailing five years ago when water was available only after expending considerable effort. When water was drawn manually, persons not paying their share could be prevented from using the water and this punishment for free riding was extremely effective as there were no alternative sources of water conveniently located. In addition, today the money needed to appoint a person for regular provision of water will 'only' improve the water supply (ie. make it more regular across time). Earlier, the supply of water was a matter of life and death for the villagers. Thus calculation of marginal costs and benefits of water supply have changed for the villagers under the two different systems of water supply.

In addition, there is another crucial aspect of the situation that has changed. This relates to the enormous daily variance in water supply under the current water regime. On some days

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"It is a public good because on the days water is available in the tank, the supply is so high that for all practical purposes consumption by one villager does not reduce the amount available for consumption by another villager. At the same time, because it is supplied by the government, manifestly for all villagers without any concomitant obligations on their part, exclusion of any villager is not possible.

there is so much water that is resembles a pure public good. On other days, often for weeks, there is no water at all. So all people who have cisterns in their homes can fill them on the days when water supply is abundant in the tubewell tank. They then have sufficient water for one to two months depending on the size of their cistern. They gain nothing from a regular water supply at the source - that is, from the tubewell tank. Therefore they have no incentive to contribute anything towards hiring a person who could attempt to ensure a regular water supply. Indeed, whatever they pay towards the salary of such a person will be a pure loss to them.

Earlier even the persons with cisterns in their houses were locked into the village system because after the rainy season large amounts of water to fill up their personal cisterns were simply not available. They depended on the village well for water after their private tanks were depleted. That supply was limited and could not be used to replenish their cisterns. However, today, on the days when there is excess water supply, a few villagers can siphon off some of the excess to fill their cisterns.

In general it is the richer villagers who can afford private water cisterns. Thus it is they who have the least incentive for cooperating in regularizing water supply for the village. That the remark in the village meeting about not contributing was made by a wealthy person is significant. The table below gives an indication of the relationship between asset holding of village families and whether they have a water cistern in their homes.

TABLE II HERE

Belonging to an upper caste and ownership of large animals (cows and buffaloes) both bear a positive correlation with ownership of drinking water tanks by a household. Sheep and goats, while they are also assets, are owned primarily by the poor. As expected, their ownership is negatively correlated with ownership of cisterns. To see if it is possible to predict whether a given household owns a personal water cistern and to determine the relative importance of the above variables in such a prediction, I conducted a probit regression. The results are provided in the table below. As is obvious, each of the Beta coefficients is significant and has the correct sign.

TABLE HI HERE

In the absence of cooperation by the wealthier and presumably more influential section of people in the village, it is clear that the informal institution for managing drinking water supply to the village will break down. In case an arrangement for improving water supply can be made it will also be more vulnerable to non-cooperation by some villagers since there exist possibilities of complementing the public water supply with private sources (by harvesting, in the first place, excess water supplied in the public system). In the earlier situation, non-cooperation was less likely because of the scarcity of the water. Even if some people did not cooperate, the rest had no desire to stop cooperating in maintaining and running the arrangement necessary for provisioning water supply.

Conclusion

The analysis above of the water problem in Dodopani illustrate that there are no easy fixes to development. They also demonstrate that to understand even simple situations, one needs intimate knowledge of rural life, of pitfalls of bureaucratic functioning, and of theoretical issues involved. This is true whether we are concerned with water delivery, health provisioning, or education; or with awareness building and creation of people's organizations. Indeed, the necessity for such knowledge and understanding shows that simple problems are only seemingly simple, and simple and easy solutions probably naively simplistic.

TABLE I

Item	Cost[1] (in Rs.)
Fixed Costs	
1. Tubewell, motor, shelter structures	150,000
2. Pipelines to villages (50,000 meters)	400,000
3. Tanks in villages	100,000
Total	650,000
Annualized cost	65,000[2]
Recurrent Costs (annual)	
1. Salary of operator	24,000
2. Diesel for motor	12,000
3. Pipe maintenance	12,000
Total	48,000
Total annual cost:	113,000
Cost per family per month:	4.71[3]

1. The costs are not exact. They were reported by the local government employee in charge of operating the tubewell.
2. While the tubewell and associated structures are estimated to last far beyond ten years, (possibly thirty years) I am taking their life to be only ten years. The shorter timespan does not aid the argument I make.
3. The figure is based on the estimate that 2,000 families are served by the tubewell. Also, this cost is borne by tax-payers at large, not by the families living in a village covered under the drinking water supply program.

TABLE II

Variable Pair	Correlation (n=174)
Caste and cistern holding	.60
Sheep + Goat holding and cistern ownership	-.10
Cow + buffalo holding and cistern ownership	.51

(Source: Data collected in 1989)

Figure I

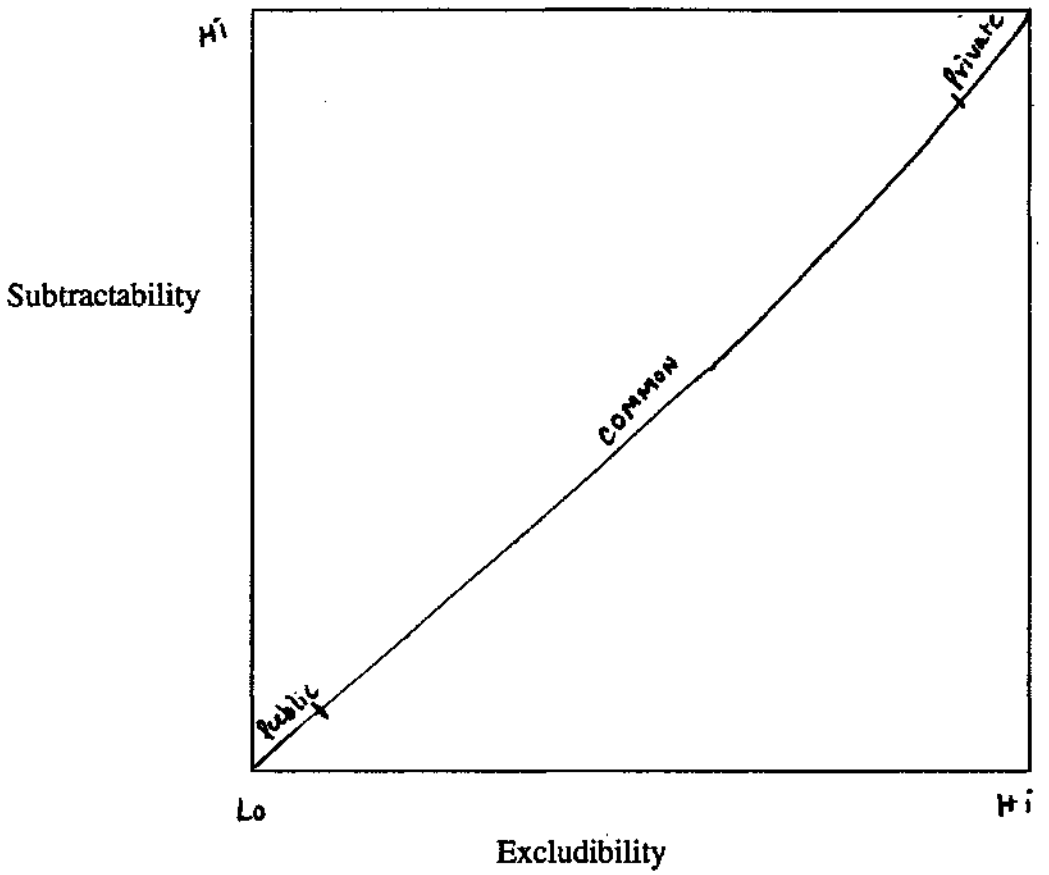
Hi
Private
Subtractability
Common
Public
Lo
Hi
Excludibility

TABLE III

Variable(n=174)	Mean	B-Coefficient	S.E.	T-Statistic
Caste	.68	.707	.247	2.86
Cows+buffaloes	1.44	.868	.199	4.36
Sheep+goats	6.44	-.074	.019	-3.92

Note: Percentage of observations on the dependent variable - the ownership of household cisterns - correctly predicted by the model is 83.3. Approximately 50% of the village households possess cisterns.