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Community-led Alternatives to Water Management: India Case Study

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1. India's water challenges: the hybrid model

Every country has to mind its water business. But for a country like India, where it rains for roughly 100 hours of the year, the management of water becomes even more critical. It literally determines if the country remains poor or becomes rich; diseased or healthy. In other words, water is the determinant of its future.

It is evident from media reports that the scarcity of water is imprinted across India. From the villages of high-rainfall states of Kerala to Meghalaya to the water-stressed regions of central India to cities everywhere, the want of water is a crying need. The reports suggest that the scarcity of water is crippling most of India. Millions do not have enough water, particularly during summer months, and women and girls have to walk long distances to fetch water. In the search for water, people are going deeper into the ground, lowering the groundwater table and leaving wells dry. The per capita availability of water for India in 2001 is expected to be half its 1947 level. Poor sanitation and unsafe drinking water account for a substantial part of the disease burden in India, contributing to diarrhoea, dysentery, typhoid, worms, jaundice and cholera. Each drought destroys the abilities of rural communities to cope. It makes them weaker and more disabled to deal with the vagaries of the monsoon. And in that way drought becomes permanent and long lasting and eats away at the very insides of the country. This is why people across the country want their politicians to deliver on this one promise: water to drink and to irrigate their crops.

The issue of water is not about scarcity but about its careful use and about its equitable and distributed access. Water is the starting point for the removal of poverty in the country. It becomes the basis of food and livelihood security. But what is clear is that water management strategies will need to be carefully designed so that they lead to *distributed* wealth generation. This will require reworking the paradigm of water management, so that it is designed to harvest, augment and use local water resources so that it leads to local and distributed wealth generation. It is also clear that local and distributed water infrastructure, will require new forms of institutional management as water bureaucracies will find it difficult to management such vast and disparate systems. It is here that countries like India must learn from their traditional community based water management systems, so that they can build ways to the future.

The current irrigation systems of India are dominated by individually owned and operated wells and tubewells. Groundwater is the main source of irrigation to agriculture, even as the country has invested in creating surface water systems. The problem is that surface water systems, built at considerable capital costs, are plagued by huge distribution losses and inefficiencies, as compared to the informal world of the groundwater agriculturists who have learnt to maximise the value of their water investment in making crops grow. But in the formal water vision, there is no place for the informal world of groundwater users. No policy can even account for them. No policy plans for them, for nobody understands how to manage this army of water users.

The point is to innovate, by borrowing from the past. The challenge is to enlist this army of informal water users into managing their resource better. It is imperative that groundwater is recharged so that the rate of abstraction is not greater than the rate of the water infiltration. The traditional water systems were designed to ensure that rainwater was stored in millions of disaggregated and diverse structures, which would in turn lead to local recharge of water into the ground. It is this distributed water harvesting that will build water security.

The great water leapfrog

The problem becomes more intractable as the country progresses: moves from using water in traditional sectors like agriculture to industries and urban areas. It is for this reason that a country like India is considered a traditional water economy and that it has to make the transition to a modern water economy. In other words, the water sector has to become part of the formalised economy, with formal institutions and mechanisms for its management and pricing.

The point to understand is what this modern and formal water economy means in the rest of the world and what it will mean for countries like India. In the industrialised world, industry and urban households use over 70 per cent of the water resources, while agriculture gets the remaining 30 per cent. In traditional water economies like India, the reverse is true: agriculture consumes over 70 per cent and industry and urban areas the rest. The point is not where we are. The point is: where are we heading?

The fact is that urban areas and industrial centres in countries like India are now putting greater pressure on water resources. Cities across the country need more water for their growing population and more importantly, their growing affluence. Their growing demand leads to pressure to source water from further and further away. The capital city of Delhi will get water from the Tehri dam, over 300 km away in the Himalaya; The software capitals of the country, Hyderabad, from Nagarjunasagar dam on the Krishna river 105 km away; and Bangalore, from the Cauvery, about 100 km away. The desert city of Udaipur used to draw its water from the magnificent Jaisamand lake but it is drying up and so the city is desperately seeking a way out of this new thirst.

The problem is that the ‘informal’ water economy of rural India, its agriculture dependent population still exists. The economy has not transformed from being agriculture-dependent to a manufacture-service sector driven one. The water crisis is about the management of these competing needs – the vast rural economies, which need water for their food and livelihood security and the newer growth economies of modern and industrial India. This water competition is leading to low intensity conflicts between different users. For instance, when the southern city of Chennai wanted to source its drinking water from the Veeranam lake some distance from the city, farmers agitated against the withdrawal for the thirsty city. When the Gujarati city of Rajkot needed water, farmers drew fire and were killed. In 2005, in two separate incidents in Rajasthan farmers were killed as they rioted against water withdrawal from their neighbouring reservoir or canal for distant cities.

It is because of this imperative that water policy has to shun the dogma that dictates against pricing of water and its efficient management. Cities and the industries of rich India must begin to pay for the water they use. But pricing and markets will not suffice. It is also equally imperative that water management paradigms and their technologies are reinvented for this poor-rich world.

On the one hand these rich cities of the poor world will have to invest in efficiency so that they do not first become water wasteful and then learn the science and art of efficiency.

On the other hand, they will also have to invest in managing and treating their waste water. Today, cities extract from cleaner upstream sources and discharge their waste – sewage and industrial effluents downstream – which in turn leads to increased problem of polluted water and ill-health for poorer users of the rivers. The capital intensity of the modern sewage system – its transportation and eventual treatment before disposal – is such that it cannot be afforded by all users, and even all urban areas. The question then is how will the modern cities of India grow, without creating water waste and pollution? How will these cities innovate so that they can practice the technologies of recycling and reuse, even before their counterparts in the industrial world? The challenge is to re-invent the most modern waste management system that reuses every drop of water discharged, at costs that can be afforded by all.

There is no denying India's water sector needs to be reformed, indeed transformed, so that it can provide clean and adequate water to all. But what has to be accepted is that there is no established model for this transformation. A country like India has to leapfrog over the modern economic paradigm, to create its own — hybrid — version of the water future. Modern water policy will have to be built on the premise that scarcity is not about the lack of resources but about being wise about the use of resources.

This paper discusses elements of this alternative water paradigm.

2. Learning the traditions of water

The current water crisis in India is not about scarcity *per se*. It is about the management of water resources so that the infrastructure is capable of reaching out to poor people living in poor regions of the country. It is here that the country needs to learn from the technologically diverse systems of rainwater harvesting that were practiced across the ecologically diverse country some many years ago. A careful understanding of these systems makes it evident that water management is not about technology, but about the manner of control and governance of the resource. These diverse system used to harvest rainwater across the different regions of the country were community-based systems, not state or private systems. It becomes clear that water then is not about technology but about deepening democracy so that communities can be involved in the governance of the resource. In the mid-1990s, the Delhi based Centre for Science and Environment published its report on traditional water harvesting systems, *Dying Wisdom*,[1] which has helped the country learn, not just about the treasures that existed in the past, but about the wisdom of water management which need to become the way of the future.

Potential of rainwater harvesting

There have been two major discontinuities in water management since the 19th century. One, the State has emerged as the major provider of water replacing communities and households as the primary units for provision and management of water. Two, there has been growing reliance on the use of surface and groundwater, while the earlier reliance on rainwater and floodwater has declined, even though rainwater and floodwater are available in much greater abundance than river water or groundwater.

Theoretically, the potential of water harvesting in meeting household needs is enormous. *Rain captured from 1-2 per cent of India's land can provide India's population of 1 billion as much as 100 litres of water per person per day.* The calculations show that there is no village in India which cannot meet its drinking water needs through rainwater harvesting.

Even in an arid area with an annual rainfall level of only 100 mm, one hectare of land will harvest as much as one million litres of water. As there is a synergy between population density and rainfall levels, less land is required is required in more densely populated areas to capture the same amount of rainwater. And in such areas, there is usually more built-up area like roof-tops which have improved runoff efficiency.

Rainwater harvesting not only provides a source of water to increase water supplies but also involves people in water management*, making water everybody's business*. Because it builds people's relationship with their water and maximises the use of local water resources it also reduces the operational and distribution costs and most importantly enables people to internalise the full costs of their water requirements, thus encouraging conserving in water demand. Most importantly, water harvesting can not only meet people's basic water needs but is part of the strategy to improve the local food and livelihood security of the rural poor.

Water harvesting *and integrated land-water management* is not new to India or to many other parts of the developing world. The art and science of 'collecting water where it falls' is ancient but this 'dying wisdom' needs to be revived to meet modern freshwater needs and modernised with inputs from science and technology.

Water harvesting can be undertaken through a variety of ways:

a) Capturing runoff from rooftops
b) Capturing runoff from local catchments
c) Capturing seasonal floodwaters from local streams
d) Conserving water through watershed management

A history of harvesting: More than two millennia old

The nature of the country's diverse ecology forced Indians to develop the art of water harvesting. Though the country has a high average annual rainfall — as much as 1,100 mm — this rainfall is not evenly spread across the year. In most parts of the country, there is precipitation for not more than 50 days. On the days when rainfall does occur, it does not fall over a period of 24 hours. In fact, heavy showers are common. Most of the country receives rain for just about 100 hours each year.

Not surprisingly, any water gifted by the heavens or flowing past in a stream has been harvested in India since antiquity. Archaeologist B M Pande explains that evidence of this tradition can be found in ancient texts, inscriptions, local traditions and archaeological remains.[2]

Dholavira, a major site of the Indus Valley civilisation, dating back to the third millennium BC was diiscovered in the 1960s. The ancient settlement lies in an arid area that gets an average annual rainfall of 260 mm. There are no perennial sources of water in the form of lakes or rivers. Subterranean water is, by and large, brackish and saline. The inhabitants of Dholavira, therefore, created several reservoirs to collect the monsoon runoff flowing down the flanking streams of the Manhar and Mansar. Stone bunds were raised across them at suitable points to divert the flow of water into a series of reservoirs that were dug out in the sloping areas between the inner and outer walls of the Harappan city. Likewise, a network of drains crisscrossing the citadel was also laid out to collect rainwater. Rainwater harvesting was the way of life.

India has an extraordinary diversity of agro-ecological systems, ranging from the hot desert of Rajasthan to the cold desert of trans-Himalayan Ladakh, from the sub-temperate Himalayan mountains to the high tropical mountains in the south; interspersed are various hill and mountain ranges, plateaus and the unique Indo-Gangetic plains which are more flood-prone than any other part in the world. Each region had its own specific way of harvesting water (**see Annexure 1: Traditional Wisdom**).

Decline of the systems: the role of the state

It is important to note that ancient Indian rulers rarely built water harvesting structures themselves. They instead created fiscal systems to encourage communities to build and manage water systems. This changed with the coming of the British rule into India.

These Indian rulers preceding the British did not boast of irrigation bureaucracies or public works departments to create these structures. Referring to Rajasthan's Thar desert, traditional knowledge expert Komal Kothari says, "While collecting information from some 600 villages, I found that the state, the *jagirdar* (landowner) or anybody who had anything to do with revenue collection did not create any water body for the people. All water bodies constructed by the erstwhile kings, *jagirdars (local chiefs)* were reserved for their personal use. The people largely had to fend for themselves."[3] Though the role of the state varied from one region to another, what historical records show is that rulers rarely built irrigation structures themselves. The massive Pichola lake in the city of Udaipur, for instance, was built by nomadic gypsies. However, the rulers did play an important role in encouraging people to build water harvesting structures.

The famous Vijayanagar kings of south India (1336-1564 AD), for instance, placed great importance on developing irrigation facilities for agricultural improvement. But they used fiscal policies to encourage the development of people built and managed infrastructure. Land tax, which was collected in kind in the form of one-sixth of the produce, was an important source of revenue for Indian rulers. The rulers' fortunes depended on agriculture. The state, therefore, had a vested interest in encouraging private initiative to develop irrigation systems. The Vijayanagar kings would make *dasavanda* or *kattu kodage* grants to individuals or institutions which undertook such works. The enterprising person would be granted a piece of tax-free land watered by the tank, canal or well which he or she excavated. The extent of the grant varied with the importance of the work. Great religious merit was also attached to the maintenance and repair of irrigation works by the Vijayanagar kings. An inscription dating to 1413 states: "A ruined family, a breached tank or pond, a fallen kingdom, whomsoever restores, or repairs a damaged temple, acquires merit four-fold of that which accrued from them at first."

Early British observers were full of praise for the Vijayanagar irrigation works they saw. Colonel Thomas Munro (the governor of Madras in 1820), noting the irrigation system in the area around Vijayanagar, said: *"To attempt the construction of new tanks is perhaps a more hopeless experiment than the repair of those which have been filled up (through siltation), for there is scarcely any place where a tank can be made to advantage that has not been applied to this purpose by the inhabitants."*[4]

British rule: changing ways of doing things

British rule, unfortunately, laid this enormous heritage to waste. In their desire to rule, administer and maximise their revenues from this rich land, the British steadily changed the land and water tenure systems, which gradually but systematically lead to the destruction of community based resource management systems.

Early British observers like Charles Metcalfe and Henry Maine had described India as a land of 'village republics'. What this meant, says historian Dharampal, is "that the 'village', to an extent, had all the semblance of the State; it controlled revenue and exercised authority within its sphere... The basic element of this 'village republic' was the authority it wielded, the resources it controlled and dispensed, and the manner of such resource utilisation... Indian society and polity had basically been organised according to non-centralist concepts... That the annual exchequer receipts of Mughal emperor Jahangir did not amount to more than five per cent of the computed revenue of his empire, and that of (later Emperor) Aurangzeb with all his zeal for maximising such receipts, did not ever exceed 20 per cent, is symptomatic of the concepts and arrangements which governed Indian polity.... there is voluminous data scattered in the British records themselves which confirm the view, that in terms of the basic expenses, both education and medical care, the expenses of the local police, and the maintenance of irrigation facilities, had primary claims on revenue..."[5]

By about 1800, a very large percentage of these revenue assignments had been altogether dispossessed, reducing their beneficiaries to penury. Most of the remaining had their assignments greatly reduced so that they could no longer perform the educational, water management or other functions that they were expected to undertake. It was the task of Thomas Munro to reduce revenue-free assignments in the ceded districts to a mere five per cent of the total cultivated land. The revenue thus collected was drained out of the land and the country, leaving behind a devastated natural resource management system. With the destruction of the indigenous financial system, community property slowly became nobody's property.

Furthermore, what the colonial rulers could not own or earn money from, they neglected. As Arthur Cotton, the pioneer of modern irrigation in India, himself noted in 1874 about local water harvesting systems: "*There are a multitude of old native works in various parts of India... These are noble works, and show both boldness and engineering talent. They have stood for hundreds of years. When I first arrived in India, the contempt with which the natives justly spoke of us on account of this neglect of material improvements was very striking; they used to say we were a kind of civilised savages, wonderfully expert about fighting but so inferior to their great men that we would not even keep in repair the works they had constructed, much less even imitate them in extending the system."*[6]

A bureaucracy is borne

The British tried to take remedial measures when they realised their mistake, but they failed to comprehend the strength of the indigenous system completely. As a result, the measures they undertook also failed. Firstly, they created irrigation and public works bureaucracies which were supposed to own and manage the neglected water harvesting systems. When these technocracies failed to revive these systems, the British authorities in Madras presidency, in the mistaken belief that local communities would undertake voluntary labour to maintain the tanks as a tradition, enacted the notorious Madras Compulsory Labour Act of 1858. With the progress of British rule, there was also a gradual shift in emphasis from minor irrigation works like tanks, wells, *bandharas* (dams) and small river channels to large dams and canals commanding extensive areas. Indian rulers, on the other hand, continued to build and maintain tanks in states which had remained free from British rule.

Independent India: perpetuating the same

Even worse, the British educated an entire class of Indians which no longer appreciated or understood this inherent strength of people's wisdom. The leaders of modern India

also turned their backs on these systems. Indians invested almost exclusively in mega-irrigation projects and depended on the same bureaucracy to manage its water systems. Over time, other changes have taken place in several parts of India which have further eroded the traditional water harvesting systems. Overall, there has been a downfall in community self-management as bureaucratic intervention in village affairs has been steadily encouraged by India's political leaders. Technological changes like the introduction of tubewells has meant that richer farmers in the command area of a tank, who can install these tubewells, no longer have an interest in cooperating with the rest of the community in managing the tanks. Many central and southern Indian cities like Hyderabad, Chennai (Madras) and Bangalore grew up around traditional water harvesting systems. But in these urban areas too, these systems have either disappeared because of pressure from real estate lobbies or have become heavily polluted. Today, traditional water harvesting systems continue to play an important role largely in remote areas where the reach of water bureaucracies remains weak, as in many Himalayan states.

3. Modern India's tryst with irrigation

Since the past 55 odd years of its Independent history, the country has invested substantial in building infrastructure for irrigation. This has, undoubtedly increased the area under food crops as well as yields. The production of food grains increased from 51 million tonnes in 1950 to over 200 million by the end of the 1990s – over half of this increase is attributed directly to investment in irrigation facilities.[7]

But even with this investment, the country remains predominantly rainfed – with vast areas of the country dependent on its seasonal and variable rainfall for growing food. By 2005 out of the gross sown area of 192 million ha, only 43 per cent is irrigated.[8] Water for agriculture remains the most critical and perhaps the most limiting factor on its growth. Equally the lack of irrigation facilities has regional variations in the country, with the poorest regions – with extreme poverty and destitution – remaining without water security.

The country's current five year plan – the national programme – aims to complete the many major and medium irrigation projects, which are in the pipeline. It estimates that 169 major and 219 medium irrigation projects have spilled over from the earlier planning periods, with a liability of Rs 92,000 crore as of April 1, 2004.[9] As much as 13 million ha of additional potential is locked in these projects.

But planners accept that this infrastructure programme has problems.

One, it is confounded by both increased cost of irrigation infrastructure and declining investment from the state in this sector. The mid-term appraisal of the 10th Plan has estimated that the capital costs of creating additional hectare of irrigation can range from Rs 40,000 ha to Rs 2,50,000 ha, where storage facilities are required – which is over a doubling from the previous decade. The states have borrowed to create the infrastructure and are finding it difficult to repay the interest, let alone the principal. By 2004-05, Maharashtra, which has worked hard to develop its water resources, has an interest burden, which adds up to over 15 per cent of its tax revenue.[10] The market has also shown little interest in irrigation bonds, with the risk of repayment high from the thousands of users of the water.

Two, it has not been able to provide water across the country. Even after years of investment in irrigation facilities, over 45 per cent of the food grain production is grown on lands, which are rainfed. These are also the lands, where poverty is extreme. In other

words, investment in surface irrigation systems has created islands of prosperity but has done little to improve local food security.

Furthermore, as the cost of infrastructure has increased, it has not been possible to recover the cost of the capital investment and operation and maintenance of the system from individual farmers. In most states of the country, agencies recover less than 30 per cent of the costs of maintenance of the system. This has lead to deterioration in systems, with an estimated 20-25 million ha of surface water irrigated canals in need of desperate repair.[11] The problem is compounded by the fact that water charges are based on the area of land and type of crop and not on the volume of water used. This does not obviously lead to careful and prudent decisions on its use, which then leads to problems of inefficient use and resultant scarcity.

This water economy is directly linked to the agricultural and livelihood economy of farmers in the country. It is also important to note that the decreasing prices of cereal grains in the world has contributed to making the irrigation infrastructure in the developing world even more difficult to sustain. Farmers of the South find it difficult to compete with the subsidies for grain production in the industrialised world and this makes them devalue their natural capital – water for irrigation.

It is no surprise that facilities created, at tremendous cost, often remain underutilised because of poor maintenance and other operational problems. This gap between the potential of irrigation created and what is utilised is currently assessed to be 14 million ha – as much as 20 per cent of the irrigation potential of the country.

In addition, large surface irrigation systems, which require water transportation over long distances, have substantial losses and inefficiencies. The report of the expert group set up to prepare an integrated water development plan for the country, says in its view surface irrigation systems operate with as little as 35-40 per cent efficiency, while groundwater irrigation systems work at 65-70 per cent.

Three, large irrigation projects require large storage – reservoirs – of water created, which in a densely populated country like India, leads to problems of displacement of villages and submergence of forests and biodiversity rich areas. It is for this reason, that the protest over the building of dams has been the most contentious environmental issues of the country. All in all, the government is finding that the strategy for creating large scale irrigation infrastructure, however urgent is limited and difficult to conceive.

Groundwater: used and abused

But it is fallacy of believe that investment in surface irrigation systems provides the country with its water for growing crops. The investment in large reservoir based irrigation systems – which store and then transport water in canals, has undoubtedly being the country's main water obsession. The British Colonial rulers created irrigation and public works bureaucracies to own and manage the till then community run water management systems. This trend continued with modern India. But even as the state took control of water from communities, private individuals regained their control over the resource as groundwater irrigation became the mainstay of farmers in the country.

It is variously estimated that as much as three-fourth of the irrigated area in the country is under groundwater. The irrigation infrastructure has been created by individual farmers – both rich and poor – using funds available from money lenders or the meagre institutional finance through state credit agencies. It can be well argued that this lack of institutional support for infrastructure and the dependence on private finance is one key cause of farmer indebtedness and poverty in large parts of the country. Groundwater

structures have increased from 4 million in 1951 to 17 million in 1997. The irrigation potential created has increased from 6.5 million ha in the 1950s to 45 million ha by 2000.[12]

But even this may be an underestimate. The recently concluded 3rd minor irrigation census – which estimates the area irrigated by sources other than large surface irrigation projects – finds that as much as 62.4 million ha -- 75 to 80 per cent of the irrigation potential is under groundwater.[13] It estimates that there are roughly 19 million wells – dugwells, shallow and deep tubewells – in the country. In other words, there are roughly as many as 19 million decision makers, who constitute the irrigation entrepreneurs of the country. Groundwater provides the bulk of irrigation infrastructure in the country.

It is also estimated that roughly 80-90 per cent of drinking water is from groundwater sources. The management of this resource will then determine the sustainability of water use in the country. Groundwater is the lifeline that will make India shine or sink.

But it is also the water lifeline that policy is least mindful of, partly because of the inherent problems of regulating its use. The frenetic pace of development of this resource has meant that groundwater levels across the country are declining sharply. The water level in 306 districts has fallen by over 4 metres during the past 20 years, with many blocks in these districts categorised as over exploited or in critical stages of resource development.[14] Technology is allowing for deeper and deeper penetration and extraction. The electricity subsidy — cheap and unreliable energy for pumping — worsens the situation, with estimations that farmers end up using almost double the water for each unit of crop when they have access to cheap or free power as compared to pump-sets using paid diesel.

The problem of groundwater is both legal and technological. Under the irrigation laws, namely the Indian Easement Act of 1882, groundwater is considered an easement connected to land. In other words, groundwater belongs to the landowner, who is free to extract and use it. The act was promulgated when groundwater use was limited both by need and by technology for well digging and water pumping. With the advent of electric powered pumps, it is possible to go deeper extract water, which leads to problems of over-extraction. The 2005 minor irrigation census found that over 50 per cent of the groundwater structures were electric powered.

In the recent years the Ministry of Water Resources has prepared and circulated a model bill to regulate and control groundwater use. But given the political sensitivities of this regulation, only five states – Andhra Pradesh, Goa, Tamil Nadu, Lakshwadeep and Kerala – have enacted some form of legislation. But what legislation does not recognise is that regulating 19 million users through systems of licensing and bureaucratic fiat will clearly be an impossible task. Instead regulation will demand tremendous innovation and management ingenuity to involve local communities in controlling use and public agencies to provide information about the state of the resource and its availability to managers. The fact is that groundwater is a replenishable asset and what is needed is a comprehensive approach to recharge wells, so that annual abstraction is limited to what is sustainable.

Recharge: role of water harvesting

But even as groundwater has overtaken the surface water systems in terms of the acreage irrigated, what is to particular concern is that minor irrigation systems – tanks, ponds and all other community-based and decentralised water harvesting systems have simultaneously declined in importance. These systems played a critical role in the

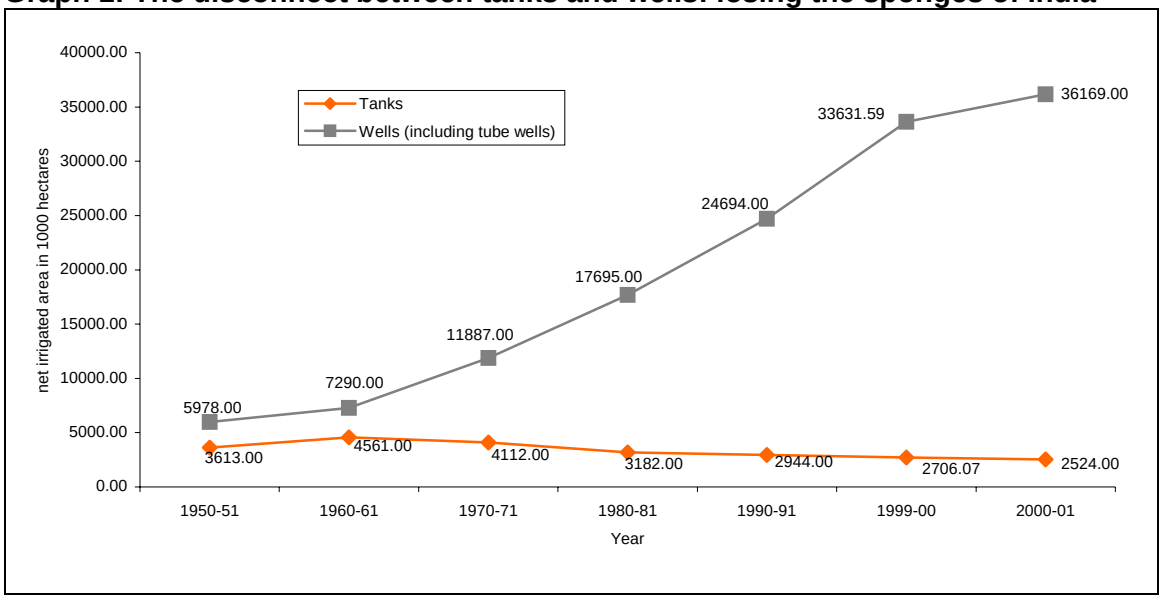
recharge of groundwater as they stored the monsoon rainwater, which then recharged underground aquifers.

According to official estimates, poor maintenance, siltation and in particular the complete disregard for the protection of the catchment areas of the tanks had meant that the area irrigated by tanks has declined from 3.6 million ha in the 1950s to as little as 2.5 million ha by 2000. During this same period, the area irrigated by wells – groundwater – surged from as little as 6 million ha to 36 million ha and more, out of a total irrigated area of 53 million ha.

This has clearly meant that not only has the ability of rural people to benefit from decentralised water structures declined, but it has seriously compromised the sustainability of groundwater irrigation as well (see graph 1). In the last decade, this loss of water bodies has continued. While the 2nd Minor Irrigation Census, conducted in the mid-1980s, counted 750,000 tanks and other surface water bodies, the next census enumerated only 556,000 such structures.

These diverse community structures were the key to irrigation in the pre-British years. During the Colonial rule, state policy deliberated negated the importance of these structures (see section: Learning the traditions of water). But even so, when India became Independent, irrigation statistics reveal that in the southern states of the country, tanks and other community managed water systems irrigated as much area as did wells. But by the late 1990s, while the area under tanks continued to decline, area under groundwater increased manifold. This then meant that there was even less recharge possibilities and groundwater extraction has thus become more unsustainable.

Graph 1: The disconnect between tanks and wells: losing the sponges of India



Source: 2000-2001 data: Statistical abstract India 2003, http://agricoop.nic.in/statistics/st3.htm as viewed on August 16, 2005.

4. Drinking water programmes: zero sum game

The provision of drinking water is a key target of the Millennium Development Goals. India, which still remains a laggard in meeting the goal, has not been wanting in its programme to provide drinking water. What is important to understand is why the programme continues to flounder and what needs to be done to provide something as basic as water to drink to all.

As early as the 1970s, the Indian government introduced the accelerated rural water supply programme to build handpumps or provide piped water schemes in the scattered hamlets and villages across the country. In 1986, the programme was revamped as the Technology Mission on Drinking Water and in 1999, the government proclaimed it would provide safe drinking water to all in five years and upgraded the mission. A new department of drinking water supply was created.

By 2002-03, the country had spent Rs 40,000 crore in creating drinking water infrastructure and over 91.6 per cent of villages were 'fully' covered – that is, they had a source of water 1.6 km from the settlement. But even government officially accepts that this estimation is not worth even the paper it is written on. Villages are "covered", but water is not available.

This is clear from the periodic surveys conducted by government to assess the shortage of drinking water in rural areas. The survey shows that even though a large number of villages are covered between the two surveys, the number of problem villages keeps growing. That is, even as government reaches 100,000 settlements each year through pipes and handpump, it finds another 100,000 — source dried-up, or water quality fallen or pipe broken — back in the list. The government assessment says, "A large number of habitations have slipped from being fully covered to partially covered status and from partially covered to not covered status. In addition, there are 217,000 habitations which are affected by water quality problems, from arsenic, fluoride or salinity."[15] The drinking water mathematics then means that 100,000 problem villages minus 100,000 problem villages is still 100,000 problem villages.

This problem of sustainability was recognised by government agencies and in early 2000 the drinking water programme was reformed. It allocated 20 per cent of the rural water supply funds to quality improvement and keeping the source sustainable, and 15 per cent for operation and maintenance (O&M). But the funds remain grossly insufficient. The Kerala based research institution, Centre for Development Studies has estimated that the entire annual expenditure on the programme some Rs 2,000 crore each year is needed just to meet the replacement costs of equipment and for its O&M.

The government also realised the need to provide greater community ownership over the programme. In late 2002 the programme was further revamped so that the "community would own, operate and maintain" the water system. Under this scheme, communities are required to contribute 10 per cent to the total capital costs; once completed, *panchayat*s (elected local government) take over the operation and maintenance of the scheme. They charge for water delivery and recover costs for maintaining the scheme. The state by downloading its public function believes that it will solve the "sustainability and quality" problem plaguing the programme.

But even with this reform, the programme falters. The simple fact is that the country has not learnt how it will build and maintain decentralised water systems, which in turn require decentralised governance. It is equally clear that technology choices and approaches for water management need change. Currently drinking water programmes fail because they plan for the pipe and not the water source. It is here that India must

learn from its traditions, how people learnt to live both with the scarcity as well as the excesses of water.

5. The paradigm shift: community-based experiences

This water history documents that people across India, had found diverse solutions in diverse ecological regions to manage their water needs. People had learnt to live, with the excesses of water, and with its scarcity. They all worked on the principle of rainwater harvesting in a country, which gets rain for only 100 hours of the 8760 hours in a year. They knew that all the rain of the year could come in just one cloudburst. The solution was to capture that rain and to use it to recharge groundwater reserves for the remaining year. The answer ultimately was to use the land for storing and channelising the rain — over the ground, or under. Catching water where it falls and when it falls.

But it was equally clear policies to optimise the water endowment of each region and need practices to organise water management at each settlement, to harvest the most and to use in the least wasteful way. Then this can only be done if local communities are involved in managing their water systems. The water agenda, therefore, needed building local interests and institutions so that its governance is put into the hands of people.

The issue then is what the country can learn from the traditional practices of water management in its modern water policy. Over the past many years, many villages scattered across India have practiced the model of community-based water management. These experiences are testimony to the potential of generating economic wealth from rainwater harvesting. What is also remarkable is the short time it takes to transform a poverty stricken, destitute and ecologically-devastated village to a relatively rich and green village.[16]

It is important to learn from the micro-experiences to understand the policies needed for the ‘scaling up’ the experiments so that the country can work with using water as the starting point for poverty removal.

The case studies given below show clearly that ecorestoration is possible even in highly degraded lands and that this can regenerate the local rural economy. The key to this ecological regeneration lies in good management and use of the local rainwater endowment but the entire exercise must be underpinned by community-based decision-making systems and institutions, and enabling legal and financial measures which promote community action.

It is important to note that the nature of the institution is critical for the management of natural resources. Village resource management needs the cooperation of people living in the settlement – the rich and the poor, the landed and the landless. The settlement-level institution must work with a high order of democracy and transparency in decision-making in order to engender cooperation and discipline within the group members. In India, village-level institutions have worked best when they are built on the Gandhian concept of a *gram sabha,* which is built on the concept of participatory democracy and not representative democracy. This is because open public forums, being more transparent by nature, work much better than small, elected village councils to bring about good natural resource management and sort out intra-community differences. Even in areas where inequality is intense, there will be greater chances of obtaining community decisions that are equitous in open village forums than in forums, which are closed and secretive. Resolution of intra-village conflicts and coordination are invariably

easier in open village meetings because they introduce transparency, accountability and confidence in community decision-making. Decisions taken in a non-transparent manner by a small coterie of village leaders rarely engender confidence within the less powerful members of the community that the benefits of their cooperation will accrue to them too, in an equitable manner.

Numerous local studies suggest investment in small water harvesting structures give high rates of return. In an evaluation of Gujarat Government's Sardar Patel Participatory Water Conservation Program under which 10,708 check dams were constructed in Saurashtra and Kutch regions, researchers noted that "within a period of three years, an initial investment of Rs.1,58,000 on an average check dam fetched total benefits worth Rs 2,51,582." And that "The investment becomes more attractive if one recognizes that the government had to in fact invest only 60 per cent of the average figure of Rs 1,58,000 under its 60:40 scheme". Under this scheme, communities invested 40 per cent of the funds for the water harvesting structures. The study estimates that in this state, of the 4.2 million ha of cultivated land, 2.2 million is rainfed and is critically dependent upon supplemental irrigation sustained by small water harvesting and recharge structures.[17]

What is also clear is that these examples remain scattered because the governance system needed to foster people's control over natural resources does not exist. It is clear that 'upscaling' the experiences will demand changes in the way we administer our land and water resources. The policy must change for practice to change.

Small vs big

It is often argued that small systems are inefficient in harvesting water, as compared to large dams and storage reservoirs. Therefore, a strategy which is dependent on harvesting water from small catchments in tanks and reservoirs is unreliable and costly.

The problem is that hydrology as a science is the biggest casualty of modern irrigation and water management discourse. It is clear that the strategy to harvest water in big and small reservoirs is not mutually exclusive. In other words, nations can store rainwater in variety of ways; large reservoirs with large catchments by building dams across rivers; in smaller reservoirs -- tank and ponds -- with smaller catchments to harvest water, or by intercepting rain in ways to percolate water into the ground, increasing recharge and sub-surface flows. All options provide ways of augmenting water availability in countries, all options are critical.

The problem has been that engineers and water planners are myopic in their thinking that 'big' is always the answer and have built water management systems singularly dependent on this one option. This has also meant that there is little or scattered hydrological research on the various options and little actual data collection on the land-water inter-relationships.

The most instructive lessons in the small-vs-big debate come from research done in Israel by scientist Michael Evenari who worked on the Negev desert where the average annual rainfall is a mere 105 mm. Evenari was intrigued that the ancient Israeli civilisation had built towns right in the middle of the Negev desert with their own agriculture and water supply systems. In his effort to reconstruct the ancient farms of the Negev, Evenari came up with a very surprising finding: water harvested from small watersheds per hectare of watershed area was much more in quantity than that collected over large watersheds. This research showed that water collected over larger watersheds had higher distribution losses. The loss was stunningly high. While a 1 ha

watershed in the Negev yielded as much as 95 cubic metres of water per hectare per year, a 345 ha watershed yielded only 24 cum per ha per year. In other words, as much as 75 per cent of the water that could be collected was lost. The loss was even higher during a drought year. After years of research, Evenari summed his findings as follows: "…*during drought years* with less than 50 mm of rainfall (normal rainfall in the Negev desert is about 105 mm) *watersheds larger than 50 ha will not produce any appreciable water yield* while small natural watersheds will yield 20-40 cubic metres per hectare and micro-catchments (smaller than 0.1 hectare) as much as 80-100 cubic metres per hectare."[18]

In India, research done by scientists at the government established Central Soil and Water Conservation Research and Training Institute in different agro-ecosystems confirms that smaller watersheds give higher amounts of water per hectare of catchment area. In simple words, this means that in a drought-prone area where water is scarce, 10 tiny dams with a catchment of 1 ha each will collect much more water than one larger dam with a catchment of 10 ha. Similarly, an intensive and decadal study carried out by the US department of agriculture in a semi-arid area of Arizona (355 mm annual rainfall) done over two decades found that for every ten-fold increase in the catchment area, the average annual runoff went down by about 38 per cent. The authors of the study point out that "because of the sparseness of hydrological data in the arid and semi-arid area of the world, there is value in the results of any hydrological investigations undertaken in arid areas. (This) research is particularly valuable because of the intensity and quality of data collection that has continued for over two years. The results obtained in the study show how transmission loss can affect the probability of obtaining various amounts of annual runoff."

But nevertheless it would be ridiculous to compare in simple terms the cost effectiveness of large systems of water storage with small systems. Large reservoirs of India, for instance, have increased storage capacity by over 200 billion cubic meters over the past 50 years, while all the tanks put together can add 15-20 billion cubic meters only. Small reservoirs are dependent on local and highly variable rainfall in their own catchments. Big storage systems are bound to be much more reliable because they can source water from large areas.[19]

The point is that small reservoirs maximise the productivity and efficiency of the distributed and locally available water resource. Secondly, small reservoirs are not built simply to collect water, but also to recharge groundwater in a distributed manner. The tanks of south India, for instance, have been critical in storing water so that the individual wells are recharged in the command area of the tank. It is this interaction between the common-private resource, which was critical for the economy of the water body. Thirdly, small reservoirs provide water and food security locally and reduce the inefficiencies in first collecting water and then distributing it over long distances. It is for these reasons that we need to move beyond the polarised debate on small vs big and move towards incorporating the small to make big changes in water for all.

Case studies: using water to build rural economies

Sukhomajri has the distinction of being the first village in India to be levied income tax on the income it earns from the ecological regeneration of its degraded watershed. Located near the city of Chandigarh, in 1979, when the nation was facing a severe drought, the villagers built small tanks to capture the rainwater and agreed to protect their watershed in order to ensure that their tanks did not get silted up.[20] The tanks have helped to increase crop production by nearly three times and the protection of the forest

area has greatly increased grass and tree fodder availability. This, in turn, has increased milk production. With growing prosperity, Sukhomajri's economy has undergone a change. "Who could imagine that televisions, tractors and bicycles could be had for mere grass and water?" asks a villager.

A combination of public, private and community investments and the participatory efforts of the villagers has lead to, according to one cost benefit analysis, a rate of return of the order of 19 per cent.[21] One of the most impressive savings resulting from the project is in the cost of desilting the Sukhna lake, which supplies water to the downstream city of Chandigarh. The inflow of sediment has come down by over 90 per cent. This saves the government Rs. 76.5 crore each year in dredging and other costs.[22]

In Sukhomajri, the main incentive for the villagers to protect their watershed came because of the assurance they got from the forest department that they would have the right to the usufruct of the degraded forest land. The villagers argued that as they were protecting the watershed, they should get the benefits from the increased biomass production. The state forest department agreed to give the grass rights to the village society as long as the villagers paid the forest department a royalty equivalent to the average income earned by the department before the villagers started protecting the watershed.

The villagers pay their village society a nominal amount to cut grass in the watershed. A part of this is used to pay the forest department and a part is used to generate community resources for the village. If the forest department's assurance, however tenuous, was not available, the Sukhomajri experiment would collapse overnight.

Ralegan Siddhi is today held up as a model of development. It is a village situated in a drought-prone area of Maharashtra where the annual rainfall ranges from 450 mm to 650mm only and where the villagers were once not even assured one regular crop.[23]

In 1975, the village was stricken by poverty. It had hardly one acre of irrigated land per family.[24] Krishna Bhaurao Hazare - a retired driver from the Indian army - began work in the village by constructing storage ponds, reservoirs and gully plugs. Due to the steady percolation of water, the groundwater table began to rise. Simultaneously, government social forestry schemes were utilised to plant 300,000-400,000 trees in and around the village.[25] Because of the increased availability of irrigation water, land that was lying fallow came under cultivation and the total area under farming increased from 630 hectares to 950 hectares.[26] The average yields of millets, sorghum and onion increased substantially.

Every effort was made in the village to ensure equitable access to the resources generated. Water is distributed equitably by building a system of community wells. In other words, all households have equal access to water from these wells, for drinking and irrigation.[1] Furthermore, to build equity in water distribution, only low water-

[1] It is important to note that water equity concepts differ between the villages of Sukhomajri and Ralegan. In Sukhomajri, the effort was to distribute water equitable by breaking the relationship between land and water. In other words, every resident was given the right to water, which could be traded by the landless or the people with land in the areas not irrigated by the ponds, with others for a share of the crop. This 'right' lead to cooperation in the village to protect the watershed which in then lead increased grass productivity. Once grass availability increased and this was equally shared, this became the driver for cooperation in the village. But in Ralegan, the right of water is not shared equitably in all households. Here the right is shared equally in all households, which own land and use irrigated water. The increased employment created because of increased productivity of the private land has lead to income generation even in the poorer households, thus engendering cooperation.

consuming crops were allowed.[27] The treatment of the watershed and the conservation of water has lead to increased availability of groundwater in the community wells. Water from these wells, supplied at a moderate price, has enabled farmers to grow two to three crops a year including fruits and crops, some of which are exported all the way to Dubai.[28]

By the late 1990s, not a single inhabitant of the village depended on drought relief. Incomes have increased substantially. By Indian standards, Ralegan Siddhi is a rich village now. Over a quarter of the households earn over nearly half a million rupees a year. This compared against the fact that there are only a million households in India -- whom the National Council of Applied Economic research calls the 'super rich' -- who earn more than a million rupees a year, including estimates of black money. Ralegan Siddhi's income distribution is also much less skewed than that of rural Maharashtra.[29]

Ralegan Siddhi is, in fact, so rich that it has now even got a branch of a major bank in the village itself. The total savings of Ralegan Siddhi villagers alone is reportedly Rs. 3 crore. For a village that was less than two decades ago, a drunkard's den with a badly degraded environment, this is indeed a miracle.[30]

An impressive system of decision making has been created in the village. Some 14 committees operate to ensure people's participation in all decision making. A participatory democratic institution called the *Gram Sabha* (village assembly) was created to take community decisions. According to the Gandhian philosophy on rural development, the *Gram Sabha,* an assembly of all village adults, should act as the most important forum for collective decision making in a village just as a nation's Parliament collectively decides on the welfare of a nation. If villagers are involved in the planning and decision making process, they are more open to any changes taking place in the village. The purpose of the *Gram Sabha* is, therefore, to involve every villager in the development process and exert social pressure wherever required. In other words, Ralegan has given greater importance to participatory democracy rather than representative democracy.

Jhabua district in Madhya Pradesh is a case where government has learnt and emulated the best practice. Transformation of rural ecosystems with people's participation described above has remained isolated and scattered, led by remarkable NGO leaders. Government efforts in afforestation and watershed management have never been able to replicate these successes. In most cases, the problem has been that the devolution of power to local communities has been half-hearted and inadequate. People's participation has remained largely stuck in the "you participate in my programme" syndrome.

In Madhya Pradesh, however, the watershed management programme has become an outstanding example in which the government has been able to intervene in a way that promotes public participation in environmental management. By the late 1990s, researchers found dugwells literally overflowing with water in a place that was described as chronically drought-prone. Some 149,283 hectares covering 374 villages in Jhabua alone which account for some 22 per cent of the district's land area have been brought under the Rajiv Gandhi Watershed Development Mission (RGWDM).[31]

The state-wide programme had covered 7,827 villages, and an area of 3.39 million hectares by end-March 1998, which is slightly more than one per cent of India's total land area. The total investment in the programme have been of the order of Rs. 300 crore since it began in 1995-96.[32]

The watershed programme in Madhya Pradesh has happened because several tiers of institutions have been created: firstly, at the state level, for policy coordination; secondly, at the district and milli-watershed-level level, for implementation coordination; and, finally, at the village level to ensure that *all villagers acquire an interest in the effort.* For example, there were 1,748 women's groups, with 25,506 participants, were created in 374 villages of Jhabua.

But most importantly, serious efforts have been made to give local communities powers over decision making. And control over resources. For instance, the villagers play an active role in managing the funds meant for the watershed programme. Nearly 80 per cent of the funds for the programme are put in a bank account managed by the Watershed Development Committees made up of village people. The Watershed Development Committee tries to bring together all the important interest groups in the village and thus replicates the concept of the *gram sabha*.

Bringing a dead river back to life

Rainwater harvesting has brought the river Arvari in dry and drought-prone Rajasthan back to life.[33] The river flows through a drought stricken region – villagers living on the margins of survival are desperately poor and find sustenance by migrating for work to cities. According to historical records of the region, the river Arvari, used to provide groundwater recharge to wells in the area. But nobody can remember seeing it flow except during the short monsoon period. Even the very old remember a dead and dry stream. The river – in its 45 km journey to its confluence in the reservoir of a dam on the river Sainthal – flows through 70 odd villages. Its source lies in the degraded hills near the village of Bhaonta-Koylala.

In 1986, working with a local NGO, the Tarun Bharat Sangh (TBS) the villagers of Bhaonta-Koylala built a rainwater harvesting structure locally known as *johad* to trap the rainwater and to use it to recharge the groundwater. Since then over 200 water harvesting structures have been built in the 70 villages in the catchment of Arvari. These small dams have helped to recharge the river – literally bringing it to life. Villages talk about Arvari's rebirth as if it was the birth of a child. "Like a child, it too, remained in the womb as we started recharging the earth with water" say villagers. It is an hydological miracle" say top geologists in the country.

Arvari's gradual way to a perennial life is similar to that of a child learning to walk. In 1990 it flowed till October. In 1991, till January next year. In 1992, till February next year. In 1993, till March next year. From 1994 it flowed till April and in 1995 the flow did not cease. It has been perennial since.

But with the water came the bureaucracy. In 1996 the villagers of Hamirpura living along the Arvari were told that a contractor had been given a licence by the state government to start fishing in the river. Under law the river is the property of the government and now that it had water, it was ready to take 'control' of its resource. But this time villagers were not going to keep quiet. They said, this was their river – a river to whom they had given birth – and they should be allowed a say in its management. Working with TBS, in January 1999 they formed a River Parliament, locally known as the *Arvari Sansad* – an association of all the villages along the river course. The meeting that declared the formation of the parliament adopted a constitution to manage the river. If it succeeds this "people's river parliament" will show the way ahead to a number of communities.[34]

Harvesting the raindrop for water security

"Four days of rain only. Just four days. And that too after three years of bad drought. But we have drinking water in our wells. This is because we have built check-dams to harvest our rain. Our neighbours are fleeing the village but we have reserved the well for drinking water only". This is what Surtabhai, a resident of village Mahudi in Gujarat, told visiting journalists from the fortnightly magazine, *Down To Earth*.[35]

The magazine was doing a follow up story. Something unusual, as journalism is not about following stories of specific villages and[36] how they fare year after year. In January 2000 – the magazine had presented a story of hope. The tale of five villages, which had harvested the raindrop to survive, indeed fight drought. It had reported then that these villages had water for drinking, even for irrigation, while neighbours had already fled looking for distress work. In June 2001, it faithfully followed these villages as the subsequent year had brought little rain and more misery. Journalists reported that even with another terrible year of drought – the third in a row – all the villages had enough water to drink. But irrigation was beginning to be a problem – but only in those villages, which had recently begun water harvesting. It was clear that water harvesting is like a bank account and that if we keep withdrawing money without investing back, the account will be overdrawn – much like our groundwater aquifers. But if we continuously deposit in the bank account, the balance will help withstand protracted periods of scarcity. In June 2002, *Down To Earth* reporters retraced their steps again to find out how these five villages located in the worst drought affected regions of India have coped with one more year of below average rainfall.

They found Surtabhai and his family struggling to deal with another year of drought. But the little rain that they had harvested by holding it in check dams and recharging the groundwater, was giving them relief. This was the story in the other villages as well. In the village of Raj Samadhiyala, in Gujarat, villages have voluntarily built check dams and village ponds since 1985. Over 45 check dams in an area of over 1000 hectares. There has been little or no rain for the past four years. Here there was ample water to drink and irrigate crops. Now the village plans to use remote sensing technologies to locate subsurface dykes to store rainwater.

Overall it was clear that even after four years of poor rainfall and certainly after three years of consecutive backbreaking drought, rainwater harvesting had helped villages withstand the worst. Sceptics have maintained that rainfall is too variable and so rainwater harvesting is not viable. But these stories revealed that it works. It is possible to build livelihoods, indeed economic well being by investing in capturing the rainwater endowment of the area.

6. Upscaling the 'difference'

The experience of villages like Sukhomajri, Ralegan Siddhi and villages in Alwar district and the several others scattered across the country shows that community based rainwater harvesting can, in fact, become the starting point to eradicate rural poverty itself. Increased and assured water availability means increased and stable agricultural production and improved animal care. Rainwater harvesting has helped Ralegan Siddhi in Maharashtra transform itself from one of the most destitute villages of the country in the 1970s to one of the richest villages today.

But it is important for policy to learn that ecological restoration is not primarily about planting trees or rehabilitating landscapes. It is about deepening democracy. In Sukhomajri, Ralegan Siddhi, Alwar, and Jhabua, natural assets began to accumulate only after communities were mobilised and won greater power to manage their environment. In each case, a non-governmental organization or the state played a catalytic role by providing the community funds to invest and helping to find ways around restrictive laws. Water harvesting then is more about water rights, than about building infrastructure.

Such cases remain few and scattered in India, in large part because the country's legal framework denies villager's property rights over common lands and water. Under the Indian water acts, the state has the sole right to capture, harvest and divert water. In three of the cases described above, the villages strictly speaking are managing the common property 'illegally': they have appropriated control, and after considerable tension and conflict they have reached an unwritten understanding with the government authorities. For instance, the state irrigation department sent a notice against the very first *johad* (water harvesting structure) built by NGO Tarun Bharat Sangh in the village of Gopalpura. They declared the structure "illegal" under the existing water laws. Under the Rajasthan Drainage Act of 1956, "water resources standing and collected either on private or public land (including groundwater) belong to the Government of Rajasthan." The villagers were asked by the government agency to "remove" these structures as all drains and small streams are government property. The irrigation agency first argued that a downstream dam would get reduced water because of these village structures. Later it changed its stand to say that these unauthorised structures could get washed away and flood local villages. Finally, the sheer persistence of the people succeeded in saving the structure. Even in Madhya Pradesh, where the state government itself initiated change, the laws on the books remain unchanged.

As these initiatives have progressed, new demands for institutional innovation have arisen. In Alwar and Madhya Pradesh, for example, watershed protection has made more groundwater available, but this has spurred the sinking of tubewells that threaten to deplete the aquifer and raise the danger of inequities in distribution between those who have pumps and those who do not. In Alwar the villagers have set up a river parliament to contend with these issues, and in Madhya Pradesh the government is considering giving village watershed committees the power to set rules over groundwater usage.

In all these cases, progress has been possible because the communities created local assemblies that deliberate in the open and invite widespread participation.

The answer again lies in fostering democracy. The above case studies show that open and participatory village institutions, with clearly defined property rights, are in the best position to balance competing interests in the community. This does not mean that conflict will disappear, or that all decisions will serve the interests of the poor. But participatory democracy does provide an institutional and legal framework that allows the poor to fight for their rights and defend the natural resources on which their livelihoods depend.

It is also clear that water harvesting is not about water alone. It is about the relationship of water with land and forests. This, unfortunately, is where policy goes horrendously wrong. Land is managed by a multitude of bureaucracies, water by another. This ensures that villagers are disenfranchised from the management of their resources (see box; Laporiya: linking water to milk). Community based water management will demand that policies are built around the resources of the villages, not around the bureaucracies

that manage the resources that the village uses. Ultimately, the water policy will have to become the developmental policy for the country.

Box: Laporiya: linking water to milk[37]

After five successive years of debilitating drought the village dairy in Laporiya — a one room shop with an electronic machine to detect fat content in the milk — was lined with people bringing their product for sale. Even in this crippling drought year of 2004 they had sold Rs 34 lakh worth of milk last year. How could this be? The map displayed in the village centre explained the transformation. The green painted area was the village common land — grazing land vested with the government. This, explained villagers, was the land they had to fight to regain control over, as it was encroached and degraded. On the map, squares had been painted. These denoted *chaukas* — a unique water harvesting system designed to retain every drop of rainwater and to recharge the aquifer. All over the common land, villagers had dug rectangular trenches less than 1 feet deep, so that rainwater would 'jump' across the land till it flowed into the village tanks.

With this system in place, the village common land became a grand water collection area. Every drop was channelled and stored in the village's three connected tanks — deepened by voluntary labour. Of the 1000-odd ha of agricultural land, roughly 600 ha was irrigated. For the past few years the tanks had barely filled; today, they were bone dry. Still, the wells have water. Laporiya practices the conjunctive use of irrigation structures — surface and ground.

But what was clear is that it was the years of water harvesting (over 10 years in this case) that had built up groundwater reserves. Built it up so well that even repeated years of drought and scarcity could be withstood. Rainwater harvesting is like putting hard-earned money in a bank account: prudently and repeatedly replenish the aquifer, then live off the interest and not mine the capital of the groundwater reserves. But this takes time. It takes people who care about their land, so that they care to harvest their water.

For Laporiya and many other neighbouring villages, the most difficult struggle has been not to combat drought, but to regain control over the village common lands. These are some of the most abused lands in the country. Grazing lands — village commons — technically fall under the control of the *panchayats (local elected bodies)*, but they vest it with the state bureaucracies. In this desert state of Rajasthan, livestock-based practices form the base of the rural economy — for milk, meat and wool. This is the economic wealth of the state.

The fact is that India desperately needs a policy for common lands — forest or grazing lands — so that these are seen as the base to rebuild rural economies. These are the catchments for water, for food and for milk. Without the commons, little private wealth gets created. Laporiya knows that in the drought-prone region it belongs to, animal-based economies are far more durable than agriculture. It uses its water to irrigate its grazing lands first, so that even after sustained drought there is some fodder for animals to eat. The precious water in the wells is used to grow animal feed, so that there will be milk and wool to provide sustenance to people. This is a lesson worth emulating.

Principles of 'upscaling'

It is important to realise that successful examples of resource management and poverty eradication remain scattered because the governance system needed to foster people's control over natural resources does not exist in large parts of the South. Therefore, the

institutional framework for governance will have to be restructured keeping in mind the following principles:

1. Planning for village resources must be done at the settlement level: Local resource management demands integrated thinking. People living in villages know that their 'village ecosystem' consists of several integrated components: croplands, grazing lands, forest and tree lands, local water bodies, livestock and various energy sources. They know the interactions between these different systems are integral to its productive use. But bureaucracies do not understand integration. Current rural development efforts in most parts of the South are extremely fragmented – if they focus on agriculture, they discount livestock rearing, if they focus on ponds to hold water, they discount the catchment area which feeds the pond. Land is managed by a one set of bureaucracies, water by another. The integration of these resources and agencies is best done through the strengthening of village-local institutions so that resource planning can be done at the level of the settlement.

2. Community participation in the programme must be secured: All new plantations and grasslands have to be protected. But since all common lands have intense users, any attempt to enclose a patch of degraded land will be strongly resented by the people, however under-productive it may be to begin with. If people's support does not exist, the survival rates of village assets like check dams, tanks will be extremely poor. It is important to note that ecologically resources like trees, grasses, ponds and tanks are fragile assets and cannot be created and maintained by any bureaucracy. It is for this reason that the programme for water management must secure the full participation of people; it must be planned by them and they must be in charge of its implementation and management.

3. Village institutions must be strengthened. Rational use and maintenance of village land and water resources needs discipline. Villagers have to ensure that animals do not graze in their protected commons, the catchments of their local water bodies are conserved and properly used, and the common produce from these lands is equitably distributed within the village. Villagers can do all this, and more, only if there is an effective village-level institution to energise and involve them in controlling and managing their environment. *Deepening democracy at the grassroots is a critical determinant for ecological regeneration and local water management.*

The nature of the village institution is also critical in ensuring equity and cooperation in the village. As the natural resource base grows, so do the interests of the rich and the powerful in augmenting their share. Strengthening property rights and village institutions to withstand this threat becomes all the more critical. It has long been held that village institutions fail to protect the poor against powerful vested interests, and that the best solution is to strengthen outside agencies. Over more than five decades of India's independence, however, bureaucracies too have become handmaidens of the rich and powerful. Their closed nature and lack of accountability engender corruption, leading to more inequality, not less. It is for this reason that open and participatory institutions at the grassroots will provide local leadership and spaces for arbitration over village level disputes.

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4. The legal framework must enable people to manage their local resources: Laws dealing with natural resources like land, water and forests will have to be changed to give people the right to improve and develop the village natural resource base. Currently, in India, the government owns a substantial portion of land and water resources. Natural resources are thus largely government property and not community

property. The result is that village communities have lost all interest in their management or protection. This alienation has led to massive denudation of forests, overexploitation of grazing lands and neglect of local water systems. This will only change if the people get a stake in the improvement of the natural resource base by reforming the current legal structure of control over natural resources.

5. Funds for water management must be directed to the village institution: In most countries, various functionaries and agencies of the government control finances for village development. Ultimately, only a small proportion reaches the community and is spent on projects over which it has no control and for which it has not set any priority. One option is to channelise funds directly to village institutions.

7. The water futures: when government learns change

The need to learn from traditional wisdom to build the modern water policy has began to take root in the country. In 2002, while releasing the national water policy, the Indian prime minister said, “exclusive control by the government machinery and the resultant mindset that water management is the exclusive responsibility of government cannot help us make the paradigm shift to participative, essentially local management of water resources.” He went on, “let this meeting send out a powerful message that harnessing every drop of rainwater is a national priority and that every village should earmark five per cent of its area for community water bodies.” “*This is a powerful idea whose time has come*” concluded the prime minister.

This message is driving programme changes in the country. In the 2004-05 national budget the government launched a massive scheme to repair, renovate and restore all the water bodies that are linked to agriculture. “The effort has to be to put into place an effective and sustained implementation of this programme so we can provide water security and hence livelihood security to our farmers” said the finance minister. This scheme is now being implemented and key to its success will be the ability of the government to learn from the micro-experiences so involve communities in the management of the resource.

In 2005, the Indian government also brought in a path-setting legislation to guarantee employment to people during times of drought and stress. The National Employment Guarantee Act will be initially targeted at 200 most backward districts of the country and gives “minimum 100 days of guaranteed waged employment to one person in all rural households”. The aim is to avert famine and hunger by providing jobs and so securing people’s livelihoods during times of extreme distress. The Act also provides for one-third reservation for women and a minimum wage guarantee.

This programme will involve creating a massive public works initiative. The government in its announcement for the programme has listed the works for employment, which includes at the very top employment generation through watershed development, renovation of water bodies, desilting of tanks and afforestation. Decentralised water harvesting is very much on the agenda of this crucial jobs-for-livelihood security programme.

The challenge is to ensure that the jobs programme will invest in building durable natural assets – ponds, tanks, community wells, other traditional water harvesting structures – which will provide not drought relief but relief against drought (see box: jobs for water). It is now imperative, for this programme to succeed, that communities across the country are engaged, in what can be known, as the biggest cooperative exercise in the world.

This will require much greater innovation that we have seen in governments working with people to build diverse and decentralised water structures.

8. Jobs and water

India in 2005 has enacted a national legislation, which guarantees jobs to people living in the poorest, most marginalised regions of the country. Under the National Rural Employment Guarantee Act the government has legislated to guarantee 100 days of employment to any rural household, whose adult members ask for work. The scheme, which will provide a security net to the poorest in times of scarcity and famine, is also an opportunity to create durable assets for rural regeneration. The scheme has come into effect in 200 of the country's poorest districts and will cost the government Rs 13,000 crore in 2006-07 in job creation.

The Act authorises the gram sabha (village assembly) to recommend the work to be taken up by the rural employment guarantee programme. The local representative body, the village panchayat, has been charged with implementation of 50 per cent of the programmes under this scheme. In other words, this scheme will involve villager in planning and executing programmes for village-level works.

This bill could actually change the economic futures of millions of Indians. But to do this, the government will have to focus, not on the quantum of money, but on *what* it is spent and *how* it is spent. The votaries of the employment guarantee bill see it primarily as welfare: doling out work to the poor in return for which they get money and can buy food to tide over another drought. But this bill can be the answer to drought and economic destitution: it can provide not just drought relief, but relief against drought.

This is an opportunity to make jobs work for development. The list of "permissible works under the scheme are clearly related to the creation and maintaining of rural assets: water conservation, de-silting tanks, planting trees, protection grazing lands and other rural infrastructure (see box: What works for employment?).

The key challenge is to ensure that the assets, which are created through this massive employment programme, last beyond the immediate famine. It is critical that its implementation ensures that the labour invested in rural regeneration leads to durable and productive assets? That is the challenge of the new generation of employment programme.

The programme, if not designed for long-term development, will lead to unproductive employment generation: digging holes to fill them with earth and then digging them again. The road constructed one year, using the labour of the poor, will be washed away the next season. The check-dam built one year will be gone by the next. The sapling, planted one year, will wither away the next. It is precisely this hole that must be plugged. But for this, the employment programme has to become the basis of village level developmental activity. The labour of the poor should be used to build their natural capital.

It is here that the country must learn from similar work schemes in the country. The largest and oldest is the Employment Guarantee Scheme (EGS) of the state of Maharashtra. This programme began in the early 1970s, when the state was facing a crippling drought. It began with public works, designed to give people money for their labour in times of drought. But in the late 1980s, it was understood that the investment

would be much more meaningful if it lead to the creation of community assets and protection of the environment. Over the past 30 years, the programme has invested in over 50,000 minor irrigation programmes in the districts. It is clear, however, that this investment, if not integrated in the developmental schemes of the village and if not executed through villagers remains unsustainable. The programme provides immediate relief so that each drought does not turn into a mass famine, but it does not lead to regeneration of the village economy.

A recent study by the Centre for Science and Environment in the EGS villages found that there has been substantial investment in water conservation in the drought affected districts. But that this investment has been more effective for private asset creation than public and common assets. A considerable amount of work has been done on building check-dams, percolation dams, bunding fields and digging trenches to improve recharge has mostly happened on private land of farmers. This has definitely improved the productivity of these lands as well as water availability. But the problem is that without work on community and government owned forest lands the work on water conservation remains ineffective. The problem is that institutional structures of EGS have not been capable of working with local communities to protect community resources.

The is why it is important in the next phase of the employment guarantee programme, which is being up-scaled at the national level to learn that asset building is not merely about jobs. Assets require clarity of ownership and stake in management. Currently, the programme is designed to create employment for building public (actually governmental) assets: roads, schools and ponds. The problem is that these governmental assets are nobody's assets. Moreover, government agencies at the village level are fractured and so, implementation of their programmes gets distorted as well.

Take water structures. A pond requires a catchment. But even as the employment programme uses labour to dig the pond, its catchment is controlled by government departments: say, the forest department or the revenue department. The pond probably belongs to the panchayat (if it is small) or the irrigation department (if it is large). Anyhow, the pond remains, what it is not meant to be, a hole in the ground: it has no water and can't recharge groundwater — a typical example of unproductive employment.

The question to ask is who can best create these durable assets? Fractured bureaucracies will provide fractured answers. The answer is to find the owners of the asset and provide them legal rights to manage these resources. To do this we will need to integrate employment generation with decentralisation and put jobs into the domain of the panchayats.

The national employment guarantee programme has incorporated this learning from earlier experiences. In the current programmes, villagers are required to plan and the local elected bodies will implement the projects. The issue now is to ensure that these village institutions have the capacity to plan and implement the schemes.

The village institutions will also need to coordinate between the different resource – owning agencies of the government. This employment programme will need different land and water bureaucracies of the state to function as line agencies of the panchayat so that the assets created are planned, owned and operated by communities, not faceless agencies. With innovation in systems of governance — strengthening the accountability of panchayats (representative and elected local bodies) through gram sabhas (village assemblies), putting the transfer of money in public domain — the money can actually reach those it's meant for. And then, be made to work. This is the

opportunity to use employment for ecological regeneration so that the labour of the poor, can build the resources to secure the present and the future.

Box: What works for employment?
List of "permissible" work under the National Rural Employment Guarantee Act

1. Water conservation and water harvesting
2. Drought proofing, including afforestation and tree planting
3. Irrigation canals, including micro and minor irrigation works
4. Renovation of traditional water bodies, including de-silting of tanks
5. Land development
6. Flood control and protection work, including drainage in waterlogged areas
7. Rural connectivity to provide all-weather access (rural roads)

9. The urban challenge: drinking water and sewage question

India is growing rapidly in its cities. By 2001, as much as 28 per cent of the country's population lived in urban settlements – in the last decade the rate of growth was a staggering 30 per cent. Cities require basic services – water and sanitation and while government estimates that as much as 80 per cent of urban Indians have access to safe drinking water and 64 per cent to sanitation facilities, it is clear these numbers hide more than they tell. Shortages of drinking water cripple cities. The quality of water supplied is increasingly a problem. The fact is that pollution of the rivers and other water systems puts pressure on the public water utilities to increase treatment costs. Groundwater levels are declining precipitously in urban areas as people bore deeper in search of the water that municipalities cannot supply. In all this, the waste generated by cities is not treated and adds to the burden of contamination of water bodies.

Finding water for cities and treating waste

The current paradigm requires cities to source water from further and further away. This then increases the cost of treatment and delivery of water. It also leads to inefficiencies in supply, with distribution losses are estimated to be in the order of 30-50 per cent in almost all cities of the country. This then results in developments, which further cripple water supply in cities. Firstly, as the cost of supply and delivery is high, the state can afford to supply water to some and not all in cities. This leads to huge problems in inequity within cities (see case study: Delhi's water and excreta tales). Secondly, the political imperative results in cities not charging its users for water supply. This, in turn leads to increased wastage and inefficiency. The burden on public utilities grows. But it is important to understand that even if public agencies were to do full cost pricing – charge users the cost of water supply and waste disposal – most cities would not be able to pay for the costs. This is because the current capital intensive technological model adopted by cities of the South requires huge investment in supply and treatment of water and waste. But the answers and alternative paradigms for urban cities are more difficult to find.

In this situation, what needs to be done? Firstly, each city will have to plug its losses. But the answer is not simply to "privatise" water supply as most cities have found that the answers that this provides are limited.

The answer will lie in finding cost effective solutions to supply and disposal. This can only be done if the water utilities are improved, services are paid for and, most importantly, we realise that distribution losses can best be plugged by reducing the length of the pipeline itself. A city will be much more efficient if it can strategise to locally

collect water, supply it locally and take back the waste locally. This can be done. The city must look at its groundwater reserves carefully and create strategies to augment these reserves. It must only draw water it requires from external sources after it has optimised its own.

The water imperative is that cities must begin to value their rainfall endowment. This means implementing rainwater harvesting in each house and colony. But it also means re-learning about the hundreds of tanks and ponds that built, indeed nourished the city in the past. Almost every city in the country had a treasure of tanks, which provided it the important flood cushion and allowed it to recharge its groundwater reserves. But urban planners over the years have allowed these water bodies to be decimated. Cities only see land for building, not land for water.

Today, these water bodies are a shame – encroached, full of sewage, garbage or just filled up and built over. Bangalore, at the beginning of the 1960s had 262 lakes, now only 10 hold water. The Ahmedabad collector – on directions from the high court – listed 137 lakes in the city but also said that over 65 had been built over already. In Delhi, 508 waterbodies were identified – again on court orders – but are not protected.

This will require re-learning the art of water management in the profession that builds houses and plans cities. Currently, the profession of builders and architects have simply never been taught how to hold water. They have been trained to see water as waste and to build systems to dispose it as fast as possible. For instance, cities in Germany are beginning to do this. To save investing in stormwater drains, they provide incentives to households to harvest and recharge rainwater. The city charges a tax based on the calculation of the paved area and the water-runoff coefficient. If rainwater harvesting is done and the load on the city's stormwater drainage is reduced, the burden of tax on the house-owner is reduced accordingly.

But this even this will not be enough. The city will have to learn to minimise its water use and work on conservation and reuse. It needs to plan carefully and reduce the water need in homes and factories. Rich Austrialia, which also is water-stressed, has passed a bill that mandates household equipment be water-efficient. But in India, flush toilets still use more water than anywhere else in the world.

Indian cities must look at their waste economy and invest in reuse. This will require them to invest in state of the art equipment that completely cleans wastewater up, making it potable again. For instance, Singapore uses expensive membrane technology to do this. The other alternative is that cities of the South leapfrog so that they minimise on generation of waste or ensure the waste is segregated — household waste from industrial waste — so that what is relatively less toxic can be cleaned up and then used to recharge groundwater or irrigate fields. For instance, the desert city of Jaipur can treat its wastewater and use it to recharge its groundwater. It could channelise the treated water to its waterbodies, so developed as to make the soil act as a cleanser. Israel does this.

But all this require a major change in mindset so that rich cities of the poor South find innovative answers in their water and excreta management. It is also a fact that modern technologies for cleaning waste are out of reach from the waste-accumulated societies of the poor South. They are too expensive to install and even more expensive to run.

The problem is that even as modern industry has universalised the use of its chemicals and other pollutants, it has not worked hard to universalise the answers needed to mitigate its deadly discharge. The reason is that industry has treated waste as a

business – it must be profitable to treat. This principle works when society has money to pollute and also to treat. But in large parts of this poor and polluted South, there is little money to treat on its human excreta, let alone its modern chemical waste.

It is here the challenge lies: To reinvent the paradigm of waste treatment by reinventing the paradigm of waste generation itself.

Case study: Delhi's water and excreta tale

Delhi, the capital city of India is a water guzzler. The cities water demand is estimated at 3,600 million lites of water per day. The public utility, the Delhi Jal Board supplies 3040 million litres per day. But only about 1,730 million litres reaches consumers because of distribution losses.

The problem is compounded by the fact that only certain parts of the city receive adequate supply of water. The political economy of water in Delhi is also a story of power and inequity:

- Three per cent of the population receives more than 450 lpcd: areas under the New Delhi Municipal Corporation get 462 lpcd; Delhi Cantonment receives 509 lpcd. Thus, this three per cent receives 11 per cent of the water the Delhi Jal Board (DJB) supplies.
- 70 per cent of the population living in villages in the National capital territory consume less than 5 per cent of total water supplied.

The city planners find that water shortages require them to search for new sources of water. It is already fighting for its share of Ganga water from the neighbouring states of Uttar Pradesh. In 2005, the conflict over its water reached flashpoint with its neighbour, Uttar Pradesh refusing to release water for Delhi's water treatment plant. The prime minister intervenes in the matter but even he was rebuffed by political leaders of the upper riparian state, who say their farmers and cities need water first. Delhi is already water-spoilt, they told the Prime Minister. The city also proposes to build more storage facilities in the upper reaches of the Himalayas for its future supply.

The cost of water supplied is also not recovered. It is estimated it costs the government Rs 8-9 to supply 1,000 litres of water; for this, it charges roughly Rs 2. Nobody knows what collection and disposal of sewage costs, but it is estimated it is normally five times higher than water distribution costs.

The city government does not have the political will to increase tariffs to charge full cost pricing. But recently, it had proposed a scheme to privatise parts of the city's water distribution so that it could supposedly lead to greater efficiency in supply and recovery of costs. But the scheme, proposed in consultation with the World Bank called the 24x7 water supply reform continued with the two travesties of city water pricing. The government would remain in charge of water tariffs, which it promises not to raise even if households use much more water. Also, the scheme does not include the collection of sewage. In other words, more water will be supplied, which will not be paid for. More sewage will be generated, which will not be paid for. This would mean that the public water utility that is inefficient also because it does not get paid would become even more burdened.

The city disposes its excreta in the river Yamuna, which flows through it. This important river of the country is virtually "dead" during its journey through the city, as the city withdraws water upstream and discharges only sewage. The river does not have any assimilative capacity to dilute the waste.

But this is not to say that Delhi does not have sewage treatment facilities. In fact, it has constructed 17 sewage treatment plants, with installed capacity to treat anywhere between 60-90 per cent of the waste generated. The fact is that the quantum of waste a city generates is in direct proportion to the water it consumes: at a minimum, 80 per cent of water supplied to a household leaves as waste. But as large parts of the city are dependent on groundwater, city planners do not know how much water the city uses and therefore, how much water it discharges.

But even as the sewage treatment plants are built, they are not utilised fully. The reason is that large parts of the city remain unconnected to the official sewerage system. Large parts of the city, an estimated 50 per cent live in slums and unauthorised colonies, where government services do not reach. In this circumstance, even as part of the sewage is collected, transported and even treated, large parts of sewage is uncollected and untreated. The untreated and the treated effluent get mixed in the drain, before discharge into the river, which then nullifies the treatment provided.

It is in this scenario, that Delhi has to rethink its water future. The answers will lie in reducing costs of distribution and so that losses in distribution. This will mean that the city will have to recharge its groundwater – through its tanks and home based rainwater harvesting systems – so that it can depend on this source sustainably. This will also reduce its operation costs, which can be invested in greater efficiency. The city will have to ensure water for all, not just the rich in the city. And, most importantly, innovate in sewage treatment systems so that it can reduce costs and recycle its waste.

Note: 1 lakh is 100,000 and 1 crore is 10 million. Exchange rates have increased steadily from 1970s and early 1980 when they stood at Rs 10 equals to 1 dollar to 2005 when the exchange is Rs 46 equals to 1 dollar.

Annexure 1: Traditional Wisdom

Each region of India had its own technology to harvest rain. To live with its water endowment

Hill areas: diverting streams

Traditionally, wherever there were streams, especially in the hill and mountain regions of India, people diverted the water with the help of simple engineering structures, into artificial channels that would take the water to agricultural fields. The most technologically sophisticated system can be traced to the northeastern India where people built bamboo pipelines to carry water from natural springs over long distances, using an intricate network of pipelines spread over difficult terrains. The entire system worked like a modern drip irrigation network that delivers measured quantities of water straight to the roots of the plants. Some 18-20 litres of water enters the bamboo irrigation systems every minute and after getting transported over several hundred metres, is reduced to 20-80 drops per minute at the site of the plant.[38]

Dry India: Harvesting the rain and capturing runoff

In several parts of India, people have been building dams across seasonal channels to capture the runoff. But these structures, unlike normal dams, are used to moisten the soil so that the post-monsoon crop would be assured of the rich soil of the tank bed itself. In dry areas of Rajasthan, people have traditionally practised conjunctive use of surface water and groundwater (*see box: Jodhpur: providing an example*). They invariably built structures like wells and stepwells — wells with a flight of stairs leading down to the water — below tanks and other types of water storage structures. Thus, when the tank water dried up, people could at least harvest clean groundwater to meet their drinking water needs. Rajasthan also has an old tradition of using rooftops as a catchment area to collect rainwater.

In areas where land is not a limiting factor, people developed customised rainwater harvesting structures called *kundis*. These are artificial wells which store runoff from an artificially prepared catchment surrounding them so that rainwater that falls on the catchment rapidly runs into the well and gets stored. Their potential can be understood by the following fact: If an area receives only 100 mm of rainfall — which would make it an extremely arid environment — this rain harvested over one ha of land would provide one million litres of water a year. As a family of five would not need more than 10-15 litres a day for drinking and cooking — 180-270 families could meet their most critical water needs by building a one-ha *kundi* in the driest regions of the world..

South India: building a culture of tanks

Not all storage structures are riverfed or streamfed. Many stuctures collect water running off a catchment area to be stored for later use. In the southern state of Tamil Nadu, a big stream is often diverted to feed a chain of 25-30 tanks in sequence. As this chain of tanks — called ‘system tanks’ — is served by a stream collecting water over a large catchment, it is traditionally considered much more desirable than a tank with a single, small catchment. The Palar anicut (dam) system, for example, supplies water to 317 tanks, irrigating about 32,000 ha in North Arcot and Chengalpattu districts. The profusion of tanks in Ramnathapuram district of the state can even be seen from a satellite.

The legacy of Bill Willcocks
Bengal’s history provides an eye-opener for irrigation managers.

In India's flood plains, the people developed ingenious techniques to use the menacing floodwaters, not just to irrigate their fields but also to fertilise them and control diseases like malaria (by making use of fish in the floodwaters to eat away mosquito larvae, for instance).

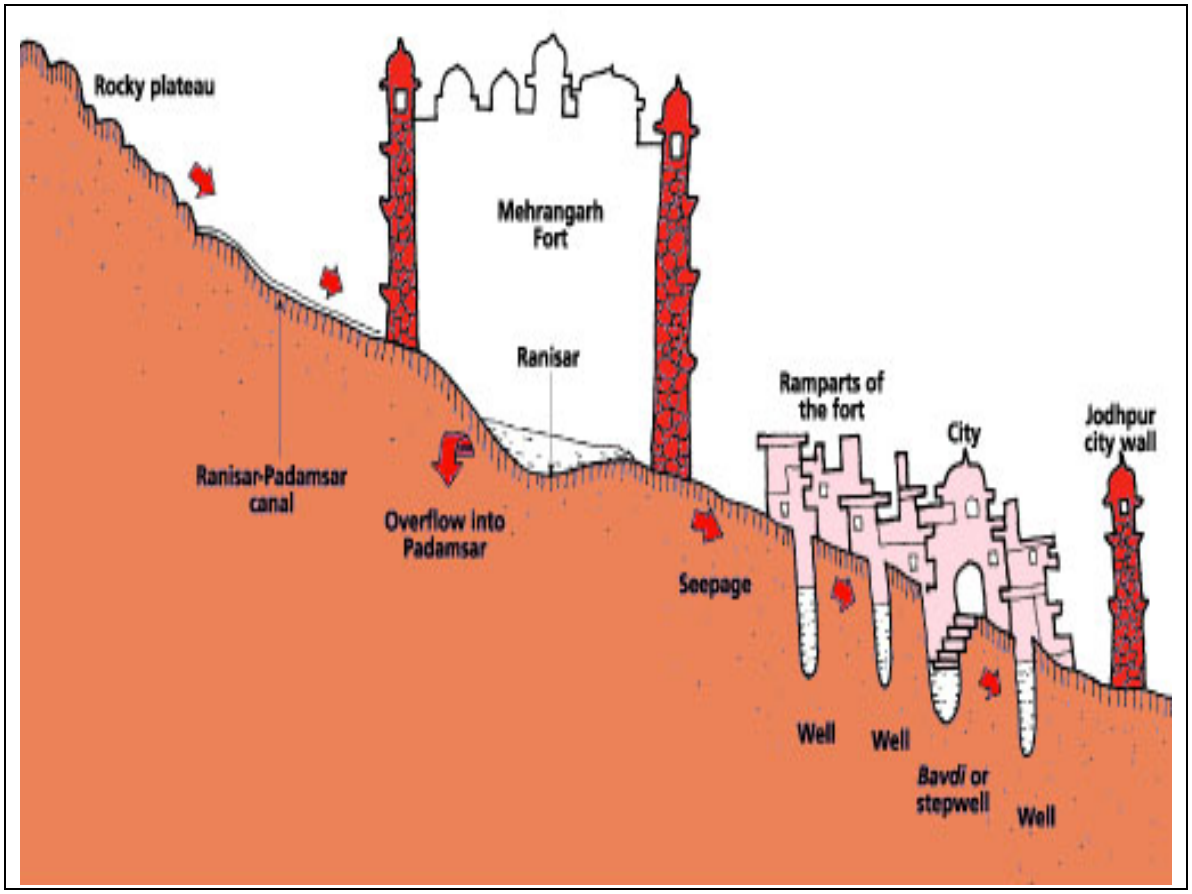
With agricultural production declining rapidly in once prosperous Bengal, the Colonial government invited William Willcocks, a British irrigation expert, to advise it on irrigation development in Bengal. In a series of lectures delivered in Calcutta in the 1920s, Willcocks stunned everyone by arguing that the absolute best that the government could do was to revive the ancient flood irrigation system of the region.[39]

When Willcocks tried to plan a system of irrigation canals for the Bengal countryside, he was astonished to find that every 'dead river' on the map sheltered an appropriate place for a canal. To his discerning eye, the parallel alignments of the main canals, maintained over long distances, contrasted sharply to what he called "the tangled meaningless mass of waterways... where we have nature's undirected handiwork." He concluded that during floods, the embankments along these canals would be regularly breached to take the floodwaters to the fields. But the British administrators had misunderstood them for flood embankments and considered the regular breaches in them as discreditable efforts of the local people. Therefore, the government did not do anything to desilt these canals and maintain them. Even worse, wherever possible, they constructed solid embankments to prevent wholesale breaches.

The resulting destruction of the overflow irrigation system of Bengal steadily led to a decline in agricultural production, increase in malaria and the famous famines. The region, which never the wisdom of its ancestors has remained the poorest in the world.

Jodhpur: providing an example

The most outstanding example of conjunctive use of water (prevalent in Rajasthan's arid regions) is in the city of Jodhpur, once a fabulously rich desert fort. The Jodhpur fort is situated at the edge of a rocky plateau. The former kings had built a series of canals to collect the runoff from the plateau and channel it into several tanks built in and around the fort. For houses that came up on the incline down the plateau, numerous stepwells and wells were constructed to capture seepage from the reservoirs above. In its 500-year old history, Jodhpur has witnessed many droughts, but never a desperation for water.



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