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Reform or Morph?
Unlocking Value in Asian Irrigation[1]

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"The development of irrigation has outrun its administration"
Col. W. Greathed, Chief Engineer, Upper Ganga Canal, 1869

Asian Irrigation in Transition

Gravity-flow irrigation has dominated irrigated agriculture in Asia for millennia. Until European colonial powers began constructing large centrally managed irrigation systems in the nineteenth century and later, much irrigation in Asia, small-scale and organized irrigation, existed around communities. During the colonial era, European initiatives in building large irrigation projects under centralized management marked a watershed in Asia's irrigation history; and until the 1940s, much new irrigation development took place under colonial governments which viewed irrigation as a way to blend "interests of charity and the interests of commerce." In India, the British levied enhanced taxes from irrigated land; in Taiwan and China, Japanese sought enhanced rice supplies by investing in irrigation. With the end of colonialism, the tradition of centralized irrigation-building and management has been continued by national and subnational governments for food security and poverty reduction with significant support from multilateral international financial agencies. However, poor management and performance of public irrigation systems were concerns throughout the colonial era; and these concerns have multiplied manyfold in the postcolonial Asia.

During recent decades, surface irrigation has been in decline in many parts of Asia. Public irrigation systems have tended to be underutilized and overcapitalized, and typically serve only a fraction of the designed command. With aging, irrigation commands have been sinking under the weight of their managerial, economic and environmental problems. In the Indian subcontinent by far the largest areas under surface irrigation in Asia, small surface structures, notably tanks in southern India and Rajasthan, *karezes* in Pakistan and Iran, *kuhls* in the Himalayas, and *ahar-pyne* systems in southern Bihar had been losing irrigated areas since the 1950s. But during the 1990s, even large public irrigation systems have begun shrinking. During the 7-year period between 1994 and 2001, India and Pakistan together lost over 5.5 million ha of canal irrigated areas despite massive investments in rehabilitation and new projects (Shah

[1]This article is based largely on the author's book *Taming the Anarchy: Groundwater Governance in South Asia*, Washington, D.C.: The Resources for the Future Press.

2008). In Central and Southeast Asia, figures are not as dismal; but the present performance and future sustainability of irrigation projects have remained a matter of growing concern.

Institutional Reforms in Surface Irrigation

In recent years, researchers, NGOs, donors and governments have sought to reverse this declining trend through institutional reforms-in the form of Participatory Irrigation Management (PIM) or Irrigation Management Transfer (IMT) to farmer associations. This idea itself derives from the variety of farmer-managed irrigation systems (FMIS) that proliferated-and can still be found-in Asia. As with all complex socio-technical systems, to work well, these systems required, generated, and nurtured a 'culture of irrigation.' So central was this culture to shaping the social lives of irrigators that anthropologist Robert Hunt called such groupings 'irrigation communities.' With large gravity-flow systems constructed by the state, system design and centralized operation acquired greater significance. But despite caution from the likes of Hunt and sociologist Walter Coward, it has been widely assumed that catalyzing and nurturing vibrant irrigation communities-water user associations-in command areas can help large irrigation systems function as well as traditional FMIS did. This assumption is now proving far-fetched.

For centuries, the feasibility of catalyzing a viable irrigation community determined the size of irrigation systems. Unsurprising, then, most FMIS were small-scale systems that could be sustained over centuries by local irrigation communities-often with cooperation aided by coercion from local authority structures. These survived and thrived as long as they met three ongoing challenges facing all multiuser irrigation systems:

Rule enforcement: Rules were enforced to keep in check the *anarchy* endemic to these systems by punishing deviations such as water thefts, vandalism and violation of distribution norms. Anarchy-control ensured efficient and equitable provision of irrigation service and helped maximize 'member-value' but required deft system-management backed by authority.

Regular maintenance: There was regular maintenance to counter the *atrophy* endemic to irrigation systems due to gradual disfigurement, arrested only by constant investment in their maintenance and upkeep. Atrophy-control ensured physical sustainability of the systems—which sometimes lasted for centuries—but required ruthless collection of irrigation service fees, often in the form of labor.

Upgradation: Systems were upgraded to minimize the *noise* by adapting the system to changing service-expectations of irrigators as changes in farming systems modified irrigation demands. The control of noise-the gap between the service system is capable of delivering and the service irrigators' demand at a point in time-is minimized by constant upgradation to meet changing irrigation demand patterns. Until some decades ago, noise-control was not much of an issue in Asian irrigation. However, during recent decades, with household farming systems in the throes of massive change, noise-control has become a critical driver of irrigation system performance.

Clearly, authority-constituted endogenously within the irrigation community or provided from outside-was always central to sustained control of anarchy and atrophy. Large systems were therefore built and managed effectively only when external authority could enforce rules,

and secure resources and labor for maintenance and repair. The colonial state had the necessary authority as well as the incentive to keep anarchy and atrophy in check. In many parts of Asia, the post-colonial state has neither. Moreover, noise was never as important a performance-depressant in Asian irrigation systems as it is today, what with farmers expecting on-demand irrigation year-round to support intensification and diversification of their subsistence farming. In this sense, decline in community and public irrigation systems is a reflection of larger changes underway in the Asian state and society.

Changing Socio-Technical Foundations of Asian Irrigation

Table 1 summarizes a broad-brush selection of socio-technical conditions that prevailed during precolonial, colonial and postcolonial eras in many Asian countries. The hypothesis is that particular forms of irrigation organizations we find in these eras were in sync with the socio-technical fundamentals of those times. Irrigation communities thrived during precolonial times when (a) there was no alternative to sustained collective action in developing irrigation, (b) strong local authority structures, such as *Zamindars* in Mughal India, promoted—even coerced—collective action to enhance land revenue through irrigation and (c) exit from farming was difficult.

Similarly, in the colonial times, large-scale irrigation systems kept anarchy, atrophy and noise in check because (a) land revenue was the chief source of government income, and enhancing it was the chief motive behind irrigation investments; (b) the state had a deep agrarian presence and used its authority to extract 'irrigation surplus' and impose discipline in irrigation commands; and (c) farmers had practical alternatives not as subsistence farming livelihoods or as gravity flow irrigation. These socio-technical conditions created an 'institutional lock-in' which ensured that public irrigation systems performed in terms of criteria relevant to their managers in those times.

Postcolonial Asian societies are confronted with a wholly new array of socio-technical conditions in which neither irrigation communities nor disciplined command areas are able to thrive. The welfare state's revenue interests in agriculture are minimal; the prime motive for irrigation investments is food security and poverty reduction, and not maximizing government income. Governments have neither the presence and authority nor the will to even collect minimal irrigation fees needed to maintain systems. So, agrarian economies are in the throes of massive change. Farmers can—and do—exit from agriculture with greater ease than ever before. Growing population pressure has made smallholder farming unviable except when they can intensify land use and diversify to high-value crops for growing urban and export markets. Finally, gravity flow irrigation systems are hit by the mass availability of small pumps, pipes and boring technologies that have made the 'irrigation community' redundant; these have also made the irrigators impervious to the anarchy, atrophy and noise in surface systems, and therefore reduced surface systems' stake in their performance.

Table 1. Socio-technical context of surface irrigation in different eras.

	Precolonial (adaptive irrigation)	Colonial (constructive imperialism)	Postcolonial (atomistic irrigation)
Unit of irrigation organization	Irrigation community	Centrally managed irrigation system	Individual farmer
Nature of the state	Strong local authority; state and people lived off the land; forced labor; maximizing land revenue chief motive for irrigation investments.	Strong local authority; land taxes key source of state income; forced labor; maximizing land revenue and export to home-markets chief motive for irrigation investments; state used irrigation for exportable crops.	Weak state and weaker local authority; land taxes insignificant; poverty reduction, food security and donor funding key motives for irrigation investments; forced labor impossible; electoral politics interfere with orderly management.
Nature of agrarian society	No private property in land. Subsistence farming, high taxes and poor access to capital and market key constraints to growth; escape from farming difficult; most command area farmers grow rice.	No property rights in land. Subsistence farming and high taxes; access to capital and market key constraints to growth; escape from farming difficult; tenurial insecurity; most command area farmers grow uniform crops, mostly rice.	Ownership or secure land use rights for farmers; subsistence plus high-value crops for markets; growing opportunities for off-farm livelihoods; intensive diversification of land use; command areas witness a wide variety of crops grown, with different irrigation scheduling requirements.

Demographics	Abundant land going begging for cultivation; irrigable land used by feudal lords to attract tenants.	Abundant land going begging for cultivation; irrigable land used by feudal lords to attract tenants.	Population explosion after 1950 and slow pace of industrialization promoted ghettoization of agriculture in South and Southeast Asia and China.
State of irrigation technology	Lifting of water as well as its transport highly labor-intensive and costly.	Lifting of water as well as its transport highly labor-intensive and costly.	Small mechanical pumps, cheap boring rigs, and low-cost rubber/PVC pipes drastically reduce cost and difficulty of lifting and transporting water from surface water and groundwater.

Rise of Atomistic Irrigation

Shrinking of surface irrigation does not mean irrigation areas of Asia are declining overall. In fact, they are not. Old community and government-managed systems are rapidly giving way to a new atomistic mode of irrigation in which millions of smallholders are creating their own mini irrigation systems and scavenge water at will using mechanical pumps, wells and rubber/PVC pipes. The rise of this new water-scavenging irrigation economy is most visible in South Asia and North China plains; here pump irrigation has begun dominating not only dryland areas but also irrigated areas where public and community irrigation ruled the roost until around the 1960s. In India, for example, even as governments keep investing in large, centrally managed surface irrigation projects, over 60% of irrigated areas are today under atomistic pump irrigation. Farmers in India, Pakistan, Bangladesh and Nepal have created more irrigation under this atomistic mode in the past 30 years than governments and colonial powers had created 200 years earlier. During the 1950s and 60s, Mao's China built massive irrigation systems to water North China plains; but today, the region irrigates mostly with small pumps and boreholes.

The same trend is now also evident in rice economies of Southeast Asia home to gravity flow irrigation communities for a long time. In Sri Lanka, known for its centuries-old tank irrigation of rice paddies, farmers were unfamiliar with irrigation pumps until the 1980s but were using some 106,000 by 2000 to scavenge water from whatever source-wells, tanks, streams-to irrigate dry-season rice and vegetables. By 1999, Vietnamese farmers had pressed into service more than 800,000 diesel pumps; and in Thailand, farmers increased

their pumps from 500,000 in 1985 to more than 3 million in 1999. And the trend was just picking up; Francois Molle found that between 1995 and 1999 alone, Vietnamese farmers had purchased 300,000 irrigation pumps, and Thai farmers had added a million. Between 1998 and 2002, Indonesian farmers increased their pumps from 1.17 million to 2.17 million. In the Philippines, David Dawe noted that "approximately 23 percent of rice farms now use pumps to access water, either from sub-soil reservoirs, drainage canals, or natural creeks and rivers."

Observers have been struck by the pace of spread of pump irrigation in Southeast Asia. In the Chao Phraya Delta of Thailand, 80% of farmers were said to have at least one pump, and in Thailand's Mae Klong project, the World Bank has estimated that in the early 1990s, a million pumps were drawing water from canals, drains, ditches and ponds to irrigate dry-season crops. Regarding the Makhamtao-Uthong canal system in Chao Phraya, Facon wrote: "Use of groundwater for irrigation has exploded during the last five years. It is reported that 28,000 tubewells (sic) are in use in the region … All the farmers interviewed during the field visit reported having individual pumping equipment used to pump from any possible source of water." The irrigation scene in Asia resembles a palimpsest, with layers of old systems of irrigation getting removed to make room for the next one of atomistic, water-scavenging irrigation.

The boom in water-scavenging irrigation is supported by the rapid rise of the Chinese pump industry, which has pared the cost as well as the weight of their diesel pumps to a fraction of their competitors' products. The Chinese export some 4 million diesel pumps annually, at a pump per hectare, and these are adding around 4 million ha of atomistic irrigation every year, mostly in South and Southeast Asia. What atomistic irrigation is able to do, that the community and public surface irrigation are unable to match, is help farmers control the noise endemic to surface irrigation systems. Hard-pressed by shrinking landholdings and energized by growing markets for high-value farm products, Asia's smallholders are intensifying as well as diversifying their farming systems; this requires on-demand irrigation year-round. Atomistic irrigation is responding to that call. It is making the farmer immune to the anarchy, atrophy and noise in surface systems, and reducing surface systems' stake in countering them.

The ascent of atomistic irrigation is at different stages in different parts of Asia just as the socio-technical fundamentals. In South Asia and North China plains, it is peaking, threatening the relevance of irrigation communities and public irrigation itself. In Southeast Asia, it is at the early stages but it is already making the control of anarchy and atrophy in surface irrigation a challenge. In Central Asia, the jury is out; well irrigation is rising, especially for backyard garden irrigation, but from a small base.

Reform or Morph?

In the midst of these changing socio-technical fundamentals, Asia's surface irrigation enterprise is up against some hard questions. Everywhere, PIM/IMT is being tried as the panacea. But can PIM/IMT help restore control of anarchy and atrophy in irrigation systems? Can institutional reforms ensure financial and physical sustainability? Can these help improve rehabilitation of Asia's surface irrigation systems? The evidence from some decades of experiments is far from encouraging; by far the most celebrated experiments-catalyzed, sustained and micro-managed by NGOs with the help of unreplicable quality and scale of resources and donor support-report only modest gains in terms of performance and sustainability, leading researchers to demand 'reform of reforms.'

Low, uncollected irrigation service fees, growing deferred maintenance, rampant anarchy and inequity in water distribution in Asian surface irrigation systems are symptoms of a larger malaise that PIM/IMT seems unable to address. Unlocking value from Asia's public irrigation capital demands a nuanced exploration of the farmer-system interplay in the context of today's socio-technical fundamentals which differ across Asia. Table 2 presents a first-cut view of the socio-technical environment in which irrigation systems function in Central Asia, South Asia, Southeast Asia and China. Institutional reforms of the PIM/IMT kind appear to have best prospects in Central Asia especially if integrated in the estate-mode of irrigated agriculture that European colonial powers popularized in Africa. In China, the model of contracting out distributaries to incentivized contractors seems to have produced better results compared to PIM; and this model needs to be improvised and built upon. The authority and backing of the Village Party Leader seems essential for such privatization to work; and for that reason, this model is unlikely to work in South Asia and Southeast Asia. In Southeast Asia, the key may lie in upgrading and modernizing rice irrigation systems to support dry-season rice cultivation as well as diversification of farming systems.

The situation in South Asia suggests that instead of institutional reforms, surface irrigation systems here themselves need to morph to fit in to today's socio-technical context. For millennia, irrigation systems were 'supply-driven.' They offered a certain volume of water at certain times with a certain dependability and farmers had no option but to adapt their farming systems to these; they adapted because doing so was better than rain-fed farming. Atomistic irrigation—offering water-on-demand year-round—has turned South Asian irrigation increasingly 'demand-driven,' giving a whole new meaning to the term 'irrigation management.' With the option of 'exit' available, farmers in command areas are now reluctant to exercise 'voice' through PIM/IMT, refusing to give their loyalty to an irrigation regime that cannot provide them irrigation on-demand year-round.

Table 2. Socio-technical environment of Asia's surface irrigation systems.

	Central Asia	South Asia	Southeast Asia	China
1. State's revenue interest in irrigation agriculture	High	Low	Low	Low
2. State's capacity to enforce discipline in irrigation systems	Some to high	Low	Low	High

3. Crops in irrigation commands	Cotton and/or wheat	Monsoonal and summer rice, wheat, cotton, sugarcane, fodder, vegetables and fruit	Wet and dry season rice; high-value market crops	Rice
4. Government compulsory "levy" of irrigated crops	Yes	No	No	Not any more
5. Spread of pump irrigation within irrigation commands	Low	Very high	High	High
6. Population pressure on farmland	Low	Very high	High	High
7. Ease of exit from farming	Low	Some	High	High
8. Core strategy for unlocking vlue	Improvise on estate-mode of irrigation farming with PIM or entrepreneurial model in distribution.	Adapt surface irrigation systems to support and sustain atomistic irrigation.	Modernize irrigation systems to support dry-season rice and diversified farming.	Improvise and build upon the incentivized contractor model for distribution and fee collection.

If we are to unlock the value hidden in South Asia's surface irrigation systems, they must morph in ways they can support and sustain the rising groundswell of atomistic irrigation; and by doing that secure the resources and cooperation they need from farmers to counter anarchy, atrophy and noise. If they themselves cannot become demand-driven, they should try integrating with a demand-driven atomistic irrigation economy. This is already happening in many systems but by default; but much hidden value can be unlocked if this happens by deliberate design. This requires a paradigm shift in irrigation thinking and planning.

Reference

Shah, Tushaar. 2008. *Taming the anarchy: Groundwater governance in South Asia.* Washington, D.C.: The RFF Press.