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IWMI-TATA Water Policy Program

Water Policy Research

HIGHLIGHT

Based on fieldwork and interviews with scores of farmers and village leaders, we show that winds of change are blowing in the dry zones of North-Central Sri Lanka, the original hydraulic civilization of the world. The social organization of tank irrigation - which for centuries had combined a stylized land use pattern, a system of highly differentiated property rights, and elaborate rules of community management of tank irrigation - remained largely intact until the Colonial Era but has now been morphing in response to demographic pressures, market signals, technical change and modernization. Thanks to a policy that created local monopoly of Farmer Organizations (FOs) in distribution of subsidized fertilizers, the role of FOs in local management of tank irrigation in Sri Lanka is stronger today than before and anywhere else in the region. The newly announced policy of extending fertilizer subsidy to all crops may weaken the power of FOs in irrigation management. Tank and canal irrigation are facing tough competition from far more lucrative agro-well irrigation of diversified market crops in upland farming areas created by clearing forests. The groundwater irrigation boom - which has taken all of South Asian plains by storm since the 1970's - has, albeit belatedly, begun engulfing Sri Lanka's dry zones as well. But Sri Lanka's agro-well boom may be far more sustainable and pro-poor than in the rest of the sub-continent, with some interesting lessons for South Asia and Sub-Saharan Africa.

Winds of Change in Ancient Irrigation Civilization of Sri Lanka's North Central Dry Zone

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Winds of Change in Ancient Irrigation Civilization of Sri Lanka's North Central Dry Zone[1]

Research highlight based on Shah et al. (2012)[2]

Hydraulic civilization of dry zone of Sri Lanka

Among all ancient rice irrigation civilizations, the three most celebrated ones are Tanjore (in today's Tamil Nadu), Cambodia and Sri Lanka. While rice irrigation institutions in Tanjore and Cambodia have metamorphosed, small tank irrigation in Sri Lanka's dry zone is the only ancient irrigation culture that can boast of an unbroken history over millennia, untouched by rise and fall of states. From about the 13th century, large state-controlled irrigation systems here atrophied with decaying state bureaucracy. However, small tank systems managed by village communities continued apace even after the state effectively collapsed. At the root of this resilience was the synergy between the tank ecology, social capital, and institutional structures - especially secure property rights to land and water that provided the incentive for the community to contribute resources and labour, to operate and maintain tanks (Leach 1961).

Figure 1 is a schematic representation of the physical layout and the various components that make-up the small tank farming system. Traditionally, tank irrigation in the dry zone represented a three-fold system of land use: irrigated rice cultivation in the tank command, rainfed shifting cultivation *(chenas)* of non-rice crops in the communal uplands, and perennial crops in the home-garden using sub-surface moisture. Rice irrigation was the pivot; but rainfed shifting cultivation in the uplands provided the elasticity enabling the village households to expand (or contract) their operational land holding in response to intra-household demographic pressures. Shifting cultivation provided cash while rice irrigation provided staple food.

Much like the tank cascades of Tamil Nadu, tanks in Sri Lanka's dry zones too are interconnected in series or parallel links within a single micro-catchment (Figure 2) in which water is continuously recycled. Surplus water from the upstream tank and the return flows from the rice irrigation are captured in downstream tank and put to use again in the latter's command area. This system helps to surmount irregularly distributed rainfall, non-availability of large catchment areas and the difficulty of constructing large reservoirs.

Tank and its socio-ecology

Property creation and reproduction was central to the persistence of the small tank systems in Sri Lanka (Leach 1961). Centuries ago, a pioneer settler family mobilized his kin to construct a new tank to settle around. Land and water rights were assigned to cooperating members as a reward. These rights that persist today with mutations were designed for equitable sharing of water scarcity and risk. Accordingly, each settler family would hold land both in the head (most easily irrigated) and tail (least easily irrigated) areas. The implication, in effect is that, what was shared is not land rights but water rights (Leach 1961:158). Ownership of land in the original tank command is central to the social organization of small tank communities, conferring on the holder or her descendants not only an identity but also an entitlement to a share of the tank water, fishing rights and the power to select and replace leaders.

The interesting aspect of small tank villages in the dry zone is that some of this age-old arrangement is still intact, although much else has changed. The basic layout of the 'Old Field' in Pul Eliya which Leach observed in 1954 remains intact to date. Also intact is the institution of *bethma* under which, in times of water scarcity, the lower field is left out while everyone has a share in the upper field being irrigated. Also intact is the institution of *Vel Vidane*, the water manager introduced by the British and vested with judicial powers under the Irrigation Ordinance of 1889. The *Vel Vidane's* role was to extract a consensus on the rice sowing date and to declare the irrigation schedule, open sluice gates, manage water distribution, oversee the preparation of field channels and 'commandeer' voluntary labour to maintain common segments of the canal as well as the tank bed. Especially in *Yala* season, *Vel Vidane* also operates a rotational irrigation system pretty similar to the Warabandi system in North-Western India and Pakistan Punjab.

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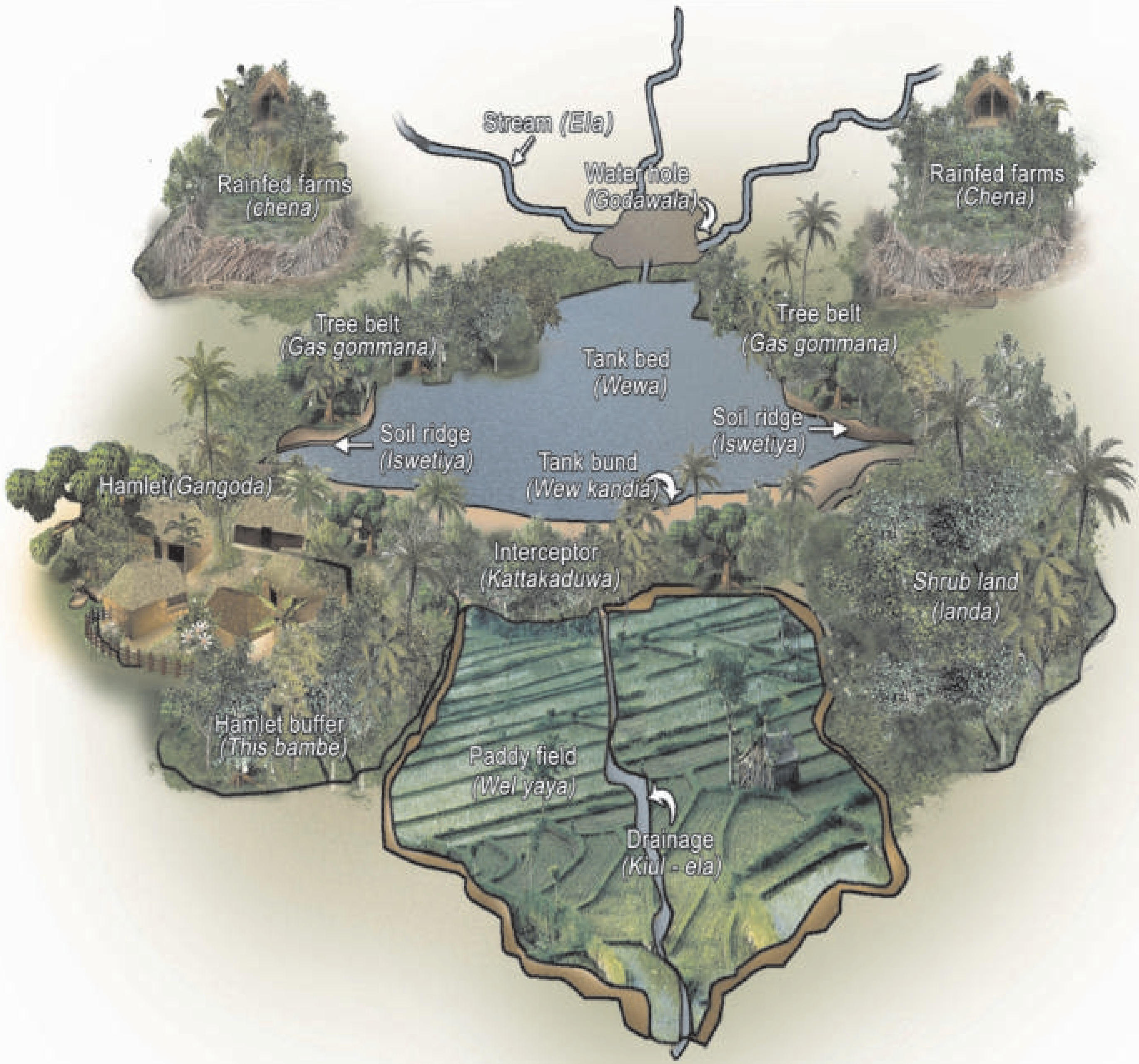
[2]This paper is available on request from p.reghu@cgiar.org

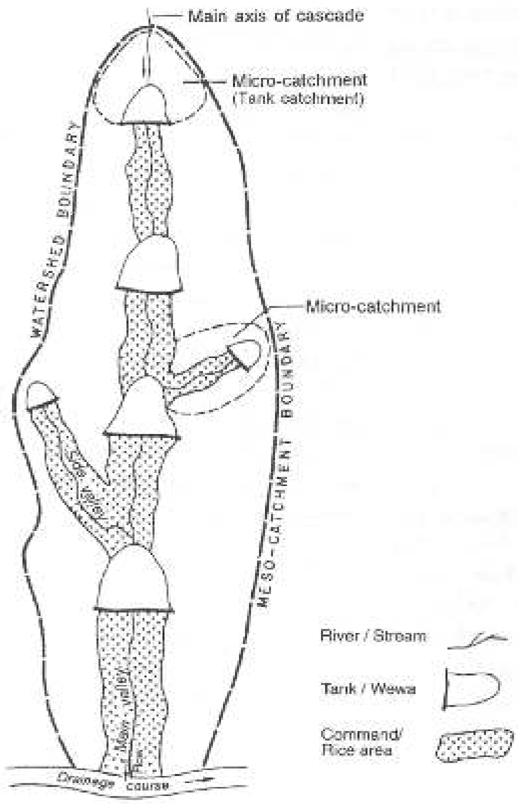
Figure 1 Social organization around a tank in the dry zone of Sri Lanka



Source: Dharmasena 2010

1. ***Chena*** – area where shifting cultivation is practiced.
2. ***Perahana*** - Literally means a sieve or filter in English. A gras strip on the periphery of the water bodu (dark green in ppt) that act as a silt trap
3. ***Godawala*** –" Upland hole" in English. Upstream sediment trap
4. ***Gasgommana*** – (gas = trees; gommana = plenty?). An area planted with large tress of the same species that act as a wind breaker to minimize evaporation from the tank surface. It also provides some ecosystem services: dry season fruits, timber, nesting for birds
5. ***Iswetiya*** – upstream conservation bund built on the periphery of the water body
6. ***Relapanawa*** – an earthen construction to prevent damage to the tank bund due to wave action
7. ***Thisbambe*** – tis = thirty. Bambe = a linear measurement – 6 ft. A strip of reserved land around the hamlet for protection
8. ***Kattakaduwa*** = Down stream wind barrier
9. ***Landa*** = scrub jungle
10. ***Akkara wela*** = "acre field" Area outside the old (purana) field that was subsequently developed for paddy cultivation. This was during the time of the colonial administration where each applicant for a dditional paddy land was allowed to develop a maximum of 1 acre.
11. ***Kiul Ela*** = common drain of the irrigated area

Figure 2 Tank cascade in a watershed



Source: Sakthivadivel et al. 1997.

FERTILIZER SUBSIDY AND POWER OF FARMER ORGANIZATIONS (FOs)

IIrrigation institutions in Sri Lanka's dry zone have likely changed more during 60 years after Leach's fieldwork than they did in 600 years before. If anything, this change is only accelerating. While the original layout of the tank command has remained, its centrality to village economy and society has declined. As population pressure grew, the original tank command got extended to include adjoining uplands. Moreover, community-owned *chena* lands, upland forest area which was used for shifting cultivation got increasingly privatized and converted into regular fields for cultivation of vegetables, millets, lentils, trees. The institution of *Vel Vidane* has weakened. After Independence, Cultivation Committees were created to replace the colonial *Vel Vidane.* When these failed, the government created FOs. But these too remained mostly defunct for a long time. This decline in irrigation institutions has not helped the rice economy of the dry zone.

Rulers of Sri Lanka - then as well as now - have accorded high priority to self-sufficiency in rice production. Farmers' priorities, in contrast, have for long been to cultivate cash crops on *chena* land that rulers - ancient, colonial and modern - have tried to restrict. Even in 1954, Leach noted that without restrictions, most villagers would devote their energies to cash crop cultivation and buy rice instead of growing it. Today, the lure of cash crops is stronger than ever. To promote rice cultivation, the present day government of Sri Lanka procures farmers' paddy at an attractive procurement price. To limit its procurement subsidy, however, it limits procurement to 1500 kg per registered (*"asweddumized"*) paddy acre and up to a maximum of 3000 kg per farmer. In addition, for 15 seasons in a row, the government has provided paddy farmers, fertilizer at a constant subsidized price of Sri Lanka Rupees (LKR) 350 for a 50 kg bag, implying a 70-75 percent subsidy (Nizam 2011) in the present day since the market price of urea is LKR 1200-1400/bag[3] . This is a huge drag on the national budget. To limit fertilizer subsidy bill, in 2003 the Sri Lankan Government decided to route subsidized fertiliser to farmers for only registered paddy acres through FOs. Registered members of FOs were to register their paddy area and indent their fertilizer requirement (along with advance payment) with the FO which would pool these indents, and submit a collective demand to the Agrarian Services Centre. FOs would then lift the fertilizer, cart it to the villages and distribute it among the farmers.

Under this arrangement, Sri Lanka's FOs got a big boost. Before, farmers had to be dragged to become FO members, to pay annual membership fee, adhere to irrigation rules and contribute annual maintenance labour. Now there was a rush to become FO members. Moreover, FO leaders now enjoy greater clout in all village affairs and matters agricultural. Several FO presidents as well as *Vel Vidane* we interviewed confirmed that it was indeed easier than before to get farmers to maintain common canals, follow sowing and irrigation schedules, and obey sluice operation discipline of the *Vel Vidane.*

Now this key source of FO vitality is under threat. In May 2012, Government of Sri Lanka changed its policy again and announced that subsidized fertilizer will now be available for all crops (Colombo Page 2012). This would bring Sri Lanka on par with India where subsidized fertilizer can be purchased by any farmer, for any crop, from any fertilizer shop. The monopoly of FOs on fertiliser distribution will weaken, if not wither away, as will their power to secure member participation in irrigation management. Only time will tell what will be the impact of this decision on paddy cultivation as well as the power of FOs.

[3] In 2005, when the subsidy was introduced in the present form, it was as high as 90 percent.

Table 1 Agro-ecological transformation of *Galenbidunuwewa* after the agro-well boom

	Before the agro-well boom	Now
Low land *Maha* season paddy cultivation	+++++	+++++
Low land *Yala* paddy cultivation	+++++	+++++
Supplemental irrigation to rice	++	+++
Mung and cow pea cultivation in *chena* land	+++++	++
Vegetable cultivation	++ (only for home consumption)	+++++ (for market)
Other market crops	+	+++++
Cattle	++	+++++
Focus of cattle husbandry	Milk for home consumption; work animals	Milk production for the market
Approach to cattle husbandry	Extensive, based on grazing	Intensive based on stall-feeding
Green fodder cultivation for milch cattle	+	+++++
Tree crops	+++	++++

Belated boom in agro-well irrigation

During the 1970s through to 1990s, when most of South Asia experienced a boom in groundwater irrigation, Sri Lanka bucked the trend. In course of our fieldwork in the dry zone, however, we found that agro-well irrigation has now taken agriculture in the dry zone by storm. Almost every farming household here has an agro-well; many have two or three. Some enterprising farmers invested in agro-wells as far back as during the 1970s and 1980s. However, in around the year 2000, constructing agro-wells became a movement. Mechanized excavators made agro-wells cheap and quick; one could be completed in a week and fitted with a pump at a cost of LKR 4 lakh (USD 3000). The village *Galenbindunuwewa* which we visited in the *Anuradhapura* district had only 1 agro-well for two decades until 2005, but added over 100 in the subsequent five years. To gauge the relative economic returns to agro-well irrigation, we asked farmers in several villages how many acres of irrigated paddy would generate the same net farm income as an acre of agro-well irrigated land. The responses ranged from 5 to 15 acres! Farmers we met in this village of *Anuradhapura* district told us an acre of agro-well irrigated vegetables earns them in net cash income 10-15 times what an acre of irrigated paddy would fetch.

Much of Sri Lanka has karst aquifers. Agro-wells are large open wells of the kind we find in many hard rock areas of India - such as Saurashtra in Gujarat or Karnataka, Andhra Pradesh or Tamil Nadu. Most agro-wells in Sri Lankan dry zones are dug in the vicinity of a tank or a stream. Agro-wells on privately owned, titled land are *pucca*, generally lined with bricks and cement. However, farmers use shallow dugouts as agro-wells when they do not have secure title on their land. Their large size helps agro-wells function like storage wells. Traditional paddy irrigation in tank commands - which has been the centre-pin of agrarian lives in the dry zone for millennia - continues to sustain in absolute sense but is rapidly losing its centrality in the village agrarian economy. In its place, cultivation of vegetables and other market crops in *chena* land with the help of agro-well irrigation is rapidly gaining ascendancy in agrarian economy of Sri Lanka's dry zone. Agro-wells are seldom used for irrigating paddy, or other such subsistence crops. Instead, they are invariably used to

Table 2 Schedule of domestic electricity rates

Electricity consumption (kWh/month)	Fixed charge (LKR/month)	Variable charge (LKR/kWh)
0-30	30	3.75
31-60	60	6.645
61-90	90	10.885
91-120	315	29.40
121-180	315	34.30
180+	315	50.40

Figure 3 Average and marginal cost of power use in Sri Lanka's Agro - well irrigation

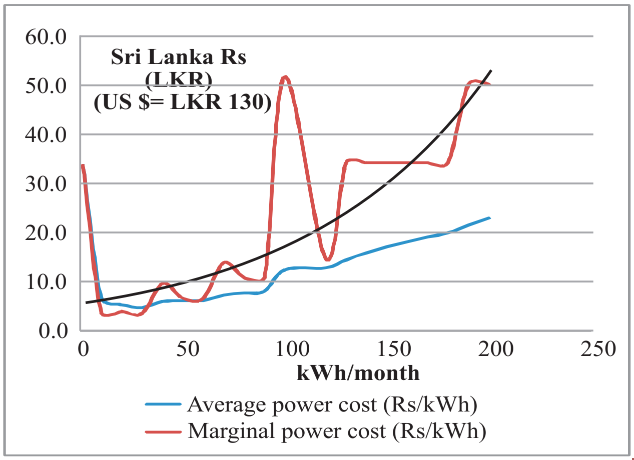


Table 3 Four energy-irrigation-livelihoods nexus scenarios of South Asia

E-I-L Zones of South Asia	Power subsidy	Groundwater structures	Type of agriculture	Net income/ha (US $)	Groundwater externality
1. Kerala, Dry Zone of Sri Lanka (mostly Humid and Hard rock)	Nil or negative	Shallow, open wells, 1-2 HP pumps in millions	Garden cultivation of high value market crops	US $ 1500-3.000/ha	Nil or Insignificant
2. Eastern India, Bangladesh, Nepal, Pakistan Punjab & Sind (Humid and alluvial)*	Little power; so no subsidy	Shallow tube wells with 5-7 HP diesel pumps	Mostly rice- wheat; some market vegetables	US $ 500-1000/ha	Nil bar arsenic; opportunity lost
3. Indian Punjab, Haryana, West Rajasthan, alluvial Gujarat (Arid and alluvial)	Heavy power 150-400/ha	Deep tube wells; 10-120 HP electric pumps	Mostly Wheat-rice; some high value farming	US $ 800-1200/ha	Depletion; fluoride and other geogenic contaminants
4. Hard rock peninsular India (Semi-arid and hard rock)	Significant power subsidy (US $70-250/ha)	Dug-cum-bore /bore wells with 5-12 HP electric pumps	Mostly grains and Bt cotton; some high value farming	US $ 600-1000/ha	Huge negative

*West Bengal is an exception. Farmers here have 24*7 power supply but it is metered and charged at near commercial rates.

support ‘high-value farming’ for the market. Market-savvy farmers make huge windfalls: Sri Lanka depends on Indian imports for onion seed; recently, when Indian onion seed developed fungal, Sri Lankan agro-well irrigators of onion seed earned LKR 7-8 lakh (USD 5400-6100)/acre net of all costs. Naturally, small holders with limited registered paddy land in tank command are drawn much more to agro-well irrigation than farmers with large paddy land holdings. While agro-well irrigation in *chena* land and gardens has grown, paddy lands are going at a discount in informal land lease markets. All that an acre of once prized paddy land fetches today is a rental is 15 bushels (approx. 400 kg) of paddy/season.

In *Galenbidunuwewa* we engaged a group of young farmers in a focus group discussion on the changes that the agro-well boom has brought about in the agro-ecology of their village. Table 1 summarizes the picture that emerged.

Unlike in the rest of South Asia, agro-wells of Sri Lanka have a smaller energy foot-print, most using 1 or 2 HP electric or kerosene pumps. Those with roadside dwellings are more likely to draw a cable to connect an electric pump with their domestic electricity connection. Those further away from road often do not have domestic electricity connection and are forced to use the more expensive kerosene pump. At LKR 150(USD 1.1)/litre, kerosene too is expensive fuel; irrigating an acre of onion with a kerosene pump may cost USD 500-700. Naturally, farmers actively manage their groundwater use to save on energy cost.

We explored in several villages if the agro-well boom led to depletion of aquifers like it has in western India. Most agro-well owners agreed that they observed a temporary fall in water level in their wells especially during drought and during *yala* season; but none we met had to deepen his agro-well or faced a dry well. Most agro-wells are sited close to tanks which help them recharge when tanks are full. All the farmers we met affirmed that agro-wells are hydraulically linked to tanks; and water level in both moves in unison. Moreover, thanks to high energy cost, groundwater demand for irrigation in a typical dry zone village is less than in say Tamil Nadu where farmers get free electricity.

Sri Lanka’s unique energy-irrigation nexus

Thanks to the boom in agro-wells, there is an increase in the demand for domestic electricity connections in the villages of the dry zone. Electricity use in agro-well irrigation in Sri Lanka at present is insignificant, but it is likely to grow rapidly. This is not because electricity is cheap, but because irrigating with kerosene/diesel pumps is much more expensive. Irrigating an acre of onion with an electric pump, using 315 kWh of electricity costs LKR 15000; but with a kerosene pump, which will need 430 litres/acre, will cost three times as much. In Western India, the groundwater irrigation boom is driven by electricity subsidies. In Sri Lanka, agro-well irrigation is booming despite steep, progressive, even penal power tariff rising to a high LKR 50/kWh (Figure 3; Table 2). Even so, there is an increasing demand for 3 phase connections by households for agro-well irrigation.

The Kerala-Sri Lanka model of groundwater irrigation

Table 3 outlines four distinct energy-irrigation-livelihood nexus scenarios obtaining in South Asia. Under scenarios 3 and 4 representing Western and Southern India, the nexus between electricity subsidies and groundwater irrigation has bankrupted electricity boards and depleted groundwater aquifers to support irrigation of low value crops. In scenario 2, referring to Bihar, Eastern Uttar Pradesh, Assam, Bangladesh, Coastal Orissa, involves abundantly recharged alluvial aquifers that remain underutilized, tubewell electrification has the potential to unleash second green revolution. But unplanned energy subsidy may lead to vast irrigated areas under low value crops that may not justify energy subsidies and depleted aquifers. In many ways, Sri Lanka and Kerala represent an ideal scenario where low value crops - such as rice - are flow-irrigated and only high value market crops - fruit, vegetables, spices, rubber, coconut - are lift-irrigated using 1-2 HP pumps run on domestic electricity connections. The high and progressive electricity tariff automatically ensures that groundwater demand is kept within limits and wells are used only for 'value farming'.

Summary and conclusion

The hydraulic civilization of the dry zone of Sri Lanka is in the throes of a transition. Urbanization, economic growth, dietary changes, globalization are chipping away at the social organization of agriculture around small tank cascades as well as in large irrigation projects. This raises several new questions for irrigation and agrarian policy of Sri Lanka.

First, since profitable market crops require high level of water control that agro-wells offer better than tank irrigation, agro-well irrigation will soon begin spreading from Sri Lanka's dry zone to its wet zones as well. Sri Lanka's irrigation commands will likely experience the same crop diversification towards high value crops supported by pump irrigation that much of South-East Asian rice irrigation areas have experienced during the recent years.

Second, Sri Lanka's fertilizer subsidy policy has played a key role in strengthening its FOs and their role in participatory irrigation management. The new policy, recently declared, of extending fertilizer subsidies to all crops will have far reaching impact on FOs as well as the agro-well boom. It will weaken the village level monopoly of FOs for distribution of subsidized fertilizer for registered paddy area. This, in turn, will rob FOs of the authority they have enjoyed over farmers especially in local irrigation management under tanks as well as canals.

Third, open market distribution of subsidized fertilizer to all crops will give a strong push to cultivation of non-paddy crops, and thence, to agro-well irrigation. We should expect to see the balance going against paddy irrigation and towards cultivation of market crops and dairy production, against tank and canal irrigation and in favour of agro-well irrigation.

Fourth, the huge cost advantage that Sri Lanka's steep electricity price offers over kerosene and diesel for pumping agro-well water will mean growing demand for electricity in agro-well irrigation. At USD 0.45-55/kWh, electricity tariffs facing Sri Lanka's agro-well irrigators are among the highest anywhere and amongst all categories of users within Sri Lanka. Rationalizing electricity pricing for agro-well irrigators can be viewed as a policy instrument for stimulating and managing high value agriculture in Sri Lanka. Rational power tariff for agro-wells may also be a powerful tool for pro-poor agricultural development because poorer farmers with small paddy areas are more dependent on agro-well irrigation for livelihoods than farmers with large paddy lands.

Fifth, agro-well users, if metered as a separate category can play a powerful role in electricity load management. In India, the West Bengal Electricity Utility has fixed Time-of-the-Day (ToD) meters on irrigation tubewells and offered farmers an enticingly low rate for off-peak night hours. Since farmers can irrigate during the night, irrigation demand for power can be used to flatten the load curve facing the power utility.

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About the IWMI-Tata Program and Water Policy Highlights

The IWMI-Tata Water Policy Program (ITP) was launched in 2000 as a co-equal partnership between the International Water Management Institute (IWMI), Colombo and Sir Ratan Tata Trust (SRTT), Mumbai. The program presents new perspectives and practical solutions derived from the wealth of research done in India on water resource management. Its objective is to help policy makers at the central, state and local levels address their water challenges – in areas such as sustainable groundwater management, water scarcity, and rural poverty – by translating research findings into practical policy recommendations. Through this program, IWMI collaborates with a range of partners across India to identify, analyze and document relevant water-management approaches and current practices. These practices are assessed and synthesized for maximum policy impact in the series on Water Policy Highlights and IWMI-Tata Comments.

Water Policy Highlights are pre-publication discussion papers developed primarily as the basis for discussion during ITP's Annual Partners' Meet. The research underlying these Highlights was funded with support from IWMI, Colombo and SRTT, Mumbai. However, the Highlights are not externally peer-reviewed and the views expressed are of the author/s alone and not of ITP or either of its funding partners.

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