# Pedaling out of Poverty: Livelihood Impacts of Treadle-Pump Irrigation in South Asia

**Tushaar Shah**

This research is set out in Eastern India, Nepal terai, and Bangladesh—the heartland of the Ganga-Brahmaputra-Meghana basin, and South Asia's so-called *poverty square*. The region packs 500 million of the world's poorest people; but it also has one of the best groundwater resources of the world, available at a depth of 1.5–3.5 m. The population density is over 500/sq. km; each of over 90 percent of the holdings is less than 1 hectare and the sizes of these holdings have been halving every 15 years since 1960. Moreover, barring Uttar Pradesh where some consolidation of holdings took place during the 1960s, the average holding is fragmented in 4–5 postage-stamp-sized parcels; the average parcel size was 0.11 hectare in Bihar and West Bengal in the mid-1980s. The development of the industrial and service sectors—which could have absorbed some of the growing labor force—is slower than elsewhere in South Asia. Overall, then, the region is stuck in a low-productivity quagmire that perpetuates its rural poverty and agricultural stagnation. Besides relieving its flood-proneness, intensive groundwater development can serve as a powerful 'trigger' to catalyze a green revolution-based rural economic upsurge in this region, as it did in Haryana and Western Uttar Pradesh during the 1960s. This has already begun to happen through rapidly growing private investment in tube wells and pumps. However, by far the majority of the poorest are left behind in this process because they cannot accumulate enough capital to invest in a diesel pump; even if they could, they cannot make it viable on their ultra-marginal holdings. The emergence of water markets has improved their access to diesel-pump irrigation; but unless there is sufficient competition, these too tend to be exploitative and arbitrary.

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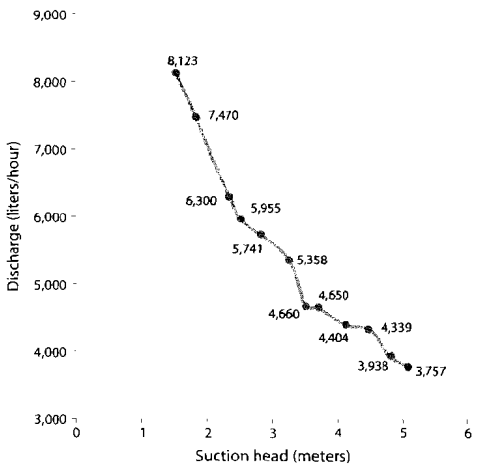
**Figure 1. Relationship between suction head and treadle-pump discharge.**




## Treadle-Pump Technology

In many ways, the treadle-pump technology is a fitting answer to the needs of the smallholders in the region. It can lift water upto a maximum height of 7 m but gives best performance of 1–1.2 l/s at a pumping head of 3–3.5 m (fig. 1). It is simple to install; easy to operate by men, women, and children; and is ideal for vegetable cultivation but is also used extensively to irrigate small plots of HYV paddy. Supplemental, crop-saving irrigation of wheat, tobacco and jute enables treadle-pump irrigators to harvest remarkably higher yields compared to rain-fed farming. The best part is its cost; the cheapest bamboo treadle pump is installed for less than US$12; the more expensive metal and concrete pump complete with a bore and a frame costs US$25–35. The going rate for the capital cost of new canal irrigation potential in South Asia is US$4,000–4,500. New tube wells create irrigation potential at US$800–1,000/ha but treadle-pump technology creates new irrigation potential at US$100–120/ha and targets it to the poorest. The technology is developed and promoted by International Development Enterprises (IDE), a US NGO that abhors subsidies but revels in taking up a technology and paring its cost down to half, and taking it to the poor through mass-marketing in a professional manner. In Bangladesh, where the treadle pump was introduced in the mid-1980s, some 1.3 million pumps have been sold including replacement demand. Eastern India and Nepal terai have an ultimate market potential for some 10 million treadle pumps; but the sales here have just hit 100,000; and the IDE has a long way to go. It has been claimed that every treadle pump sold results in an annual increase of US$100 in the net income of an ultra-poor household; at this rate, if and when IDE does saturate this market potential, it will have accomplished one of the most powerful and best targeted poverty-alleviation interventions the world has seen, by increasing the net annual income of South Asia's poorest rural households by a billion dollars, and that too, at little cost to the public exchequer.

## Livelihood Impact

This study was designed to examine whether the picture is indeed as rosy as the IDE suggests. Some 3,000 poor households—adopters and potential adopters—were interviewed



in six locations: North Bengal, Eastern Uttar Pradesh, Nepal Terai, North Bihar, Coastal Orissa, and North-West Bangladesh. A special study on gender was carried out, too. Numerous other field studies were consulted to derive the following main conclusions:

Treadle-pump technology does 'self-select' the poor; however, the first-generation adopters tend to be the less poor; the poorest wait for 'validation' before adoption.

Early adopters are not more literate; they do not have more surplus family labor; they just seem to have easy access to capital.

Treadle-pump adoption transforms smallholder farming systems in different ways in different subregions; in North Bengal and Bangladesh, adopters take to cultivation of HYV rice in the *boro* season; elsewhere, they turn to vegetable cultivation and marketing.

Adoption invariably results in increased land-use intensity, and thus has a powerful 'land-augmenting' effect; however,

Photo: Caryn Kedge

**Poor communities hold the key to village-level water management**

The study of smallholder water management practices in Africa and Asia is a research theme that IWMI will substantially expand over the coming three years. There have been many attemps at developing effective and low-cost water management practices suitable for poor people—and poor people are among the innovators, developing some of the most practical approaches. IWMI researchers feel there is tremendous scope for the spread of some of these practices.

IWMI scientists are now identifying practices that can have the highest impact on improving the water situation for poor people. These innovations will be scientifically scrutinized, and the most promising ones sifted out. In doing this, IWMI can assist governments and NGOs to identify appropriate practices for specific situations, and see how they can be used to improve the lives of poor people.

South Asian villages hold a wealth of knowledge and useful practices, for water harvesting, groundwater recharge and shared management of a common village well or resource. Here IWMI is working with the NGOs, Pradan[1] and IDE to identify high-potential practices.

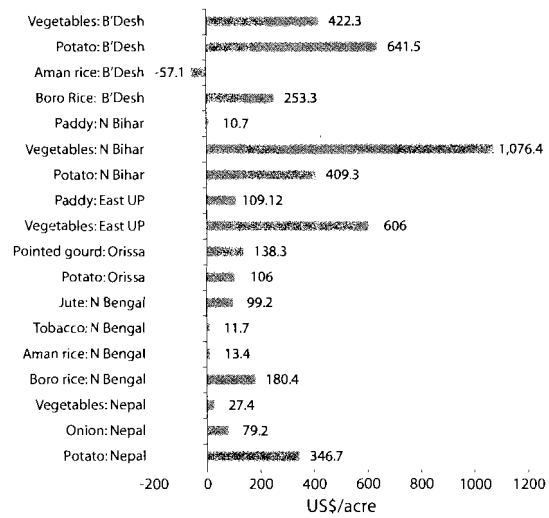
In sub-Saharan Africa, low-cost, informal irrigation such as treadle pumps and bucket drip-kits are being used in rural communities and family gardens on an increasingly wide scale. IWMI's research projects on these topics are asking three key research questions: what is the extent of this informal irrigation (using satellite imaging to gather these data, which are not known); what are the real economic impacts and constraints of these practices on poor communities; and what will be the consequence for water resources, as several million more people jump on the small-scale irrigation bandwagon.

[1]Pradan is Professional Assistance for Development Action.

adopters also resort to 'priority cultivation'; they provide crop-saving irrigation in a large part of their holdings but practice highly intensive farming in the 'priority plot.'

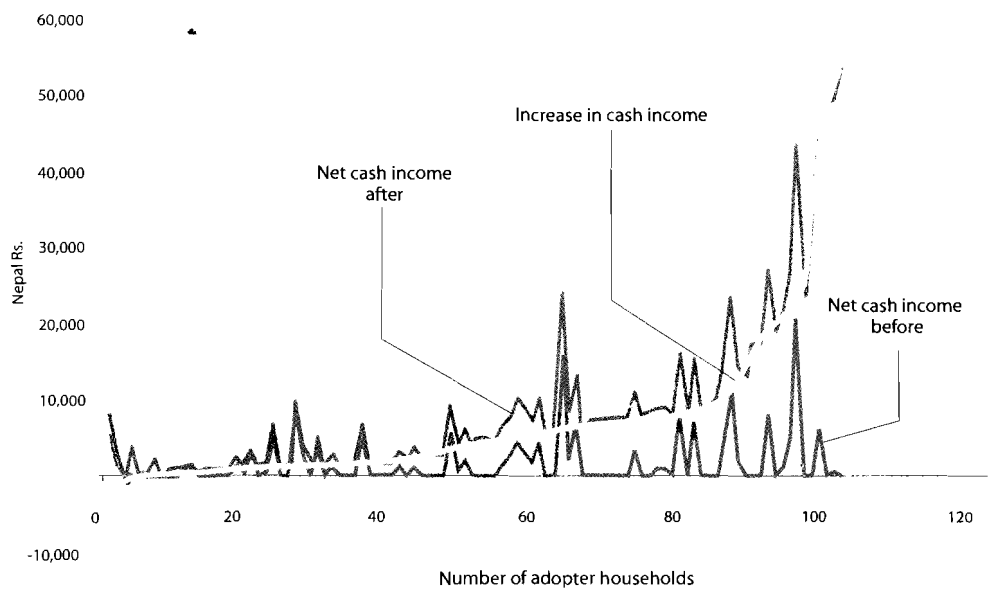
Because of highly intensive cultivation of treadle-pump irrigated plots, average crop yields on these are much higher than those obtained by farmers using diesel pumps or other irrigation devices (fig. 2).

**Figure 2. Income impact of the treadle pump: Increased value of output/acre (US$).**




Overall income impact is the product of increased land-use intensity, increased proportion of high value crops, and improved crop yields. Income impact varied across households and regions but an *average* increase in annual net income of US$100/year seems a conservative estimate; at least 20 percent of adopters earn US$5–600 more per year in net terms (fig.3).

**Figure 3. Increase in net cash income per household after treadle-pump adoption: Nepal terai.**



## The Impact of Treadle-Pump Adoption

Impact of treadle-pump adoption at household level takes two forms: less-enterprising among the poor use it to bring their surplus family labor under productive use. Their gain is an 'implicit wage' on family labor that is 1.5–2.5 times the market wage rate. In contrast, the more enterprising among the poor use treadle-pump irrigation to make a transition from 'subsistence farming' to *intelligent commercial farming;* it is the latter who evolve and use new ideas like early planting to beat the market glut, husbanding hired diesel-pump irrigation with treadle-pump irrigation, priority application of inputs, building market linkages, growing new types of vegetables, and so on; they earn much more from treadle-pump irrigation—only a small part of their increased earning is a return to their labor; the bulk of it is a return to their entrepreneurial effort—by innovating, risk-taking, searching for new market opportunities, and so on.

## Second-Generation Impacts

A number of hypotheses about the second-generation impact emerge from our research:

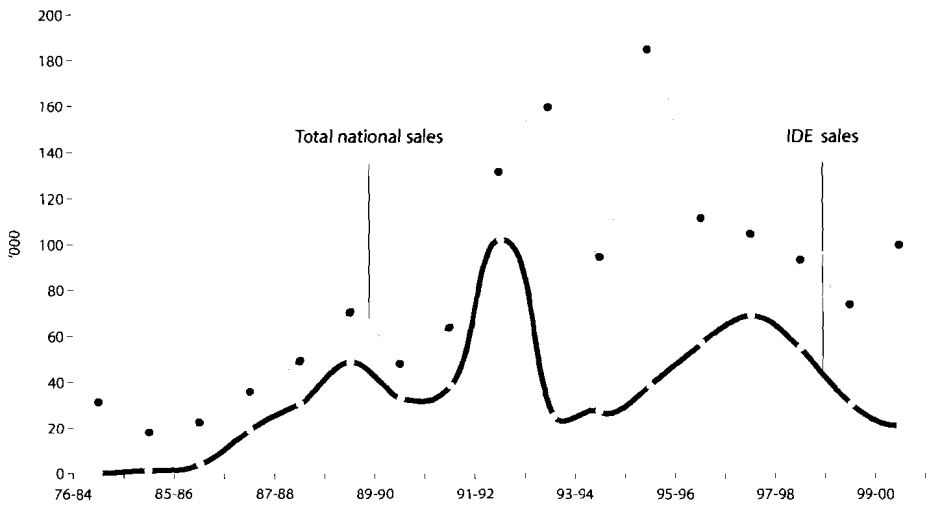
Treadle-pump adopters not only obtain high productivity of land but also secure high 'crop-per-drop' and high 'cash-per-drop' through intensive management of treadle-pump irrigated plots; for, unlike diesel pumps that deliver 8–10 l/s, a treadle-pump discharge of 1–1.2 l/s is easier to manage.

The short-run impact of treadle-pump adoption on household income, food security, better cash flows, etc., seems well-established; in the longer run, treadle-pump adopter households are likely to perform better in terms of savings and capital accumulation, investment in agriculture, education, and so on.

As the density of treadle pumps in a community increases, the local labor market becomes tighter as treadle-pump adopters withdraw fully or largely to work on their own lands; this is likely to result in greater employment and higher wage rates for the landless and non-adopters who are more dependent on wage labor.

Similarly, the growing treadle-pump density is likely to ease the demand pressure in local pump-irrigation markets obliging water sellers to offer a better deal to their buyers, who

**Figure 4. Treadle-pump sales in Bangladesh.**




may be mostly non-adopters of treadle pumps. In Bangladesh, there are regions where the treadle-pump density is as high as 1.5–2/ha; many of these have used treadle pumps for the past 12–15 years; it is therefore possible to test these second-generation hypotheses in North-West Bangladesh.

## Issues

The overall scale of the livelihood impact of treadle pumps will then ultimately depend squarely upon how fast the IDE can place the pump in the hands of the poor. A big opportunity to push the sales of treadle pumps has arisen from the recent successive hikes in Indian diesel prices, which will put marginal farmers in East India in great misery. Depending on private pump-irrigation markets, their irrigation costs will shoot up from Indian rupees 25–35/ hour of 5 hp diesel-pump output (approximately 15–18 $m^3$) to Rs 48–70/hour. Since the price of purchased pump irrigation is the implicit wage of pedaling the treadle pump, the diesel price hike will give a big impetus to treadle-pump demand.

But cashing-in on this opportunity seems easier said than done. The technology seems to be a super-performer—but its marketing remains a challenge. In Bangladesh, treadle-pump sales grew at a meteoric pace until 1995 when the market began to show signs of saturation; in Eastern India and Nepal terai together—with 8–10 times the market potential—

treadle-pump sales over 6 years have barely reached 200,000, less than what Bangladesh sold in 1995–96 alone! What explains this drastic performance differential? It is difficult to say; but one hypothesis is, business strategy. In Bangladesh, the IDE strategy was driven by the 'let-a thousand-flowers-bloom' concept. A whole variety of treadle pumps—offering the farmer a wide range of price-quality options—is manufactured by 85–90 independent manufacturers who market them through a decentralized, largely unregulated marketing channel on which the IDE has very little influence, much as it would like to have. In Bangladesh, the fastest moving treadle pump was the cheapest, and could not possibly have been the best on offer (see fig. 4). In India, in its concern for high quality, the IDE has adopted a more 'professional' approach in building a manufacturing base, a marketing network and a promotional strategy that delivers a presumably superior product at a commensurately higher price under one brand name, *Krishak Bandhu* (farmer's friend); the IDE maintains fairly tight control over the consumer price, marketing margins and quality through its own organization. Could it be that there are lessons to learn from the Bangladesh experience? Could it be that a variety of treadle-pump qualities, at a range of prices delivered through a decentralized manufacturing-cum-marketing network with the IDE, taking a purely promotional role, would do more to put the treadle pump into the hands of the poor?

Tushaar Shah is Research Leader of IWMI's Policy, Institutions and Management Program.

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