

# The use of sludging and well-pointing techniques to sink small diameter tube-wells

by Greg Whiteside and Simon Trace

**A traditional well-sinking technique provides a low-cost solution to water supply, and an add-on technique makes it practical for a wider number of terrains.**

THE REPLICABILITY of water projects ultimately depends on ordinary people being willing and able to afford the full costs of installing and maintaining their own schemes. Only a few technologies in use today make this an achievable goal, and among these the hand-installation of shallow tube-wells offers perhaps the best prospect for progress. The per capita costs in Nepal for tube-wells sunk using the 'sludger' and well-pointing techniques rarely exceed US\$2; the methods are simple, require a minimum of equipment, and allow villagers to participate fully in the planning and installation of their facility.

Conventional drilling machines, while often technically accomplished, are expensive and invariably offer little opportunity for communities to become meaningfully involved with tube-well installation. The complexity of the operation and the numbers of skilled attendants required to man the rig often leave villagers feeling alienated from the process and disinclined to assume any responsibility for it. Traditional waterpoints, on the other hand, will nearly always have been built by hand using local skills and labour. The introduction of further hand-installation techniques, such as rotary drilling, jetting, well-pointing, and sludging,

techniques which positively invite community participation, would seem to offer a greater opportunity for a true sense of scheme ownership to develop, and for total costs to remain within local budgets.

Two of these techniques, sludging and well-pointing, are used widely in the Terai region of Nepal, and a combination of the two methods can increase the success rate for boring and sludging in difficult ground conditions.

## Sludging

Sludging is used extensively in many parts of Asia<sup>1</sup> to bore holes of between 25mm and 150mm in diameter to depths of up to 60m in areas where the permanent water table lies within the atmospheric suction limit (i.e. within about 6.5m of the surface). The inability of sludging to penetrate hard strata limits its use to areas of soft alluvial deposits, such as those found, for

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*A Nepali mistri covers the pipe with his hand to create a vacuum, while the assistant operates the bamboo lever.*



Water and mud squirts out of the top of the boring pipe on its down-stroke.

example, in the river flood plains of Bangladesh and northern India.

Sludging uses a boring pipe, usually of 40mm-diameter galvanized iron (GI), which is moved up and down by the action of a bamboo lever pivoted about a simple frame (see Figures 1 and 2). The pipe initially rests in the corner of a small excavated pit filled with a mixture of water and cow dung. The water and dung mix acts as a 'drilling mud' and helps to stabilize the bore during the sludging operation. The pipe is then raised and dropped by two assistants, usually villagers, using the bamboo lever. On each up-stroke a technician (*mistri*) uses his hand to seal the top end of the open pipe. This creates a vacuum and causes

the column of water inside the pipe to be lifted with the pipe. On the down-stroke the *mistri* releases the seal, and the pipe drops faster than the column of water inside it. The cycle is repeated with the column of water moving upwards relative to the pipe until it begins to be pumped out of the top. The weight of the pipe acting on a case-hardened socket helps to fluidize the soil in the bore on each down-stroke. The soil is then sucked up with the pipe and out of the top a few cycles later (the assembly effectively works as a simple force pump). Sinking rates of up to 20m per hour may be achieved using this technique.

At 1.5m intervals the discharge is sampled and the strata layer identified.

## Waterlines

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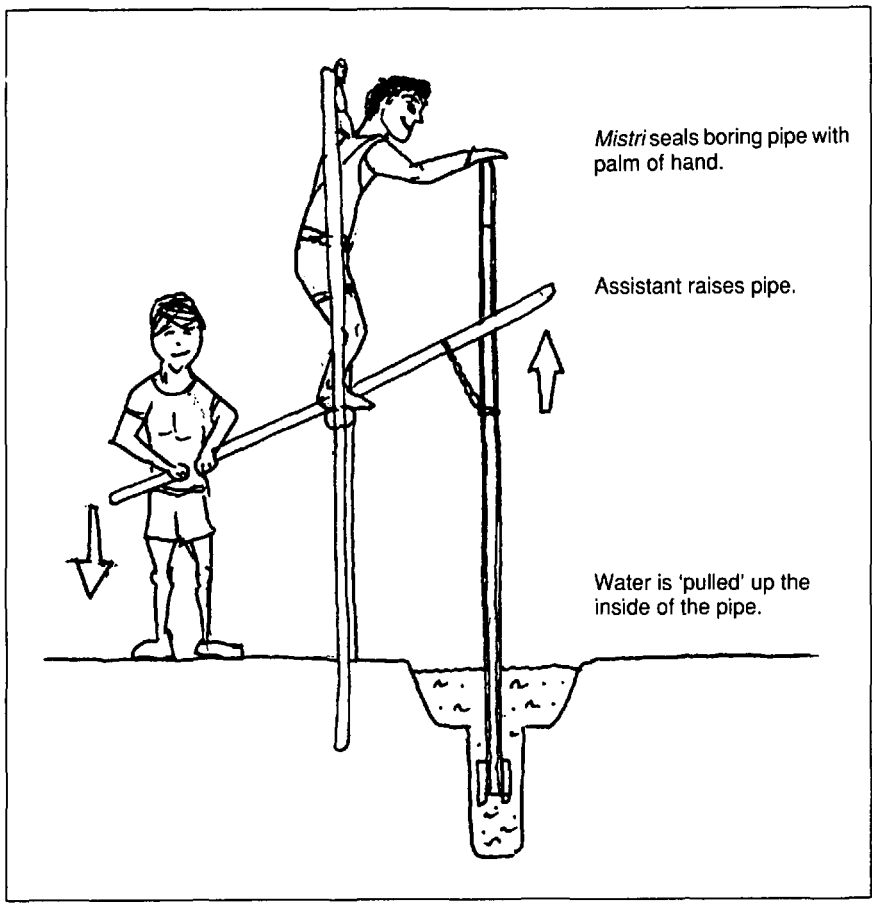


Figure 1. Water and mud is removed from the hole on the up-stroke.

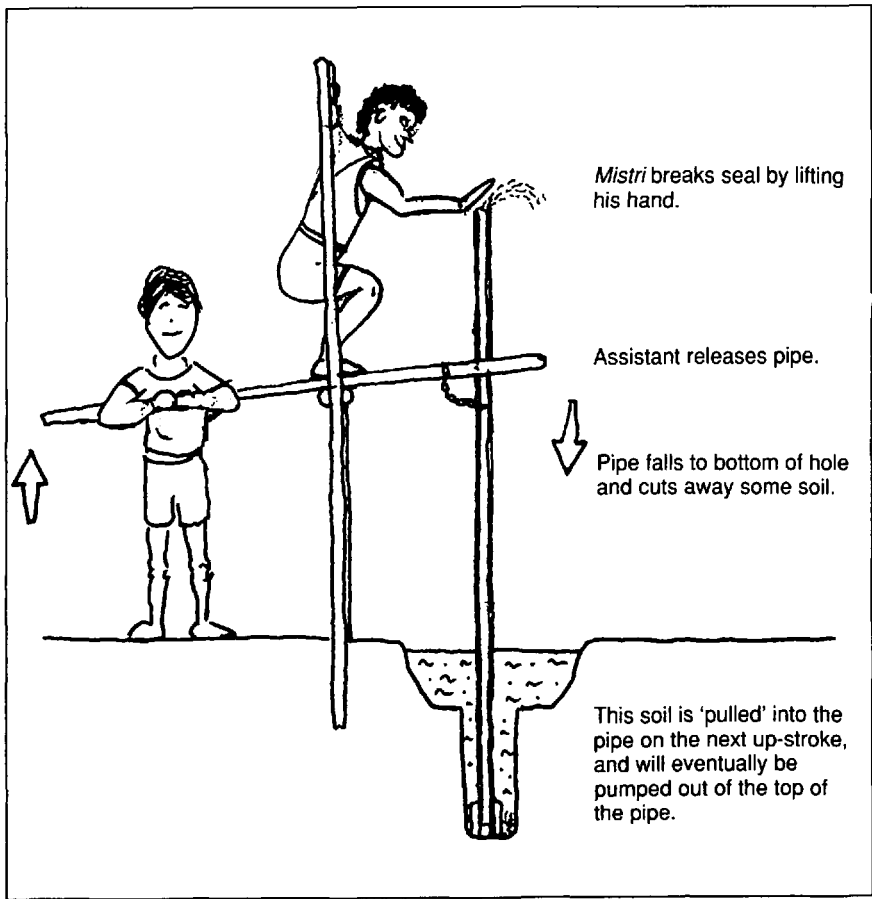


Figure 2. Water and mud is ejected from the pipe on the down-stroke.

Experienced *mistris* are often able to gauge this not only visually but also by the feel and note of the boring pipe impacting in the hole. Accurate logs

may be kept and screen sizes and locations determined.

Additional pipe lengths are added as the sinking continues to a depth of

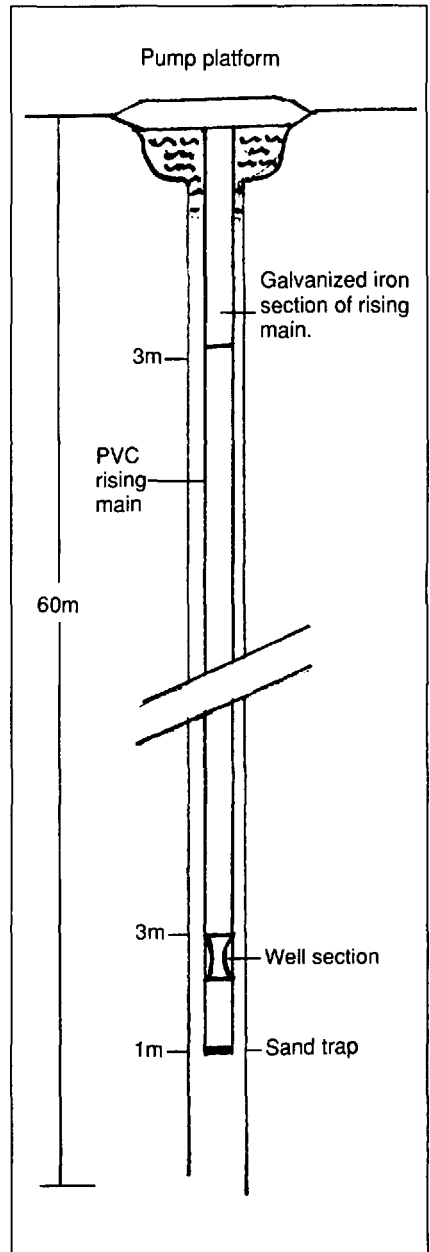


Figure 3. The final installation, the top 3m are galvanized iron, the rest PVC.

about 2m below the preferred screen depth. The GI pipe is then withdrawn and replaced by a PVC rising main fitted with a sand trap (1m) and well screen (2m). The PVC pipe rises up to within 3m of the ground surface, where it is joined to a 3m length of GI pipe fitted with a mild steel cross, which is firmly concreted into the pump platform. A suction handpump is then fitted and the well area developed prior to regular use, as shown in Figure 3.

### Well-pointing/hammering

One constraint to the widespread use of sludging is its inability to bore through hard materials. Often the presence of a single small stone in the path of the boring pipe is enough to cause the hole to be abandoned. Rarely are materials lost to the site, but the need to relocate may de-motivate local

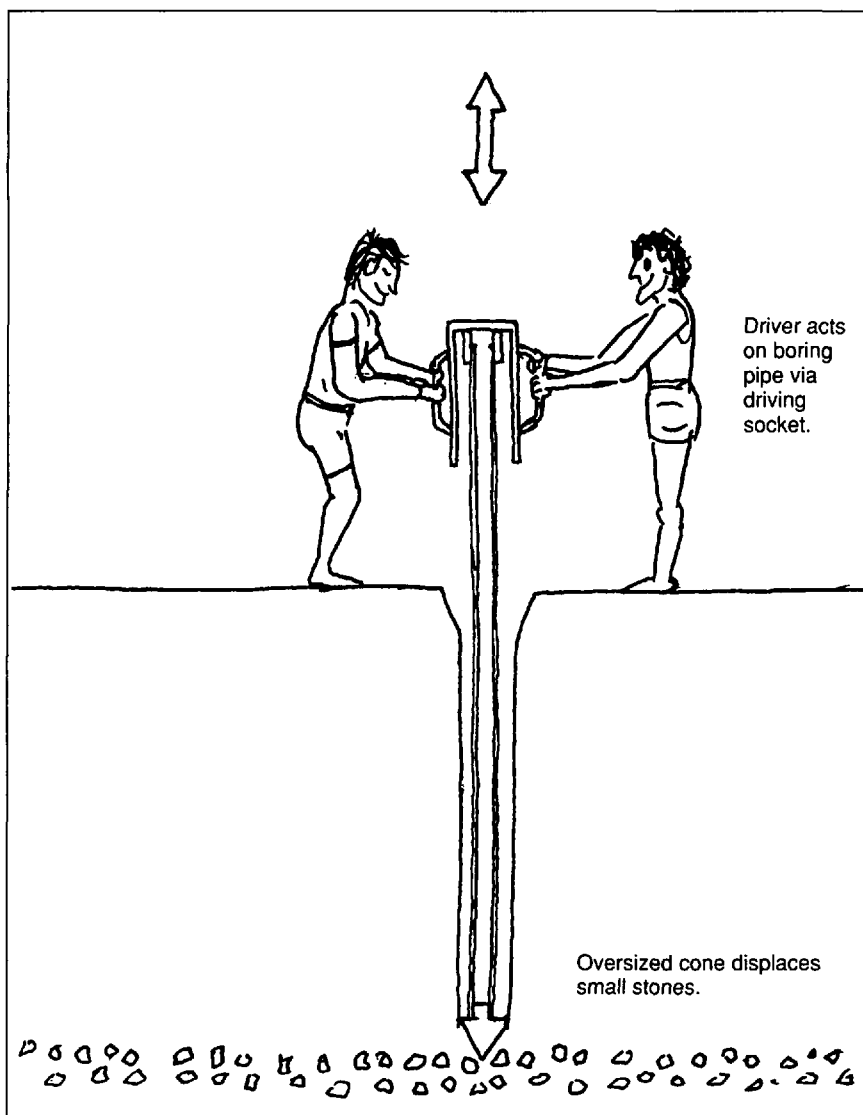


Figure 4. Two men hammer the boring pipe through the obstruction.

users, particularly when they have selected the original well site.

One simple technique used to avoid the abandonment of these holes uses a modification of the well-pointing method<sup>2</sup> known locally as hammering. This involves a simple, fabricated driver acting on a boring pipe fitted with an oversized cone at its lower end and a driving socket at its upper end (Figure 4). The outside diameter of this cone should be the same as that of the sludging socket.

When a stony layer is encountered the sludger pipes are removed and replaced with the hammering pipes, care being taken to avoid collapsing the sides of the bore during the change-over. Two men then hammer the pipe through the obstruction, at which point these pipes are jacked or winched out and the sludger pipes are reinstalled to continue boring.

If further stones are anticipated, then hammering is continued to the desired depth using the standard well-pointing

technique. In such circumstances it is usually not possible to withdraw the hammering pipes and they have to be left in place to form the rising main. This rising main incorporates a well screen of the type illustrated in Figure 5. A 32mm PVC spiral-cut screen is inserted into a pre-drilled 40mm GI pipe and located by way of flanges at top and bottom. The upper flange butts between the surfaces of the lowest joint in the rising main and is secured using a standard socket. The lower flange, of slightly smaller diameter, seals the bottom of the screen to allow a natural gravel pack to develop over time in the space between the PVC and GI pipes. This arrangement ensures that the screen is protected during driving and allows considerable cost savings over commercially fabricated metal screens.

A drawback of this procedure is that one has little knowledge of the aquifer and of the screen's position in it during driving. Test pumping at regular intervals between hammering will help

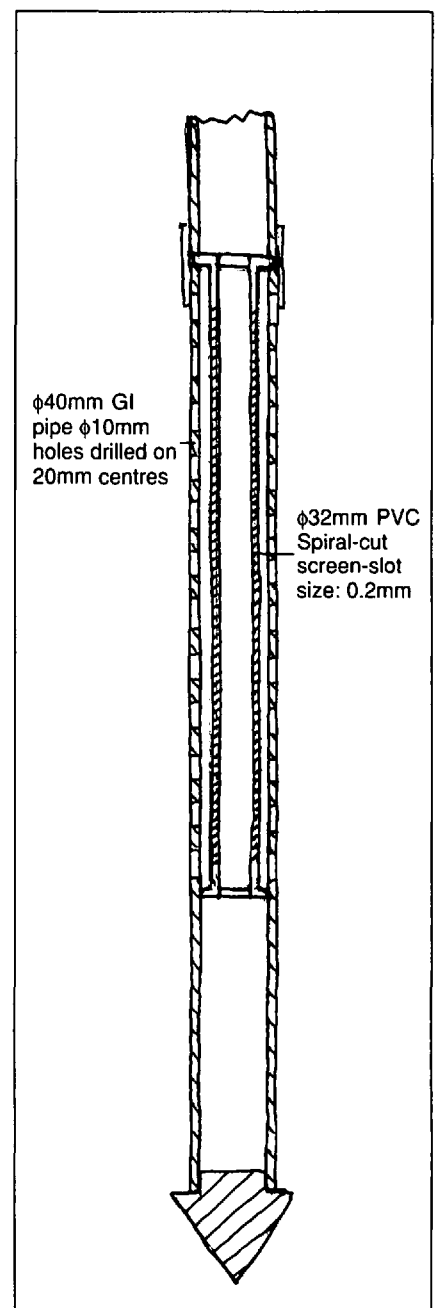


Figure 5. The well point screen that is used when the boring pipe is left in place and used as a rising main.

ascertain the presence of water and give some measure of hydraulic conductivity, but in the absence of independent data on aquifer characteristics, a degree of uncertainty will remain as to the well's likely long-term performance.

## References

1. 'Well sinking made easy in Bangladesh's ideal terrain', *World Water*, Liverpool, 1979.
2. Stapleton, C.K., 'Tubewells and their construction', *Waterlines*, Vol.2 No.1, IT Publications, July 1983.

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