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REACHING THE UNREACHED: CHALLENGES FOR THE 21ST CENTURY

Borewell rejuvenation for sustainability

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THE RURAL WATER supply programme of the Government of India is based on tapping the ground water sources by means of borewells. Since its inception, more than 2.5 million borewell hand pumps have been installed over the last 25 years. Today some 550 million people in about 430,000 habitations of the country rely on this system of supply for their domestic water needs. The borewell hand pump system is thus the backbone of the rural water supply programme in India.

The ground water potential of an area depends on its hydrogeological conditions. In India about 80 per cent of the area is covered by the hard formations which consists mainly of Granites, Gneiss, Basalt and compact sandstone. In hard rock formations occurrence and movement of the ground water is restricted to the weathered zones and fractures and fissures. The success of the water well drilled in hard formations thus depends on the number of water bearing fractures penetrated by a well and the degree of the interconnection among the water bearing fractures.

Hydrogeological and geophysical surveys such as resistivity investigations have been found to be very useful for locating suitable well sites. Remote sensing techniques such as satellite imagery are also used for locating sites in difficult and hilly areas where the regular scientific source finding methods cannot be used.

Depending on the local hydrogeological conditions, the average depth of a well drilled in hard rock formations varies between 50 to 60m. The well yield varies from a few hundred litres per hour (lph) to 5000 lph, with an average overall success rate of about 85 per cent, depending on the method of site selection used.

Well rejuvenation for sustainability

In hard rock formations, wells are drilled using air hammer rigs. These wells are cased upto a depth of an average of 10m. The remaining lower part of the well drilled through hard rock is left naked to allow free flow of water into the well.

It has been observed that due to reasons such as ageing and prolonged pumping, the yield of some of these wells deteriorates over the years. According to one estimate, about 6 to 8 per cent wells are reported as defunct annually for reasons such as reduction in well yield— a factor which threatens the sustainability of the borewell handpumps.

Field experience indicates that such borewells can be successfully re-claimed using rejuvenation techniques at less than 25 per cent of the cost of drilling a fresh well.

Technology

One of the most effective means of rehabilitating a failed well and turning it into a successful one is hydrofracturing. This technique involves the injection of water into the well at a very high pressure (80 -100 bars), as a result of which new fractures are created and existing fissures are cleaned and opened up.

In practice, an inflatable rubber packer is lowered into the well to a required depth below the water level. Depth for setting the packer is determined using the lithological chart of the well and / or by well logging in advance. The packer is then inflated using a hand operated hydraulic pump to isolate the productive zone of the well. Later, clean water is injected in the well through the packer at a very high pressure to open up the existing fractures and to create new fractures.

As the pumping continues, the pressure builds up in the isolated section of the well. The opening of the fracture is signalled by a sudden drop in the working pressure. The process is continued with further injection of water to propagate fracture until some balance is reached. At this stage, when no further pressure variations can be observed, the water injection is discontinued. Later on the well pump is tested to record improvement.

It has been observed that by hydrofracturing, a poor yielding well or a nearly dry well can be generally rehabilitated and transformed into a productive borewell with a capacity of supplying water to a community of 250 people through a hand pump.

Potential and scope

In India about 150,000 borewells are drilled annually throughout the country under the Rural Water supply Programme. The average drilling cost for a borewell with an average depth of 60m is about $800. Given that about 15 per cent drilled wells fail to yield the required rate to sustain pumping, the loss every year from failed borewells works out to about $18 million.

Generally a fresh borewell is drilled to replace the failed well at an additional cost of $800 each. The hydrofracturing technique offers an environmentally safe method for re-claiming a failed well at less than $150 per well, saving $600 per re-claimed well. Thus an annual saving upto $ 14 million could be achieved through use of the hydrofracturing technology.

This technique can also be used to rejuvenate the large number of successful borewells which reportedly dry up (either completely or seasonally) due to reasons such as

overpumping, lowering of water level, silting and clogging of the fractures. The rejuvenation of such wells is important from the point view of sustainability of safe drinking water sources along with the community based management of the system.

The new well may not to be located as conveniently as compared to the existing well, or it may not yield water of the quality acceptable to users. Moreover, the lack of dependability of the source may reduce the interest of villagers in community based management. Hydrofracturing helps to ensure social security and sustainability—gains which are difficult to evaluate in terms of monetary benefits.

Application and results

The hydrofracturing technology was first successfully used in early 1984 by an NGO in Madhya Pradesh. Later it was introduced in the India country programme in 1989, by importing 10 hydrofracturing units for the State Governments of Maharashtra, Gujarat, Madhya Pradesh and Rajasthan, which helped to demonstrate the application of the hydrofracturing technology. Today some 30 units are operating in ten States.

The data on hydrofracturing collected from the user States includes fracturing pressure, pre and post fracturing yield and formations in which the fracturing is done. The analysis of the data collected indicates:

- Hydrofracturing can be done only in hard rocks.
- The success rate varies from 50 to 100 per cent, depending on the hydrogeological set-up. However, an average success rate of 70 per cent is common in many regions.
- The improvement in the yield varies from less than 25 to 200 per cent.
- It is uneconomical to re-claim dry borewells. The reported success rate is less than 10 per cent.
- Best improvements can be achieved for wells with pre-hydrofracturing yield ranging between 10 to 50 lpm.

Illustrations 1 and 2 present results of the analysis of the hydrofracturing data in terms of the success rate and per cent improvement achieved.

Set-up and costing

A hydrofracturing unit consisting of the high pressure injection pump, prime mover, water tanker, carriers, including a set of fracturing accessories, generator and submersible pumps costs around $160,000. However, recently the cost has come down to $120,000 largely due to interest taken by local manufacturing companies.

With a saving of $650 per re-claimed borewell, the initial investment in the unit can be recovered by successfully hydrofracturing just 200 borewells. The life of the unit is estimated as 1000 borewells.

Conclusion

The use of hydrofracturing has proved to be very useful for re-claiming poor yielding borewells. It offers an environmental- friendly method for rejuvenating old wells at a relatively low initial investment. It can be used in India and elsewhere as a cost saving technology for sustaining borewells drilled for Rural Water Supply.