

## India's groundwater crisis

ON JULY 30, 2012 · IN DEVELOPMENT, WATER SECURITY

### India's groundwater crisis (pdf)

By Paul Wyrwoll, Australian National University, Australia



Irrigation garden, Kerala, India

Water security is widely recognised as one of the major challenges to India's economic and social development<sup>1,2,3</sup>. The nation's average annual rainfall is extremely abundant by global standards, yet much of this rain falls in relatively brief deluges during the monsoon and there is great disparity across different regions. The combination of these climatic conditions with a range of man-made pressures has driven India's farmers, households, and industry to increasingly depend on groundwater rather than surface water in rivers and lakes. But this dependence is leading to a rapid and very worrying deterioration in the nation's groundwater resources, a deterioration that is underlined by current events.

The first two months of the 2012 monsoon have seen [remarkably weak rainfall](#), but existing groundwater bores in many areas can no longer be relied on as an alternative to surface water: the lack of replenishment from the rains is exposing the simple fact that the water table has fallen too quickly due to over-extraction. Previously productive tube-wells are [now dry](#). Extreme water shortages are currently widespread in some [major cities](#), as they were across the country during the [2009 drought](#). Whilst a lack of reservoir infrastructure is also a contributing factor to current shortages, the fact that groundwater resources are unable to compensate as before indicates that what was once a problem of long-term sustainability has developed into an urgent crisis – one that is fundamental to India's broader water security today and for a long time to come.

Groundwater is a critical resource in India, accounting for over 65% of irrigation water and 85% of drinking water supplies<sup>4</sup>. However, on current trends it is estimated that 60% of groundwater sources will be in a critical state of degradation within the next twenty years<sup>4</sup>. In the most seriously affected north-western states, recent satellite measurements indicate an average decline of 33 cm per year from 2002 to 2008<sup>5</sup>. Local observations of annual water table decline exceeding 4 metres are common throughout India<sup>5</sup>.

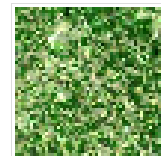
India's declining groundwater resources are the product of a number of drivers. Utilization of groundwater facilitates irrigated agriculture in areas far from rivers; in fact, this was key to the agricultural "green revolution" that occurred from the mid 1960s<sup>2</sup>. In places where surface water is available but unsafe for drinking or farming—more than 70% of India's surface water resources are polluted by human waste or toxic chemicals<sup>3</sup>—groundwater has often been seen as a safe alternative<sup>6</sup>. Urban water supply infrastructure is often poor and unreliable: well drilling is typically the most economical means of obtaining household water<sup>4</sup>. In Delhi, the local government estimates that 40% of the water transmitted through the mains system is lost through leakages<sup>7</sup>; for many, the only other alternative to bores are expensive supplies purchased from water-trucks.

In rural areas, electricity subsidies allowing farmers to pump groundwater cheaply have become entrenched in the political landscape<sup>8</sup>. They are likely to become even more so as energy requirements increase to extract water from

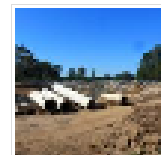
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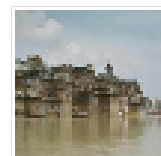
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greater depths<sup>1</sup>. Low cost encourages excess water withdrawal, an inefficient usage pattern commonly exacerbated by ineffective application methods and the wastage of agricultural produce between farm and market<sup>9</sup>. In order to feed a growing and wealthier population, it is projected that agricultural water demand in the India of 2030 would need double to 1,200 billion m<sup>3</sup> if these inefficient practices continued<sup>10</sup>. The problems are only going to get worse unless urgent changes occur.

So we have some sense of why India's groundwater is being unsustainably exploited, but why is this so important? Aside from the physical absence of the resource, the state of groundwater quality in India is a critical health issue<sup>6</sup>. As wells are drilled deeper in pursuit of the falling water table, the water which is extracted frequently displays higher levels of arsenic, fluoride, and other harmful chemicals. The attendant health effects have been well documented throughout India<sup>11,6</sup>, particularly in poorer rural communities where there is no alternative for drinking water. Falling water tables can also induce leakage from a contaminated external source<sup>12</sup>, such as saline water in coastal areas or surface water polluted by sewage, agricultural fertilizers, and industry. Depletion of groundwater is not simply a case of drawing down a replenishable resource, but potentially one of permanent degradation.

Unsustainable groundwater depletion is a very serious issue. And it is a very difficult problem to address<sup>13</sup>. Groundwater is a classic example of a 'public good' – a resource where it is difficult to exclude potential users and it is not in the self-interest of the individual to use the resource in a collectively beneficial manner: if one user reduces the volume of water they withdraw the overall impact will be minimal. The likely result? All users compete with each other to extract as much water as they can while the resource still exists and everyone is worse off than if they cooperated and each reduced consumption. Of course, it does not have to be that way: we easily could envisage a situation where neighbouring farmers in a single community are able to cooperate effectively. But what are the prospects of voluntary cooperation between a large number of different communities using the same aquifer? Or how about millions of households across a major city?

Environmental public goods typically require some form of government regulation to change the incentives of users and produce socially optimal outcomes. In India, however, it would seem almost impossible for the national government to manage the estimated 25 million groundwater extraction structures already in existence<sup>8</sup>; this is particularly the case given that India's government institutions require significant strengthening and responsibility for groundwater management is fragmented throughout different official departments<sup>4</sup>. What's more, India's state governments have primary jurisdiction over groundwater usage and, in many cases, state agencies are even more poorly equipped. Both underground aquifers and above-ground rivers traverse the borders of Indian states; competition over water use is already a major source of inter-state conflict<sup>2</sup>, as well as between users at a local level<sup>4</sup>. To date, the difficulties of regulation and collective management of India's groundwater resources have been overwhelming, and are a fundamental cause of the state of crisis<sup>2,4</sup>.

The link from water to food security and health in India compels urgent solutions to the unsustainable levels of demand for its dwindling groundwater supplies. But, given the multiple levels of the problem outlined above, this is no simple task. A comprehensive World Bank study concluded that high-level policy reform in the shape of regulatory measures, economic instruments, or tradable groundwater extraction rights is simply not a credible way forward<sup>4</sup>. Instead, this report proposed that "bottom-up" community management may be the only hope. Other studies have supported this proposal<sup>8</sup>, with particular focus on community level groundwater recharge and the use of communally managed alternatives to groundwater, such as small dams. Notably, the [International Water Management Institute](#) administered a [successful trial targeting farming villages in Gujarat state](#), the results of which are now being incorporated into national policy.

Asking whether India's groundwater crisis will eventually be addressed might actually be the wrong question: solutions will simply have to be found. What these solutions are, how long they take to find, and how serious the consequences become are the more relevant issues.

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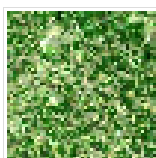
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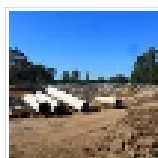
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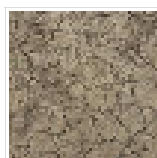
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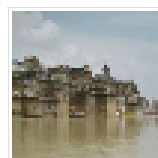
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**Jaime Saldarriaga** says:

August 7, 2012 at 4:50 am

Looks like India Water issues are some of the most challenging in the world. Timely decisions must be made by responsible agencies to clear the future water outlook.

**Anupam K Singh** says:

August 11, 2012 at 6:38 pm

India's groundwater problem is unique and needs a range of interventions from water accounting, IWRM,