with the IPCC report. However, the report was confusing because all the Indian water, food security, fisheries and biodiversity problems were attributed to climate change. The projections of temperature rising up to 5.8°C by 2100 and sea level rise were framed as 'The planet is doomed' by the NDTV 24×7 coverage on 13 February 2007. At the same time, the media also covered a lot of awareness campaigns by non-governmental organizations (NGOs) like switching off lights for an hour. The highest coverage in both CNN-IBN and NDTV 24×7 was in the year 2009. This happened because of the Conference of the Parties (COP) meeting in Copenhagen in 2009, which was considered important for both the developed and developing countries to control carbon emissions so that the temperature rise does not reach beyond 2°C by 2050. This summit discussed about the mandatory emission cuts for individual countries. The debate over who should cut how much emission was a serious issue as the developed countries wanted to ignore their past emissions and instead forced the developing countries to cut their emissions, thus affecting these growing economies. The developing countries disagreed with that view and argued for a proper agreement which would make the developed countries accountable for their past emissions and which would prescribe transfer of funds and technology from the developed countries to solve the problem. India's stand was not to have a legally binding cut in emissions, as it is a growing economy and several areas in the country still do not have access to electricity.

From Figure 3, it is evident that policy makers and NGOs were the dominant sources used by NDTV 24×7 and CNN-IBN. A 2009 video from NDTV 24×7 titled 'Legally binding cuts out of question' carried the lead statement of the then Indian Environment Minister, Jairam Ramesh[10]. Another statement from the then Minister explains how the US climate change drafts are completely unacceptable in the case of India. A programme by NDTV 24×7 titled 'Chaos in Copenhagen' clearly showed how the developed countries were blocking the efforts of the developing countries to have an equitable agreement[11].

More public engagement will happen only if there is more climate change news from the media. Since it is difficult for the media to give exclusive stories on climate change, a joint collaboration among Government, NGOs and the media is needed to keep the issue alive. Only when the issue is discussed more in the public arena, will there be a chance of action at the policy level. With proper implementations of policies, India will be able to tackle this global problem and minimize the impact of climate change on the people and protect their livelihoods.


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# Growth of water purification technologies in the era of 'regulatory vacuum' in India

*Saradindu Bhaduri, Aviram Sharma and Nazia Talat*

Privatization and commodification of drinking water provisioning is a key phenomenon of 'post-liberalization' India[1]. A rapid and sustained growth in bottled water consumption and a matching increase in home purification technologies have largely been the backbone of this process. During the last decade and a half, the consumption of bottled water saw a rapid growth.

According to some market reports the industry was pegged at USD 1454 million by 2011 and supposed to reach USD 3925 million by 2017 (ref. 2). Similarly, home purification technology is expected to increase from USD 522.40 in 2012 to USD 1142.75 in 2015 (refs 3, 4). Rapid, and uneven urbanization and inadequacy of the existing institutional mechanisms to ensure good quality drinking water to the ever-increasing urban population remain crucial for growth of these 'alternatives'[5]. Along with the different aspects of 'access'-related issues with drinking water, in fact, the popular perception of 'quality' has also undergone a sea change in the last two decades. For drinking water, the publication of a report by the Centre for Science and Environment showing presence of pesticides in bottled water of some established brands has also been a game changer[6]. This report created unprecedented media coverage on the issue, and led to formation of the First Joint Parliamentary Committee on public health in independent India. This episode not only influenced the public perception about water quality, but also altered the business landscape for water purification technologies in India. The next few years witnessed extraordinary growth of water

purification technologies, both at the firm level and in households, and reverse osmosis (RO) emerged as the key in this changed landscape of water quality.

## Water quality concerns and the rise of RO

Our research shows that bottled water firms of all size class, ranging from major multinationals, to the vast majority of India's 2700 small proprietory firms, use RO-based water purification technologies in their manufacturing plants. Although water purification nowadays is not a single-step process, but involves multi-stage purification with diverse technologies (like ultraviolet water purification, ozonization, carbon filtration, etc.), the use and application of all these technologies revolve around RO, and the complete system often goes by the name of RO.

Globally also, research and development in the field of RO technology (especially the membrane which filters out solid particles) has increased consistently ever since its inception in the 1960s[7]. One might keep in mind, however, that it was originated to make sea water drinkable, and dominated water purification processes in coastal areas of the US and other countries, including India. In the field of drinking water purification, however, RO is a relatively new technology in the Indian market compared to UV, chlorination, carbon adsorption, etc. both in bottled water firms as well as at the household level. It has, however, now become a market leader in this field. Manufacturers of RO purifiers not only include giants firms like Aquaguard, Kent, etc. but also numerous small assembling units importing the key components of RO and often selling the assembled products at a much cheaper rate. A rough estimate suggests the presence of roughly 5000 small assembling units in Delhi.

The popular trust on water obtained from RO purification is neither substantiated nor backed by many scientific reports, either in India or abroad. This new euphoria about RO does not keep in mind that the suitability of a water purification technology depends on source water. Water supplied by public utilities has been already treated for those impurities that RO wants to purify, and the 'over treatment' by RO can actually harm us more than merely quenching our thrust[8].

## The 'other' face of RO technology

What RO does is simple. It pushes water with pressure through a membrane to remove dissolved particles of size greater than 10 nm, which means almost everything, and lowers the newly discovered menace of water, namely the total dissolved solids (TDS), and drains out the impure water from the system[9]. It, however, removes all minerals indiscriminately, and herein lies the problem.

In the process of lowering the TDS, often to zero, RO makes water acidic and sour in taste. Acidic water (low-pH water) may have indirect health hazards[11]. People also generally prefer 'sweet' taste of water. To fulfil this sensory expectation, the manufacturers of RO have resorted to a novel technique. They have introduced a TDS controller, which will decide what percentage of feed water will be passed through the RO membrane. The rest would bypass the membrane, and would meet the treated water later. This, to say the least, presents before us a dilemma about the quality of feed water. If the quality is so bad that it needs RO for purification, then why bypass some of this 'dangerous' water from being treated by RO in the first place? Alternatively, if the feed water is not so dangerous, then why do we need RO which unnecessarily treats it? Unfortunately, we do not have any answers coming either from the scientists or the policy makers.

The efficiency of RO depends much on the pressure it applies to send impure water through its membrane. During industrial use, it wastes water to the tune of 30–40% (ref. 10). This is a huge wastage, given the large (and expanding) size of the bottled water industry. Ironically, it has failed to capture the concerns of climate change enthusiasts and policy makers. The major bottled water firms that we surveyed do not have any concrete plans to use this 'extra' water (worse in quality than the feed water as it carried all impurities with higher concentrations). Some firms feed the wastewater into groundwater aquifers, which has the potential to contaminate the aquifers, at least in the short term; it also affect the water used for irrigation and drinking. The problem is compounded when groundwater has arsenic or fluoride, and RO ploughs back all of them with greater concentration to the acquifiers. This problem is more at the household level, typically, because water pressure of home-based purification machines is much lower compared to their industrial counterparts. Occasionally, an RO purifier can waste about four-fifths (80%) of feed water, and all this, most certainly, is drained out. RO also requires electricity to function efficiently. RO was conceptualized to desalinate sea and brackish water and to provide freshwater to areas where potable water was otherwise not available. Of course, the wastage of water and feeding back untreated water to its source are not a concern when the source is a sea or an ocean. They become problematic when groundwater is extracted for treatment through RO.

## The road ahead

One would perhaps have to be content with the fact that privatization of water provisioning has come to stay. Judicious regulation is, therefore needed, to protect groundwater and public health We can only offer a few suggestions to this end. First, a public information dissemination system must be put in place to provide necessary information about the quality of water to common public. Secondly, quite often use of purification technologies at home and consumption of bottled water are a reflection of mistrust on public supply of water. However, public utilities seldom inform common people about their purification exercises. While it is understandable that they are grappling with the daunting task of supplying 'sufficient' drinking water to the ever-increasing urban population, they should also better inform us about their work to prevent spread of wrong information. Thirdly, plans were mooted a couple of years ago to make groundwater a common property. This law has to be implemented soon to put a check on unscrupulous use of groundwater solely for private gains. Finally, scientists must engage themselves with more epidemiological studies on water quality and its health effects. We could lay our hands only on a few such studies in Delhi[12–14]. If this is the situation with Delhi, imagine the situation of scientific studies on water quality in other smaller Indian cities. Indeed, the absence of comprehensive epidemiological studies is, perhaps, the largest weakness of India's science and technology regulation making exercise today.

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