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Impending water crisis in India and comparing clean water standards among developing and developed nations

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ABSTRACT

"Water usage across fast developing sub continental economies is growing at unprecedented rate which is more than twice the rate of the population growth for the past century. Although there is not yet a global water shortage, about 2.8 billion people, representing more than 40% of the world's population, live with some form of water scarcity[1] off which almost 1.2 billion live under conditions of physical water scarcity, which occurs when more than 75% of the river flows are withdrawn in countries like India and China. Remaining 1.6 billion people live in areas of economic water scarcity, where human, institutional, and financial capital limits access to water, even though water is available locally to meet human demands. These conditions are prevalent in much of Southern Asia and Sub Saharan Africa. Symptoms include lack of or underdeveloped water infrastructure, high vulnerability to short and long term drought, and difficult access to reliable water supplies especially for rural people. On the other hand there is surprising connection between the quality of fresh water and healthful longevity and health benefits. All over the world and throughout time, wherever you find clean and contaminant free water, you find the healthiest, most vibrant civilizations. Water can often emerge as an issue in the relations between nation-states. Water treaties and agreements often come about because of the existing political environment. But the politics of water is not limited to the international sphere; domestic politics often plays a major role in water security. "Water because it's cheap we take it for granted on the contrary because it's priceless we shouldn't." This paper is an overview of the issues surrounding India's water scarcity, and also comparison of clean water standards between developing and developed nations.

Keywords: Water, Water standards, Water Purification, Water Parameters, Water Crises.

INTRODUCTION

Water is important and essential to life. Everybody knows this. But one obvious question confronting each of us is do we really know about water. One common perception about drinkable water is that all of it is more or less equal at molecular level having a simple composition, yet such a simple molecule is complex by nature and it could hurt us in many ways. Of all the planet's renewable resources, fresh water may be the most unforgiving. Difficult to purify, expensive to transport and impossible to substitute, water is essential to food production, to economic development, and to sustain life itself. Global Freshwater reserves are rapidly depleting and this is expected to significantly impact many densely populated areas of the world more so in India and China. The reasons are:

• *Global Climate Change in the Future could threaten Water Supplies and Sustainability*
• *International Community Increasingly Views "Equity and Access to Water" as a Fundamental Human Right*
• *Increasing Water Demand for Agricultural activities has a major impact on Water Security*
• *Water Security and Domestic Politics are often Intertwined in developing countries where Water Can be a Source of Inter-state conflicts at international level, conflicts at the inter-state level, conflicts between upstream and downstream riparian's, intra-state rivers conflicts between communities and the state, conflicts between farmers, the environment, and conflicts within irrigation projects.*
• *Rampant pollution of fresh water resources The lack of adequate attention to water conservation, efficiency in water use, water re-use, ground water recharge* [2] *and eco-system sustainability. Pollution induced environmental degradation conflicts and competition for fresh water.*
• *The system of 'water rights' under common law in India which gives the ownership of groundwater to the landowner, despite the fact that ground water is a shared resource from common pool aquifers.*
• *Uncontrolled use of the bore -well technology which has allowed the extraction of ground water, primarily for irrigation, to grow at phenomenal rates, often exceeding recharge.*
• *Communities not being in control of their water resources. Water is used as a political tool, controlled and cornered by the rich, who do not pay the price for this scarce resource. The poverty of incomes, capabilities and opportunities of many is compounded by 'water poverty'.*

Its importance to human health and well-being was underlined in mid1993 when the United Nations' New Commission on Sustainable Development made improvement of water quality standards as well as one of the first priorities for technology transfers from wealthy countries to poorer ones. Water plays a central and critical role in all aspects of life viz. in the national environment, in our economies, in food security, in production, and in politics etc. Water security is emerging as an increasingly important and vital issue of sustainable development for the Asia-Pacific region particularly so for **India and China.** In South Asia, water has been a cause of conflict since ancient times. For example: *One of the earliest water conflicts in the sub-continent is recorded in the famous Goutama Buddhar Kappiyam: a conflict over the sharing of Rohini river water between the Sakyan and Koliyan clans, which was, according to Dr. Ambedkar, the cause of the Buddha's leaving home.*

The South Asian region is also distinctive in terms of the varied political regimes (the political equation between a numbers of the countries in the region is highly volatile) and social systems. In his seminal work on water issues, Ramaswamy Iyer elucidates how the problem with water issues is not that water issues complicate political issues (that rarely occurs), but that complicated political issues make the smallest water issues between countries, intractable[3]. Although diverse in nature, the South Asian continent shares in a common cultural and historical heritage revolving around water and agriculture. Water is said to be the mainstay of all civilizations, more so for South Asian countries because they have a short, well defined monsoon and scorching summer.

In the future, diminishing and degraded freshwater resources could lead to internal instability in many nations, and possibly even spark interstate conflict. Perhaps no other resource other than oxygen is so intricately linked to human health and survival. However, as the region's population growth continues to surge, the demand for water is increasing substantially, without a concomitant increase in water resources. Many Asian countries are beginning to experience moderate to severe water shortages, brought on by the simultaneous effects of agricultural growth, industrialization, and urbanization. "There will be constant competition over water, between farming families and urban dwellers, environmental conservationists and industrialists, minorities living off natural resources and entrepreneurs seeking to turn it into a commodity resources base for commercial gain" UNICEF report on Indian water[4].

The inadequacy in the supply and access to water has only recently taken centre stage in global reflection as a serious and threatening phenomenon. Communities and individuals can exist even for substantial periods without many essential goods; however, humans can survive only a few days without clean, safe drinking water. Many people living in poverty, particularly in the developing countries, daily face enormous hardship because water supplies are neither sufficient nor safe. Women bear a disproportionate hardship. For water users living in poverty this is rapidly becoming an issue crucial for life and, in the broad sense of the concept, a right to life issue. Water is a major factor in each of the three pillars of sustainable development economic, social and environmental. In this framework, it is understood that water must meet the needs of the present population and those of future generations of all societies. This is not solely in the economic realm but in the sphere of integral human development. Water policy, to be sustainable, must promote the good of every person and of the whole person. About two-thirds of the human body is composed of water. Much of planet earth and our atmosphere is composed of water as well. Water is essential in each aspect of our life on earth. So, if we as humans are allowed to choose how pure or impure we want that two-thirds of our bodies to be, most of us would likely choose to go with the purest form possible.

With regard to water supplies, experts currently distinguish between the problems of "water stress" vs. "water scarcity". Water stress occurs when a country's annual water supplies drop below 1,700 cubic meters per person. When these levels reach between 1,700 and 1,000 cubic meters per person, occasional water shortages are likely to occur. However, when water supplies drop below 1,000 cubic meters per person, the country faces water scarcity which can threaten food production, undermine economic development, and harm ecosystems[5]. With this level of importance and significance, we would want the water we drink or use to be of greatest purity, and for that purpose we enforce certain standards, standards which classify certain qualities of water as usable and the others as non usable. All Governments, whichever country it may be has recognized its responsibility in setting up standards. We have plethora of set standards, classifying permissible limits of chlorine, fluoride, bacteria, BOD, COD, and what not. But the question of utmost importance is whether these questions are effective against the high levels of polluted water these days.

When analyzing freshwater and its relationship to human consumption, it is useful to delineate two concepts: availability vs. access. Availability refers to the physical presence of adequate water supplies, whereas access refers to the ability of people within a particular country or region to actually receive or gain access to clean freshwater. Obviously, these are two distinct types of problems, although they can both be present in a region experiencing water stress or water scarcity. Availability may be more dependent on physical or environmental factors (i.e., the geography of a particular country or climate change, etc.), whereas access may be more dependent on social or political factors (i.e. how much of a country's agricultural sector is dependent on irrigation, or how effective a country's municipal water supply is, etc.).

The Challenges

India's water crisis is predominantly a manmade problem. India's climate is not particularly dry, nor is it lacking in rivers and groundwater. Extremely poor management, unclear laws, government corruption, and industrial and human waste have caused this water supply crunch and rendered what water is available practically useless due to the huge quantity of pollution. In managing water resources, the Indian government must balance competing demands between urban and rural, rich and poor, the economy and the environment besides preventing water stress situation by integrating its regional water management programs at national level**.** There are a number of challenges that face India today: the increase in population that could be anywhere between 1.4 and 1.65 billion in 2050. Food grain demand could go up to 450 million tonnes per annum. The per capita water demand will increase for industries and cities almost on a daily basis. Power demands will be three to four times what they are today, even if half the households remain without access to electricity, pollution and looming climate change will make the rainfall (the primary source of water), droughts, and floods more and more destructive, yet more and more frequent and at unusual places and times. Besides this there are the problems of diversion and damming of our rivers upstream by China.

Water shortages both in the form of stress and scarcity are emerging very fast and India is experiencing similar shortages. Meanwhile, India's supply of water is rapidly dwindling due primarily to mismanagement of water resources, although over-pumping and pollution are also significant contributors. Climate change is expected to exacerbate the problem by causing erratic and unpredictable weather, which could drastically diminish the supply of water coming from rainfall and glaciers. As demand for potable water starts to outstrip supply by increasing amounts in coming years, India will face a slew of subsequent problems, such as food shortages, intrastate, and international conflict. In 1998, a government minister warned that per capita availability of freshwater was declining due to rapid population growth and industrialization. The minister told the Indian parliament that the per capita availability of freshwater in 2025 is expected to be 1,500 cubic meters per year, as compared to 2,200 cubic meters in 1997 and 5,300 cubic meters in 1955. In 2006 between the domestic, agricultural, and industrial sectors, India used approximately 829 billion cubic meters of water every year, which is approximately the size of Lake Erie. By 2050 demand is expected to double and consequently exceed the 1.4 trillion cubic meters of supply [6]. But the response of the Indian government of more big dams, more hydropower projects, more long-distance water transfer, interlinking of rivers and desalinization on a grand scale is completely off the mark.

India has the largest irrigation infrastructure in the world, but as the Union Finance Minister said in his last budget speech, the performance of this infrastructure is possibly the poorest in the world. The World Bank's report card on India's water sector in June 2005 (interestingly titled: *India's Water Economy: Bracing for a Turbulent Future*) stated, 'the cost of replacement and maintenance of India's stock of water resource and irrigation infrastructure would be about $4 billion a year, which is about twice the annual capital budget in the Five Year Plan', and nothing of this amount is allocated to the maintenance of existing water infrastructure.

In 2006, the International Water Management Institute found that the proportion of canal irrigated areas is decreasing across the country. India's reservoirs are silting up: the latest data from Central Water Commission, analyzed by us, showed that capacity equal to at least two-thirds of the additional storage capacity that we are adding annually through new large dams at huge economic, social and environmental costs is silting up and little is being done. The generation of electricity per MW installed capacity from large hydropower projects has reduced by over 20 percent in the last twelve years as a result of aging machines, silting reservoirs, and overdevelopment in some of the river basins. The clearest sign of how poorly India is dealing with water resources development and management is the growth of water-related conflicts. But what is the response of the government to this reality? There is no democracy in water resources development and the solution lies in changing that situation in fundamental ways.

We know that besides being used for drinking purposes it has a multiple uses, not just in the industry, it is forms a base for all kind of activities in the economy. And even more pitiable fact is that it is a victim to the corrupt practices of our country's politicians. The Government of India allocates subsidized water to the farmers for farming purposes only a fraction of which goes to the desired destination. As a scarce commodity, water is prone to exploitation. TI India's 'India Corruption Study 2005', which sampled 14,405 respondents from 151 cities and 360 villages, found that water was one of the public services most clearly identified with corrupt practices [7]. And this also has to be noted that India is not the only country where the natural resources face the corruption from bureaucracy of the government. In America *a Water Law*, passed on 10th July 2007, declared the public ownership of all surface and underground water, regardless of whether it is located on private or public land. Landowners will henceforth have to pay the government to use their own wells, signalling an increase in bureaucracy that is likely to usher in a lucrative new arena for corruption [8].

Apart from that there are certain regions in our country where there is very meagre quantity of available ground water which is the major source of drinking water, as well as it is also an important source of water for the agricultural and the industrial sectors. In the arid regions of northern India, groundwater is often the only source of available drinking water. India possesses about 432 bcm of groundwater replenished yearly from rain and river drainage, but only 395 bcm are utilizable. Of that 395 bcm, 82% goes to irrigation and agricultural purposes, while only 18% is divided between domestic and industrial use [9]. Total static groundwater available is approximately 10,812 bcm [10]. Overexploitation of aquifers in some areas has resulted in falling groundwater levels. Experiments in some areas are being conducted to assess the feasibility of aquifer storage and recovery to alleviate the water shortage problem [11].

In addition, fluoride and arsenic have become increasingly recognized as problem elements in a number of groundwater sources, though they rarely occur together in high concentrations under the hydrogeological conditions pertaining in the region. India's rivers also have high fluoride content, beyond the permissible limit of 1.5 ppm, which affects 66 million people nationwide are believed to suffer from problems with fluorosis (dental or skeletal) as a result of long-term exposure to high-fluoride drinking water. The polluted water then seeps into the groundwater and contaminates agricultural products when used for irrigation. Over 21% of transmissible diseases in India are related to unsafe water [12].

An estimated 05 million people are likely to be drinking water with concentrations of arsenic greater than the national standard of 50µg/l, principally in West Bengal [13]. A large amount of survey, patient identification and mitigation work has been going on in recent years in West Bengal to alleviate the arsenic problems [14]. Millions of the poorest are affected by preventable diseases caused by inadequate water supply and sanitation. It can be easily inferred that the actions regarding monitoring the water quality are insufficient and need a greater boost. However, monitoring of water and its quality has been started recently. Given that India does not regulate water usage, it should come as no surprise that there is also little regulation on pollution and even less enforcement of what regulations do exist. Millions have been spent on pollution clean-up, but no one knows where it went (most likely into the pockets of corrupt government officials) because no changes have been seen. In 2005, a government audit indicted the Jal Board for having spent $200 million on pollution clean-up achieving essentially no tangible results [15]. The basin supports population of about 544 million in its co-basin States [16]. Every river in India is polluted to some degree. Combination of sewage disposal, industrial effluents, and chemicals from farm runoffs, arsenic, and fluoride has rendered India's rivers unfit for drinking, irrigation, and even industrial purposes [17]. The water quality in underground wells violates the desired levels of dissolved oxygen (DO), having high concentrations of toxic metals, fluoride, and nitrates [18] and coliform, the presence of which is one measure of filth.

WHO'S guidelines for drinking water quality, 2006

The quality of drinking-water is a powerful environmental determinant of health. Drinking-water quality management has been a key pillar of primary prevention for over one-and-a-half centuries and it continues to be the foundation for the prevention and control of waterborne diseases. Water is essential for life, but it can and does transmit disease in countries in all continents from the poorest to the wealthiest. The most predominant waterborne disease, diarrhea, has an estimated annual incidence of 4.6 billion episodes and causes 2.2 million deaths every year. There are several variants of the faecal-oral pathway of water-borne disease transmission. These include contamination of drinking-water catchments (e.g. by human or animal faeces), water within the distribution system (e.g. through leaky pipes or obsolete infrastructure) or of stored household water as a result of unhygienic handling. Millions of people are exposed to unsafe levels of chemical contaminants in their drinking water. This may be linked to a lack of proper management of urban and industrial wastewater or agricultural run-off water potentially giving rise to long term exposure to pollutants, which can have a range of serious health implications. These below mentioned guidelines in Table 1 are the international reference point for standard setting and drinking water safety [19].

Table 1 – Drinking Water Parameters

ELEMENT / SUBSTANCE	SYMBOL / FORMULA	NORMALLY FOUND IN FRESH WATER / SURFACE WATER / GROUND WATER	HEALTH BASED GUIDELINE BY THE WHO
Aluminium	Al		0,2 mg/l
Ammonia	NH_4	< 0,2 mg/l (up to 0,3 mg/l in anaerobic waters)	No guideline
Antimony	Sb	< 4 µg/l	0.02 mg/l
Arsenic	As		0,01 mg/l
Barium	Ba		0,7 mg/l
Berillium	Be	< 1 µg/l	No guideline
Boron	B	< 1 mg/l	0,5 mg/l
Cadmium	Cd	< 1 µg/l	0,003 mg/l
Chromium	Cr^{+3}, Cr^{+6}	< 2 µg/l	0,05 mg/l
Copper	Cu		2 mg/l
Cyanide	CN^-		0,07 mg/l
Fluoride	F	< 1,5 mg/l (up to 10)	1,5 mg/l
Iron	Fe	0,5 - 50 mg/l	No guideline
Lead	Pb		0,01 mg/l
Manganese	Mn		0,4 mg/l
Mercury	Hg	< 0,5 µg/l	0,006 mg/l
Molybdenum	Mb	< 0,01 mg/l	0,07 mg/l
Nickel	Ni	< 0,02 mg/l	0,07 mg/l
Nitrate & Nitrite	NO_3, NO_2		50 mg/l and 3 mg/l
Selenium	Se	< < 0,01 mg/l	0,01 mg/l
Silver	Ag	5 – 50 µg/l	No guideline
Sodium	Na	< 20 mg/l	No guideline
Uranium	U		0,015 mg/l

Indian Government has also dutifully recognized its responsibility in forming standards and putting them as a part of the Indian legal framework as given in Table 2.

Table 2 - Indian Standard Drinking Water Specification (BIS 10500: 1991) [20]

SUBSTANCE / CHARACTERISTIC	REQUIREMENT (DESIRABLE LIMIT)	PERMISSIBLE LIMIT IN THE ABSENCE OF ALTERNATE SOURCE
Colour, (Hazen units, Max)	05	25
Odour	Unobjectionable	Unobjectionable
Taste	Agreeable	Agreeable
Turbidity (NTU, Max)	05	10
pH Value	6.5 to 8.5	No Relaxation
Total Hardness (as $CaCo_3$) mg/lit. Max	300	600
Iron (as Fe) mg/lit, Max	0.3	1.0
Chlorides (as Cl) mg/lit, Max.	250	1000
Residual, free chlorine, mg/lit, Min	0.2	00
Calcium (as Ca) mg/lit, Max	75	200
Copper (as Cu) mg/lit, Max	0.05	1.5
Sulphate (as SO_4) mg/lit, Max	200	400
Nitrate (as NO_3) mg/lit, Max	45	100
Fluoride (as F) mg/lit, Max	1.9	1.5
Phenolic Compounds mg/lit, Max.	0.001	0.002
Mercury (as Hg) mg/lit, Max	0.001	No relaxation
Cadmiun (as Cd) mg/lit, Max	0.01	No relaxation
Selenium (as Se) mg/lit, Max	0.01	No relaxation
Arsenic (as As) mg/lit, Max	0.05	No relaxation
Cyanide (as CN) mg/lit, Max	0.05	No relaxation
Lead (as Pb) mg/lit, Max	0.05	No relaxation
Anionic detergents (as MBAS) mg/lit, Max	0.2	1.0
Chromium (as Cr^{6+}) mg/lit, Max	0.05	No relaxation
Mineral Oil mg/lit, Max	0.01	0.03
Pesticides mg/l, Max	Absent	0.001
Alkalinity mg/lit. Max	200	600
Aluminium (as Al) mg/l, Max	0.03	0.2
Boron mg/lit, Max	01	05

Table 3 – European Union Guidelines

PARAMETER	SYMBOL/FORMULA	PARAMETRIC VALUE (mg/l)
Acrylamide	C_3H_5NO	0.0001
Antimony	Sb	0.005
Arsenic	As	0.01
Benzene	C_6H_6	0.001
Benzo(a)pyrene	$C_{20}H_{12}$	0.00001
Boron	B	1.00
Bromate	Br	0.01
Cadmium	Cd	0.005
Chromium	Cr	0.05
Copper	Cu	2.0
Cyanide	CN	0.05
1,2-dichloroethane	$ClCH_2CH_2Cl$	0.003
Epichlorohydrin	C_3H_5OCl	0.0001
Fluoride	F	1.5
Lead	Pb	0.01
Mercury	Hg	0.001
Nickel	Ni	0.02
Nitrate & Nitrite	NO_3, NO_2	50 & 0.50
Pesticides & Pesticides - Total		0.0001 & 0.0005
PAHs	$C_2H_3N_1O_5P_{1\ 3}$	0.0001
Selenium	Se	0.01
Tetra and Trichloroethene	C_2Cl_4/C_2HCl_3	0.01
Trihalomethanes - Total		0.1
Vinyl chloride	C_2H_3Cl	0.0005

INDICATOR PARAMETERS

PARAMETER	SYMBOL/ FORMULA	PARAMETRIC VALUE
Clostridium perfringens (including spores)		0/100 ml
Conductivity		2500 µS/cm @ 20°C
Hydrogen Ion Concentration	$[H^+]$	≥ 6.5 and ≤ 9.5
Iron	Fe	0.2 mg/l
Maganese	Mn	0.05 mg/l
Oxidisability		5.0 mg/l O_2
Sulfate	SO_4	250 mg/l
Sodium	Na	200 mg/l
Coliform bacteria		0/100 ml
Total organic carbon (TOC)		No abnormal change
Total indicative dose		0.10 msv/year

MICROBIOLOGICAL PARAMETERS

PARAMETER	PARAMETRIC VALUE
Escherichia coli (*E. coli*)	0 in 250 ml
Enterococci	0 in 250 ml
Pseudomonas aeruginosa	0 in 250 ml
Colony count 22°C	100/ml
Colony count 37°C	20/ml

Council directive 98/83/EC on the Quality of Water (Chemical Parameters) intended for human consumption as adopted by the European Union on 3rd November 1998 ADOPTED BY THE EUROPEAN UNION, ON 3rd NOVEMBER 1998 is given in Table 3 above.

Comparison of certain recurring parameters in all the above mentioned standards is given in Table 4 below.

Table 4 – Comparison among Standards

PARAMETER (mg/l)	WHO	INDIAN STANDARDS	EUROPEAN UNION
Cyanide	.07	.05	.05
Chromium	.05	.05	.05
Copper	2	1.5	1.5
Iron	.5	1.0	.2
Lead	.01	.05	.01
Manganese	.4	.3	.05
Mercury	.006	.001	.001
Selenium	.01	.01	.01

The guidelines present a varied picture. Certain parameters in Indian standards are stricter like Cu (compared to both), Cyanide (compared to WHO), Cu (compared to WHO), Mn (compared to WHO), Mercury (Compared to WHO) and in certain parameters it is relaxed like Fe (compared to both), Pb (compared to both), Mn (as compared to EU). But over all it can be seen that both EU and Indian government impose stricter standards when it comes to drinking water. This displays our commitment towards ensuring a better quality of water to out citizens and is commendable, but the responsibility does not end here. The real work which needs done if the proper enforcement of these standards which is a difficult task. The guidelines imposed by the countries are influenced by considerations like economic expenditure and planning. However, on certain critical issues, one which involves potable water, as well as aquatic life and the environment as a whole should not be restricted to a research exercise. We do not need to find out what needs to be done, because that is what has been overdone, we need to proceed to the next step implementation, which requires initiative, dedication, perseverance and consciousness.

CONCLUSION AND ACTION PLAN [21]

There have been lots of strategies and plans that have been made and a lot of gone in the cold bag. The need of the hour is not another plan but implementation of the existing plans. The government has shown the greatest enthusiasm in undertaking the formation of committees which make reports and more reports. These reports have been published. Guidelines have been issued, ordinances have been passed and that is all which has effectively been done. If we need the problem of this grave danger to be solved we need to take action, and for that total reliance on government will not help. We have to take matters in our hands and start contributing in our own way. The reason that UN guidelines have been mentioned is not that we need to ape the west and follow their way of combating the problem. But they understand the problem at a more comprehensive level and have undertaken a greater level of research than us. We can have our own researches and then come to the standards our kind of country requires and then take action accordingly. And that appears a more suitable way to many since each country has different relief, availability of resources, pace of development, priorities and then subsequent plan. It makes sense if we wish to follow our own way, our own graph towards the solution. The only requirement is an imminent action and its implementation. It will only worsen matters if we keep sitting on the already aggravating problem. Guidelines for the Millennium Development Goals [22] are as follows.

Action 1: *Governments and other stakeholders need to move the sanitation crisis to the top of the agenda.*
Action 2: *Countries must ensure that policies and institutions for water supply and sanitation service delivery, as well as for water resources management and development, respond equally to the different roles, needs, and priorities of women and men.*
Action 3: *Governments and donor agencies must simultaneously pursue investment and reforms for improved water supply, sanitation, and water management.*
Action 4: *A focus on sustainable service delivery, rather than construction of facilities alone, must be at the center of efforts to reach Targets.*
Action 5: *Governments and donor agencies must empower local authorities and communities with the authority, resources, and professional capacity required to manage water supply and sanitation service delivery.*
Action 6: *Governments and utilities must ensure that users who can pay do pay in order to fund the maintenance and expansion of services– but they must also ensure that the needs of poor households are met.*
Action 7: *Governments and their civil society and private sector partners must support a wide range of water and sanitation technologies and service levels that are technically, socially, environmentally, and financially appropriate.*
Action 8: *Institutional, financial and technological innovation must be promoted in strategic areas.*
Action 9: *The United Nations system organizations and their Member States must ensure that the UN system and its international partners provide strong and effective support for the achievement of the water supply and sanitation target and for water resources management and development.*

Another factor in addition to the plans mentioned is that we need better equipment and continuous up gradation of the existing ones. These measures taken not only help the mankind in general by giving better health but also provide better water management techniques to prevent a water shortage. This can be achieved by large scale investments in new recycling and conservation technologies as mentioned in examples below.

Recycling Technologies

- *The "Deep Pond System" in Hyderabad treats 37,854 liters of wastewater per day* [23].
- *"Forward Osmosis Desalination" reduces the cost of desalinating water and the quantity of brine discharged* [24].
- *Implementation "Metal-Mediated Aeration Process" for purification of water is more economical than existing water treatment methods* [25].
- *Implementation "Ostara reactor" increases the effective capacity of wastewater treatment plant and also initiates fertilizer production* [26].

Conservation Technologies

- *EcoTech provides a technology based solution to water measurement and management* [27].
- *"Varsha, the Rain Gun" –micro-irrigation equipment helps conserve irrigation water by up to 50%* [28].

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