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Sustainable development and ground water depletion in India: A conceptual study

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Abstract
Globalization has made India more business-oriented than society-oriented. Thus, environmental problems do not get priority from the policy makers. India is suffering from ground water crisis from a long period of time. Free water results in wastage and water-pricing brings objection from the political domain. In this critical juncture, this paper aims to assess the probable role of India in solving the problem.

Keywords: Globalization, ground water crisis, sustainable development

Introduction

The concept 'Sustainable Development' comprises of two words namely sustainable & development. The basic idea that has been gathered over the years on sustainable development is that a holistic approach to be taken for overall improvement of mankind without undermining the importance of environment and without compromising the rights of future generation on natural & human-made resources. However the academic idea may lose its importance & direction in real life. Further, approach to sustainable development may vary from country to country & even from one locality to another locality. International as well as domestic politics play a pivotal role in shaping the allocation of natural resources and human capital for production of goods & services. Corporate lobby also influences Governments on decision-making on environmental issues sighting cut-throat completion & immediate gain. Countries stand on different position of growth path & hence their response to environmental protection differs to a great extent. Sustainable development needs a huge funding specially flow of wealth from developed countries to developing countries. It may not be possible taking into consideration domestic requirements of the developed countries and sighting political differences among different countries. Again, basic development indicators, say population density, education level, gender equality etc. influence achievement of sustainable development goal of every country.

Today we live in a globalized world. Each & every country competes with another regarding attraction of foreign direct investments. India liberalized its economy in 1991 under the leadership of the then Finance Minister of India, Dr. Manmohan Singh. The basic idea of liberalization was that to convert India from a agriculture dominant economy to an industrialized nation and also to take advantage of free trade with the rest of the world. This process of industrialization & consumerism are expected to unleash enormous pressure on natural resources of India. This article attempts to study sustainable Development in India from the perspective of groundwater.

Objective of the study

This article attempts to study availability of ground water in India amidst globalization and also after taking the call of sustainable development.

Methodology of the study

This is a theoretical based research work. Information collected from research works published in journals mostly via internet.

Limitation of the study

This article is based on secondary information. It is a theoretical study. Information has been collected mostly via internet. Reliability of this information is questionable.

Scope for further study

Mathematical model based research work based on field study & theoretical work would enhance quality of knowledge in this segment.

Review of literature

Water is one of the most essential natural resources and it is likely to become critically scarce in the coming decades due to continuous increase in its demands, rapid increase in population and expanding economy of the country [1]. Variations in space and time are responsible are responsible for uneven distribution of precipitation in India [1]. This uneven distribution of the precipitation results in highly uneven distribution of available water resources both in space and time, which leads to flood and drought [1]. Presently, India is facing a decrease in available water resources that has implication on India's agriculture sector [2]. Several regions in the country are experiencing water stress [2]. If water use efficiency does not improve, the country could suffer water scarcity in the next 1 to 2 decades [2]. India faces a turbulent water future [3]. The current water development and management system is not sustainable: unless dramatic changes are made-and made soon in the way in which Government manages water, India will have neither the cash to maintain and build new infrastructure, nor the water required for the economy and for people [3].

One in nine people do not have access to clean water close to home and just two thirds of the world's population-4billion-live in areas of physical water scarcity, where for at least part of the year demand exceed supply [4]. Water Scarcity exists for two reasons [4]. Physical scarcity means there isn't enough water to go around [4]. Socio economic scarcity means there is water present, but it isn't available to

all because of lack of investment and political will [4]. This paper reveals some important information related to India as depicted below [4]:

Country	Population living with water scarcity during at least one part of the year	National Water Footprint (Litres per person per day including Virtual)	% of water from inside the country/% imported
India	1 billion	3,000	97/3

a. Table Showing India's water footprint etc [4]:
b. United Kingdom imports nearly 7% of its virtual water from India [4].
c. India's rate of ground water depletion increased by 23% between 2000 and 2010 [4].
d. India is the third largest exporter of ground water-24% of the global water [4].
e. 600 million people live in areas of high to extreme water stress [4].
f. 88% of households have clean water close to home [4].
g. 75% of households do not have drinking water on the premises [4].
h. 70% of drinking water is contaminated [4].

Another study reveals opposite views [5]. It is encouraging to see the initiatives undertaken by the Government of India in terms of the National Water Mission, the National Water Policy, the formation of the unified Jal Shakti Ministry and various schemes such as the Nal Se Jal and Swajal Schemes for water supply in urban and rural areas, the Ganga Rejuvenation Scheme and the R & D Program in Water Sector [5]. Leveraging these policies, all the concerned stakeholders-both public and private need to come together to set up and execute a unified action plan to reach the goal of an efficient water management [5].

A corporate water risk and sustainability framework for quantification and analysis of water risks within organizations and their supply chains need to be developed [6]. Thus in addition to qualitative water accounting in the supply chains, quantification of water use and impact is the necessary step which would establish a decision making and management framework for water risk reduction and over the long term successful engagement of the stakeholders in accurate sustainability reporting and disclosure [6].

In water stressed parts of India irrigation pumps extract water from aquifers 24 hours a day for wealthy farmers, while neighboring smallholders depend on the vagaries of the rain [7]. High- income households use far more water than poor households [7]. In Mumbai, per capita water use is 15 times higher in high-income suburbs linked to the utility than in slum areas [7]. However, in aggregate the world is on track for the target for water largely because of strong progress in China and India, but only two regions are on track for sanitation (East Asia and Latin America) [7].

Economic instruments such as increasing water tariffs have acted very positively in rationalizing the behavior of water users thereby reducing substantial water consumption (unnecessary waste of water) in cities [8]. This has positive impacts on the water supply agency as well as households to rationalize their thinking [8]. On the one hand, reduction in water consumption helps in conserving water and meeting water supply needs in all areas, and reduces water uncertainty and accessibility; on the other hand, increased revenue collection helps to build new infrastructure and also maintain existing water networks [8]. The Government has shown the greatest enthusiasm in undertaking the formation of committees which make reports and more reports [9]. These reports have been published. Guidelines have been issued, ordinances have been passed and that is all which has effectively been done [9]. A generic and long standing problem in the area of education in water resource management in India is the disconnection between University education and professional requirements [10]. Despite all State run programmes there are 76 million people who do not have access to safe drinking water in India today [11]. Over 68,000 children die every year from diarrhea by unsafe water and poor sanitation in India [11]. 2300 people die every day from water-related diseases [11]. The 'Har Ghar Nal' (Tap for every House) programme by the Government has set an ambitious aim to have 70 per cent coverage by the end of 2017, wherein the current coverage is limited to 17 percent as per Government data [11]. Currently, nearly 77.5% of rural habitants are being provided with 40 litres of drinking water per capita on a daily basis [12]. Water availability per person is dependent on population of the country and for India, per capita water availability in the country is reducing due to increase in population [13]. The average annual per capita water availability in the years 2001 and 2011 was assessed as 1816 cubic meters and 1545 cubic meters respectively which may further reduce to 1486 cubic meters in the year 2021 [13].

Groundwater and surface water are thus the two sources of water available for human consumption [14]. Over the years due to swelling population, increasing industrialization and expanding agriculture, the demand for water has multiplied [14]. It is evident from the table given below that the per capita availability of water reducing progressively from 1816 cubic meters 2001 to 1545 cubic meters as per the 2011 census [14]. On the other hand it has been estimated that the per capita water use in India will increase from the current level of 99 litres per day to 167 litres per day in 2050, so the gap becomes widening day by day [14].

Table: Per capita water availability in India [14]

Year	Population (Million)	Per capita water availability (m^3/year)	% change from previous year
1951	361	5177	-
1955	395	4732	-8.59
1991	846	2209	-53.31
2001	1027	1816	-17.92
2011	1210	1545	-14.92
2025	1394	1341	-26.37
2050	1640	1140	-14.98

Water is a vital yet extremely limited commodity of strategic value for India [15]. The magnitude of India's internal water scarcity and mismanagement problems pose serious and worsening security challenges of national concern for the rising power [15]. Indeed, India's water resources shortage and management deficiencies have the unintended consequence of fostering domestic frictions over water availability and between water resource consumers [15]. When viewed in the wider context of India's external relations with Pakistan and China—which both have equally serious and worsening water issues—it is evident that water availability is a strategic issue for all three [15]. It is also

apparent that India's increasing water security requirements have the potential to intensify trans-boundary competition for access to more safe water, thereby increasing the odds of exacerbating existing Indo-Pakistani and Indo-Chinese tensions [15]. Given the impact that any solution to India's water problems is likely to have on Pakistan, and in the absence of proper water-sharing mechanisms with thirsty China, India's water security is a matter of regional as well as national concern [15].

The most important lesson that emerges out of the foregoing discussion is that technological initiatives to improve the drinking and irrigation water supply have to be duly complimented by grassroots people's participation in management of water distribution [16]. The decentralized community managed water supply programme in Gujarat has proved to be an emulative model for the entire country [16]. Another very significant lesson is the balanced importance that has been given to both micro-water harvesting and large water resources development projects, leading to unprecedented agricultural growth in the State [16]. Increased water availability and reduction in consumption of conventional power has also led to a reduction in the carbon footprint of water supply, further promoting the development of a low carbon economy in the State [16].

Theoretical discussion

Water is the symbol of life & civilization. Water is required for primarily five purposes etc. drinking, sanitation, irrigation, industry & energy. India is not a water rich country. India gets rainfall mainly in the name of monsoon for four months spread disproportionately over its vast geographical terrain.

India accounts for about 17% of the world's population but only 4% of the world fresh water resources [2]. Distribution of these water resources across the vast expanse of the country is also uneven [2]. India has entered the era of globalization with other countries of the world. India is becoming more industrialized with the passage of time during this tenure of globalization. As India is getting changed from an agriculture driven economy to industry & service sector driven economy, its water requirement is also changing.

Surveys conducted by the Tata Institute of Social Sciences (TISS) showed most of urban cities are water deficient [2]. Nearly 40% of water demand in urban India is met by ground water [2]. As a result ground water tables in most cities are falling at alarming rate of 2-3 meters per year [2]. It is happening at a time when India is striding forward for more urbanization & study shows that more people would start living in Indian cities [17]. According to the 2011 Census, the urban population grew to 377.1 million as compared to 286.1 million in 2001 census showing a growth of 2.76 percent per annum during 2001-2011 [17]. The level of urbanization in the country as a whole increased from 25.7 percent in 1991 to 27.82 percent in 2001 and to 31.14 percent in 2011 – an increase of 3.3 percentage points during 2001-2011 compared to an increase of 2.1 percentage points during 1991-2001 [17].

Population of India is still increasing and thus projects gradual decrease of per capita water availability in India [Review of Literature]. Alarmingly, according to different studies, India is becoming more dependent on ground water for agriculture (Table 1 & Table 2). Although ground water gets replenished by precipitation but overdependence on ground water may cause a serious problem for future generations & thus cause a problem for achievements of sustainable development goal of India. It is worth to be mentioned that income from agriculture in India is showing steady decrease since Independence. At the same time study shows more water would be required in other areas namely drinking, industry, energy etc. It is to be noted that quantum of total water requirement would increase significantly over time but only the proportionate demand for irrigation would decrease (Table 3). Keeping in view the rising effect of global warming & irregular rainfall it would be a Himalayan tough task for Indian Government to arrange additional water requirement in future.

Although pessimistic views have projected a very grim future on water scarcity in India but this projection may change easily with prudent use of technology, manpower & resources. The time has come to respond in a holistic & democratic manner taking all stakeholders in confidence.

Table 1: Net irrigated area by source in India (in percentage)

Year	Canals			Tanks	Tube wells	Other wells	Other sources
	Government canals	Private canals	Total				
1950-51	34.33	5.45	39.78	17.33	-	28.67	14.22
1951-52	35.58	5.67	41.25	16.57	-	30.96	11.22
1952-53	35.56	6.39	41.95	15.64	-	30.88	11.53
1953-54	34.50	6.01	40.51	19.93	-	30.57	9.59
1954-55	35.45	5.59	41.04	18.22	-	30.45	10.29
1955-56	35.25	5.98	41.23	19.43	-	29.61	9.73
1956-57	35.14	6.02	41.16	19.94	-	29.14	9.76
1957-58	35.85	5.82	41.67	19.59	-	29.44	9.30
1958-59	35.86	5.47	41.33	20.34	-	28.57	9.76
1959-60	36.64	5.43	42.07	19.26	-	29.46	9.21
1960-61	37.19	4.87	42.06	18.50	0.55	29.01	9.88
1961-62	37.54	4.67	42.21	18.54	1.04	28.51	9.70
1962-63	37.75	4.47	42.22	18.63	3.51	26.30	9.34
1963-64	38.09	4.48	42.57	17.76	3.97	26.10	9.60
1964-65	37.89	4.30	42.19	17.97	4.09	26.27	9.48
1965-66	37.43	4.17	41.60	16.17	4.91	27.94	9.38
1966-67	37.98	3.81	41.79	16.44	6.34	27.83	7.60
1967-68	37.86	3.49	41.35	16.52	7.77	25.74	8.62
1968-69	37.87	3.13	41.00	13.53	10.64	26.59	8.24

1969-70	38.82	2.92	41.74	13.44	12.38	24.63	7.81
1970-71	38.50	2.78	41.28	13.22	14.34	23.88	7.28
1971-72	38.81	2.76	41.57	11.84	15.04	23.88	7.67
1972-73	38.12	2.71	40.83	11.37	16.94	23.79	7.07
1973-74	37.47	2.67	40.14	11.98	17.22	23.59	7.07
1974-75	37.55	2.54	40.09	10.51	19.53	22.68	7.19
1975-76	37.39	2.48	39.87	11.48	18.92	21.97	7.76
1976-77	37.03	2.41	39.44	11.10	21.14	21.78	6.54
1977-78	37.58	2.30	39.88	10.68	20.91	21.73	6.80
1978-79	37.58	2.22	39.80	10.34	21.44	21.73	6.69
1979-80	36.17	2.19	38.36	9.04	24.16	22.21	6.23
1980-81	37.32	2.17	39.49	8.22	24.62	21.08	6.59
1981-82	38.16	1.21	39.37	8.34	25.52	20.75	6.02
1982-83	38.62	1.22	39.84	7.22	26.47	21.08	5.39
1983-84	38.84	1.12	39.96	8.42	26.04	20.19	5.39
1984-85	37.50	1.12	38.62	7.17	27.44	20.94	5.83
1985-86	37.53	1.11	38.64	6.60	28.43	20.34	5.99
1986-87	37.68	1.07	38.75	6.29	28.89	20.02	6.05
1987-88	35.64	1.07	36.71	5.88	30.74	20.08	6.59
1988-89	36.06	1.00	37.06	6.49	29.72	20.58	6.15
1989-90	35.64	1.02	36.66	6.30	30.08	21.06	5.90
1990-91	35.35	1.00	36.35	6.13	29.69	21.73	6.10
1991-92	34.74	0.93	35.67	6.00	30.42	21.79	6.12
1992-93	32.81	0.96	33.77	6.32	31.44	22.08	6.39
1993-94	32.44	0.94	33.38	6.17	31.90	21.85	6.70
1994-95	31.70	0.91	32.61	6.18	32.43	22.12	6.66
1995-96	31.01	1.05	32.06	5.84	33.54	22.07	6.49
1996-97	30.65	0.40	31.05	5.12	35.09	22.60	6.14
1997-98	31.13	0.38	31.51	4.70	35.65	22.52	5.62
1998-99	29.77	0.37	30.14	4.87	37.25	21.95	5.79
1999-00	29.98	0.34	30.32	4.41	38.31	21.90	5.06
2000-01	28.59	0.37	28.96	4.45	40.94	20.42	5.23
2001-02	26.34	0.37	26.71	3.84	40.83	20.98	7.64
2002-03	25.63	0.38	26.01	3.35	43.58	20.26	6.80
2003-04	24.87	0.36	25.23	3.36	43.03	20.85	7.53
2004-05	24.45	0.36	24.81	2.93	38.94	20.54	12.78
2005-06	27.00	0.37	27.37	3.43	39.23	20.13	9.84
2006-07	26.68	0.36	27.04	3.32	39.50	20.57	9.57
2007-08	26.11	0.34	26.45	3.12	41.74	19.07	9.62
2008-09	25.95	0.31	26.26	3.13	41.16	19.88	9.57

Source: www.indianstatistics.org, Statistics on Indian economy and society

Table 2: Net irrigated area by source in India (in percentage)

Source	2005-06	2010-11
Canals	27.35	26.19
Tanks	3.86	3.48
Wells	16.84	18.46
Tube wells	43.57	45.17
Other sources	8.38	6.70

Source: All India report on agriculture census 2010-11, Agriculture census division, Department of agriculture, Cooperation & Farmers welfare, Ministry of agriculture & Farmers welfare, Government of India, 2015.

Table 3: Water requirements for various sources [Source: National commission on integrated water resources development (NCIWRD)] [14]

Sources	2010		2025		2050	
	Water demand in KM^3 (or bcm)	Percentage (%)	Water demand in KM^3 (or bcm	Percentage (%)	Water demand in KM^3 (or bcm	Percentage (%)
Irrigation	557	78.45	611	72.47	807	68.39
Drinking	43	6.06	62	7.35	111	9.41
Industry	37	5.21	67	7.95	81	6.86
Energy	19	2.68	33	3.91	70	5.93
Others	54	7.60	70	8.32	111	9.41
	710	100.00	843	100.00	1180	100.00

Conclusion

It can be concluded with certainty that ground water in India is getting depleted at a rapid pace. Water is natural resource and it is available good quantity in India. To the contrary irrational & unplanned use of both surface & ground water may create a serious problem for a significant proportion of

Indians in near future. Water is already scarce in some States of India. Water pricing is a huge problem in India. It has been observed that due to political lobby water pricing has failed in many States. Free water also causes of wastage & irrational usage. Government initiative is visible but at the same they are not sufficient to achieve sustainable goals. India needs to invest huge funding for maintenance, rebuilding & replacements of already crumbling age-old water system. Obviously additional funding would be required for constructing new facilities. India's already strenuous relations with neighbors like China & Pakistan may get worsen due to water issue.

Recommendation

Formulation of rules and allocation of funding has already failed to solve water problems in India. It is recommended to take a strategy of participative management where people can play a significant role. Water pricing is very important for raising funding but keeping in view the level poverty in India, it is recommended that a differential pricing system needs to be developed where the people living below poverty level may be completely excluded from water pricing. Water Census may be started all over India & the report of the same may be available to public for ensuring transparency. Population control is essential in order to ensure water rights of future generations. Government must ensure adequate supply of quality water to the urban poor & rural poor. Rain water harvesting may become useful tool to combat falling level of ground water & hence it is recommended that suitable enforceable law may be formulated for this purpose. Government must take proper initiatives for creation of awareness programme which may include induction of water issue in the curriculum of schools, creating an atmosphere of dialogue with people at Panchayet (lowest political level), level, with the people living in the urban slums, discussion in the Parliament & the Assemblies etc.

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