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Research Article

Challenges of sustainable development in terms of water, ecosystem and society – a chemists' vision

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Abstract

The first most basic, simplest but unique chemical i.e. water, the cradle of life, of this blue planet i.e. earth, is now in danger. In the current global scenario, water, ecosystem and sustainable development of the society are intrinsically linked and interdependent. In our country (India) the management of water sources is concerned only upto quantitative management where as the qualitative aspect is almost ignored. Conventionally quality management of water resources in the country has been dealt under separate disciplines of chemistry, engineering, geology, ecological sciences and policy studies. This article discusses the various components that impact water management in relation to ecosystem and society and also the causes, challenges and remedial measures for the maintains of safe and green water ecosystem for society and whole living environment which is facing the risks of different health hazards of various water contaminations.

Key Word: Sustainable Development, qualitative management, Pesticides, socio-economic development

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INTRODUCTION

Water, a basic necessity of life is needed for drinking, domestic uses, for irrigation of crops, production of different goods and for recreation purposes. Global studies show a challenging future and a chaotic view when considering total use and water availability, in third millennium. Most Asian countries will have severe water problem by the year 2025. Over 2 billion people, or half of the world population have suffered from diseases due to drinking polluted water. More than 250 million new cases of water borne diseases are reported each year, resulting in more than 10 million deaths and nearly 75% of these water borne disease cases occur in tropical areas. WHO in one of their surveys have estimated that 80% of deaths of infants in rural areas of developing countries including India, are due to water borne diseases. More so, in a vast distributed, multicultural society of India where high rates of mortality and morbidity due to water borne diseases are well known, without adequate supply and scientific management of water resources sustained socio-economic development is difficult to achieve to meet the needs of the fast growing population, agriculture and rising industrial production sectors is deeply affecting the water ecosystem of the nature. The need of high productivity in agriculture, the use of hazardous chemicals in the form of pesticides is very high. Such indiscriminate and heavy use of pesticides has deeply contaminated the surface as well as groundwater regime of the hydrosphere, which in turn affected the food grains, dairy products, fruits, vegetables, fodders, horticulture land and living environment (Society) as a whole.

Water Quality and National Water Policy:

Enhancing the quality of life of the unserved and underserved by meeting their basic needs are the central concern of our development process. Water is one of the three (air, water and food) most basic needs for the survival of human beings. There is a needs of realization that along with quantity, quality of water is most vital factor. WHO study have

revealed that almost 80% of the sickness by which our people suffer and 30% of the death particularly the high infant mortality in the developing countries are attributable to unsatisfactory quality of water. Safe water is defined as the water, that is free from pathogenic micro-organisms, poisonous substances, excessive amount of minerals and organic matter which would produce undesirable physiological effects. It should be free from colour, turbidity, taste and odour and of moderate temperature and aerated. To provide assured quality of drinking water in adequate quality. Govt. of India has taken up measures during last decade. The National Water policy approved and adopted in 1987 under the chairmanship of the Prime Minister states. Adequate drinking water Facilities to be provided to the entire population both in urban and rural areas by 1991. Irrigation and multipurpose project should invariably include a drinking water component. Wherever there is no alternative source of drinking water drinking water needs of human- being and animals should be the first charge on any available water and both surface water and ground water should be regularly monitored for quality. A phase programme should be undertaken for improvement in water quality.

Drinking Water Standards: Adopted under National Water Policy-

The saints have said, water is nectar, water is life and given directions to maintain its purity. A number of factors enter into the choice of a best available raw source water for drinking water supply. The source water quality in most tropical areas differs from that of temperate areas in 3 major ways: Physical and chemical, Biological and Social and economic. To monitor drinking water supply on sustain basis water quality standards have been laid down by WHO at international level and by different countries at their respective national levels. In India water quality standards have been laid down by Ministry of Health (ICMR), BIS, ISI and Ministry of Works and Housing (CPHEEO). The quality of water definced by the standard values is such that it is suitable for human consumption and for all usual domestic purposes, including personal hygiene.

Water Quality Upgradation and Assurance:

The first step in developing standards, it is essential to establish scientifically based recommendations for each assignable use of water. Establishment of recommendations implies access of practicable methods for detecting and measuring the specific physical, chemical, bacteriological, biological and aesthetic characteristics. Majoriry of water quality problems are related to bacteriological or other biological contamination, although a significant number of very serlous problem may occur as a result of chemical contamination of water sources as that of fluoride and arsenic contamination in certain pockets of our country. In upgradation of drinking water quality related to bacteriological contamination following points should be considered: source, quality, surveillance and control sanitary inspection, collection of water sample, bacteriological analysis, determination of residual chlorine, remedial and preventive measures, community education and movement. To control drinking water quality, surveillance is to be enforced. The surveillance means keeping of a careful watch at all times, from the public health point of view, over the safety and acceptability of drinking water supply. Surveillance requires a continuous and systematic programme of surveys carried out at different points of water distribution sustem. A surveillance programme aimed at ensuring a consistently acceptable level of drinking water quality. If it is to be fully effective may also require legislation supported by regulatory standards and codes of practice. However, in developing countries many of which lack adequate community water supplies and in particular in the rural areas and urban squatter settlement of such countries, surveillance should take into account local conditions and be adopted to the levels of economic and manpower development. Monitoring of water quality is required to undertake at village, district, state and regional levels in order to eradicate and control water borne diseases and ensure safe water supply. Physical, chemical, bacteriological and radiological tests wherever necessary are undertaken for following parameters-

Examination	Parameters
Physical	Colour, odour, taste, turbidity, pH, conductivity and total dissolved salts
Chemical	Organic compounds, inorganic salts and metals
Bacteriological	Faecal indicators, sulphate reducing bacteria, iron bacteria and different worms
Radiological	Naturally occurring Sr and Ra

Table 1: Drinking and Domestic Water Quality Standard Values

(Laid-down by BIS, ISI, ICMR and WHO)

Parameters	BIS (1991)		ISI (1993)		ICMR (1995)		WHO (1998)	
	Permissive	Excessive	Permissive	Excessive	Permissive	Excessive	Permissive	Excessive
Colour	–	–	Unobjectionable	–	Unobjectionable	–	Unobjectionable	–
Odour & Taste	Disagreeable	Nothing	Disagreeable	Nothing	Unobjectionable	Nothing	Disagreeable	–
Temperature (^{0}C)	–	–	–	–	–	–	–	–
Turbidity (NTU)	10.0	250	–	–	5.0	25.0	5.0	25
pH	6.5 – 8.5	9.0	7.0	8.5	7.0 - 8.5	8.0 - 9.2	6.5 - 8.5	6.5 - 9.2
EC (µS/cm)	400	–	750	2250	300	750	–	–
Salinity	–	–	–	–	–	–	–	–
TDS	500	2000	500	1500	500	1500	500	1000
Total Alkalinity	172	400	200	400	–	–	120	–
Total Hardness	300	600	300	600	300	600	300	500
Fluoride (F^-)	0.6	1.5	0.7	1.5	1.0	1.5	0.8	1.5
Chloride (Cl^-)	250	1000	250	1050	200	1000	250	600
Nitrate (NO_3^-)	45	100	50	80	20	50	10	45
Sulphate (SO_4^{-2})	150	400	250	400	200	400	200	400
Phosphate (PO_4^{-3})	–	–	0.10	–	0.10	–	–	–
Sodium (Na^+)	25	75	–	–	25	80	20	75
Potassium (K^+)	08	12	–	–	–	–	5	10
Calcium (Ca^{+2})	75	200	–	–	77	200	75	200
Magnesium (Mg^{+2})	30	100	30	100	50	150	30	150
DO	5.0	–	–	–	4.0	6.0	6.0	–
BOD	3.0	5.0	2.0	5.0	2.0	5.0	5.0	–
Coliform (MPN/100 ml)	50.0	240	50.0	-	4.0	10.0	3.0	10.0

Note: [All values, Except Colour, Odour, Temperature, Turbidity, pH, EC and Coliform count, are in mg/l].

Table 2: Drinking Water Standards Regarding Toxic Substances

(Laid-down by WHO and ICMR)

Trace metal (ppm)	WHO 1984	WHO 1998	ICMR 2002	Effects
*Arsenic	0.5	0.05	0.2	Cancer
*Barium	1.0	-	-	Heart, Blood vassels and nerves
*Cadmium	0.01	0.005	-	Kidney
Copper	1.0-1.5	1.0	0.5-1.5	Large doses – liver damage
*Chromium	0.05	0.05	0.05	Cancer
*Cyanide	0.2	0.1	0.01	Biological activity and death
Iron	0.1-0.5	0.3	0.1-1.0	Colour and bad taste
*Lead	0.05	0.05	0.01	Lead poisoning
Manganess	0.1-0.5	0.1	0.1-1.5	Colour and bad taste
Mercury	-	0.001	-	Liver and Brain (CNS)
*Selenium	0.01	0.01	0.05	Cancer and dental caries
Silver	-	-	(USPHS,0.050)	Argyria (Skin and eyes)
Zinc	5-15	5	5-15	-
			*Toxic	

Table 3: WHO Guidelines for Aestnetics Related Substances

Substances	Value (ppm)
Aluminum	0.2
Chlorine	250.0
Copper	1.0
Hardness (as $CaCO_3$)	500.0
Iron	0.3
Manganese	0.1
pH	6.5-8.5
TDS	1.000
Sulphate	400.0
Turbididity, NTU	5.0
Zinc	5.0

Table 4: WHO Guidelines for Health Related Substances

Organics Substances	Value (ppm)
Alddrin and dieldrin	0.00003
Benezene, 1 , 2 – dichloroethane, pentachlorophenol, tetrachloroethane and 2, 4, 6 – trichlorophenol	0.01
Benzo – pyrene and hexachlorobenzene	0.00001
Carbontetrachloride and lindane	0.003
Chloroform	0.03
2,4, D (chlorophenoxy)	0.1
DDT	0.001
1,1-Dichloroethane	0.0003
Heptachlor and heptachlor epoxide	0.0001
Methoxychlor	0.03

Table 5: Environmental Classification of Water Related Infections

Category	Infection	Pathogenic Agent
Faecal-oral (water borne or water washed)	Diarrhoeas and dysenteries	P
	Amoebic dysentery	P
	Balantidiasis	B
	Campylobacter enteritis	B
	Chloera	B
	E. coli dilarrhoea	P
	Giardiasis	B
	Rotavirus dirrhoea	P
	Solmonollosis	V
	Shigellosis (bacillary dysentery)	B
	Yerainiosis	B
	Enteric fevers	B
	Typhoid	B
	Paratyphoid	B
	Polimyelitis	V
	Hepatitis A	V
	Leptospirosis	S
	Ascariasi S	H
	Trichuriasis	H
Water Washed Skin and Eye infections	Infectious skin diseases	M
	Infectious eye diseases	M
	Louse-borne typhus	R
	Louse- borne relapsing fever	S
Other Water Based penetrating Skin -ingested	Schistosomiasis	H
	Guinea worm clonorchiasis	H
	Diphyllobothriasis	H
	Fasciolopsiasis	H
	Paragonimiasis	H
Other Water related Insect vector biting near Water bodies	Sleeping sickness	P
	Filariasis	H
	Malaria	P
	River blindness	H
Mosquito –borne virusus	Yellow fever	V
	Dengue	V
	Other	V

NOTE: *B-Bacteria; P- Protozoan, S- Sphe. ; M-Miscellaneous; H-Helminth; R-Richettain; V-Virus*.

Water and Excreta Related Diseases

Water and sanitation related diseases have been found to remain in single most important cause of mortality and morbidity. Water related diseases may be divided into those caused by a biological agent of disease (a pathogen) and those caused by some chemical substances in water. The first group may be called the water related infections and may include some of the greatest causes of disease and death in the developing countries (for instance diarrhoeal diseases and malaria). These water related infections have 4 transmission routes, which are explained in table 5. The second group includes chemical related diseases, such as fluorosis (linked to high fluoride levels in drinking water) and infantile metheamoglobinaemia (related to high nitrate levels in drinking water). The latter groups are overwhelmingly overshadowed by the water related infections in the developing countries, but some of them are slowly gaining importance in India, particularly due to industrial developments and large scale pollution of surface as well as ground water. The arsenic contamination of ground waters in west Bengal, affecting large number of people, altered state and central Government authorities.

CONCLUSION

Almost all social and productive uses of water introduce pollutants into it. However, the principal burden on water quality comes from household (municipal waste), industry and agriculture. In our country assured drinking water supply even in all major cities cannot be guaranteed at every consumer and particularly in monsoon months, when some of the other areas suffer from water borne disease outbreaks. The present system is not fully geared to undertake quality assurance for entire population. In this massive efforts the water quality management (WQM) issue have not been addressed effectively. Due to in - efficient WQM, impact of such massive water supply input on health status in hardly visible. High mortality and morbidity of water born disease still continuing as a cause of our serious concern. The experience and learning from the various approaches so fair initialed as well as the existing information and knowledge are considered not reasonably adequate for evolving and developing such system. Need of an Applied Research which can help in acquiring practical in sight to the issue have strongly being felt. Evolving a long term strategy without carefully evaluating its impact may result to waste of resources without achieving desired result. It is proposed to carry out an applied research

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