IMPACT OF CLIMATE CHANGE ON INDIAN WATER RESOURCES

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Abstract: Paper attempts to discuss critical issues affecting human living in India, especially regarding availability of (contaminants-free) pure water, affecting vitality of life in urban and rural areas. Environmental changes following warming are responsible for depletion of water bodies. Its implication for safe water use by humans requires deeper probing. It is modern India’s bane that most of its inhabitants in urban and rural areas do not have access to safe water. Present generation is rather sandwiched between health and development paradox. Subject matter of human induced changes to environment and ecological balance is discussed intensely at various forums among intellectual and scientific community as also by others. Taking into consideration large volume of evidence gathered through research, scientists and researchers accept increase in atmospheric temperature, attributing it to indiscriminate use of fossil-fuels. Impact of warming is felt by people in different parts of the world. Paper attempts to debate conundrum for developing country like India that strives to accelerate its development programme.

Keywords: Global warming, climate change, GHGs, CO₂ emission, water resources

INTRODUCTION
Population in India has expanded rapidly during last century putting tremendous pressure on scarce natural resources. Environmental deterioration and ecological imbalance is also rapid.¹ Paper attempts to discuss issue of climate change on our depleting water resources. Indians are known to display a sort of ambivalent attitude towards water and water bodies. While we show reverence to water, as observed during religious ceremonies and folk customs on various family and community ceremonies, the attitude of people towards water and water bodies leaves much to be desired. Availability of safe drinking water is a priority as people’s health, hygiene, survival and above all wellbeing is directly linked to it. Konkani proverb suie vinnem konnachean xinvom nozo, udka vinnem konnachean tandum nozo (as stitching requires needle, for survival humans need water) signifies critical importance of water for humans. Availability of clean water is a human need and should be a right too. Scientists, intellectuals and academicians are increasingly discussing about climate change and environmental issues from global perspective as also analyzing policy changes put into force by various governments to positively address the issue. Public awareness about climatic change and its impact on day to day living is also increasing.
as it has serious implication on livelihood and survival of humanity. Following court directives environmental education is integrated into curricula at all levels in India so as to create genuine awareness about environmental concerns. As disaster scoffs at humanity, scientists and academicians in general and Intergovernmental Panel on Climate Change (IPCC) in particular are making a fervent plea for concerted action to hold, halt and positively reverse global warming and consequential climate change. In spite of efforts of capitalistic countries and big business, the Copenhagen Accord, in 2010, accepted need to contain global warming to below 2°C. Agreement was reached following protected negotiations and by accepting argument of developing world for fair play and sustainable development.

According to Richard L. Ottinger, (2010), Copenhagen Climate Convention acceptance to contain global warming to less than 2°C is very significant objective by any standard though there are doubts whether it can be realistically achieved in near future when nations are competing with each other to promote faster economic growth. It was indeed noteworthy that for first time most world leaders came to terms with reality of climate change. Most leaders, in fact even quoted from IPCC scientific reports on climate change and global warming, with a fervent plea for arresting alarming trend in order to save earth from havoc resulting from environmental disasters. M. Montini, (2011) states that from advent of twenty first century general mood at least overtly is to pursue ways and means to save humanity and ensure uninterrupted food production, safe water supply and pollution free environment. Surely, trends point that health and living is increasingly becoming focus of scientific community, academicians, research scholars and commoners as well.

The discomfort as a result of global climatic change is indeed high and scientists, economists, (urban) planners, decision makers, etc. are attempting relentlessly to examine and find strategies to deal with it. Worsening climatic conditions is also receiving attention of world leaders, media, activists, industrialists and ordinary citizens. The issue is addressed even in popular and folk media and vernacular press often. So everybody is aware of the issue as indicated by several international meetings and national level seminars and workshops sponsored by governmental and non-governmental organizations. However, there is more lip service than concrete actions on ground. Various deliberations are held and diplomatic initiatives undertaken in order to take progressive steps. Such moves conclude often in arriving at some give and take and pledges in form of conventions and treaties. Habitually at such meets promises are made and concessions or assistance assured to developing and underdeveloped countries. However, these promises usually remain largely unfulfilled and assured assistance hardly given in full, even when such countries suffer pangs of global climatic change not of their own making. Implementation of climate change mitigation policies in developing and poor countries is also at a very slow pace as financial and technological constraints are a major hindrance. Climate change is largely due to human developmental activity during last century. Developed and developing economies’ consumption of fossil fuels has over the last 3-4 decades increased manifold which results in incessant release in atmosphere of carbon dioxide (CO₂) a significant greenhouse gas. Besides, increasing vehicular use leads to emission of other gases like oxides of nitrogen, sulphur and carbon. Oxides of nitrogen and sulphur are responsible for causing acid rain. Vehicles running on engines burning fossil fuels
have lesser efficiency leading to waste of scarce resource. So using cleaner energy sources as CNG (compressed natural gas) and fuel cell technology in hybridized form could result in better outcome. Enhanced levels of GHG concentration will increase average temperature, influence precipitation in different regions and cause storms in some places and droughts in other areas with loss of lives, property and crops. As glaciers melt at a rapid pace hitherto unknown sea levels will rise putting at risk settlement along the coast and those living along river banks. At various places in India coastal communities are evacuated by government due to rise is sea level and loss of coastline. Coastal ecology is rapidly changing. For a country which has one of the longest coastlines in the world this does not portend well taking into consideration vast settlements along coasts and dependent on fishing and allied activities for a living.

If one scans through the annals of science journals and magazines it is clear that since advent of twentieth century there has been drastic changes in atmospheric temperature, rainfall patterns, evaporation, and other climatic conditions. This is a century known for two things: one is rapid industrialization of West, later followed by developing world, which has seen unprecedented and indiscriminate use and burning of fossil fuels. Secondly, twentieth century also witnessed not so infrequent wars causing large scale destruction in various parts of the world. So far no comprehensive study has been undertaken to gauge extent to which wars have contributed to global warming as a result of unwarranted and mindless destruction in various parts of the world. Climatic catastrophes are a recurrent feature in different parts of the globe affecting life and resources. R.K. Mall, Akhilesh Gupta, Ranjeet Singh, R. S. Singh, L.S. Rathore, in 2006, concluded that consequent to rapid pace of industrialization there has been a one-third increase of carbon dioxide in atmosphere, from about 280 parts per million by volume (ppmv) to about 369 ppmv over the last few decades. Due to this there is a 0.6°C rise in earth’s temperature. Taking into consideration economic growth and emissions at current levels it is estimated that average earth’s temperature will enhance from 1.4-3°C by end of current century. However, assessment for temperature increase is anticipated to be in range of 2.5-5.8°C, for a high emission level than current rate taking into consideration that BRICS (Brazil, Russia, India, China and South Africa) nations whose economies are in fact developing at faster rate will add vast volume of greenhouse gases, which fact cannot be overlooked. BRICS economies are rapidly expanding especially that of China and India and will continue to do so for quite some time. Earlier, in 1984, Titus and Barth while taking stock of the impact of warming on sea level rise had stated that there will be an associated rise in sea level anywhere between 0.09m to 0.88m. Due to global warming the ice caps in various parts of the world are melting at a faster rate and adding a vast volume of fresh water to sea water.

R.K. Mall, et.al., quoting from IPCC reports and other studies state that scientists who studied sea ice over a long period have estimated a considerable decline of about 40% in Arctic Sea ice cover from summer to early autumn for last over fifty years. While sustained studies are underway to gauge impact on Antarctica and recent reports do not indicate encouraging scenario. It is also observed that climate change brunt is faced by high mountain ranges. For instance, glaciers in Himalayas are observed to be fast diminishing. Glaciers in the Himalayas – third pole of the planet – are melting since 1850. Besides it is a known fact that atmospheric temperature in
Himalayan ranges has increased by about 1°C from 1970s. Recession of Himalayan glaciers is expected to continue in this century and IPCC had earlier reported that they are actually receding faster than other world glaciers, though there are recent corrections in its estimation. While Himalayan glaciers are generally in retreat, due to varying climatic and topographical conditions the recession is not uniform for all glaciers across Himalayan range. As glaciers melt at faster rate there are often floods in north Indian plains. Droughts in many parts of Indian sub-continent have also become regular phenomena. This is a densely populated region in the world and slight changes in climate have distressing impact on living and sustainable development.

Steady increase in atmospheric temperature over last century is an accepted fact. There is a shared agreement amongst scientific community that rise in atmospheric temperature is associated with indiscriminate burning of fossil-fuel as development and GDP (Gross Domestic Product) takes centre stage of world economies, instead of GNH (Gross National Happiness). However, scientists are not in agreement regarding magnitude and rate of future climate change. Developed countries have seized upon this and are hesitant to effectively deal with menace of climate change so as not to lose their prime position in world economy. However, even amongst developed countries there are two opinions. While some countries seek ‘rapid action’, others back ‘wait and watch’ policy till scientists and researchers come up with definite answer to intricate and complex problem of global warming.

Though scientific community is certain about the climate change there is a certain degree of uncertainty regarding extent to which greenhouse gases and aerosol concentrations are likely to vary or remain constant at current level as economies continue to grow. There is also an element of reservation as to extent to which climatic changes are either due to human activity or resulting from random atmospheric and ocean current changes. It is also said that volcanic eruption and changes in intensity of sun are also causing climate change in no small measure. This coupled with ambiguity regarding timelines of probable disastrous impacts requires a more flexible and proactive approach to looming natural disasters.

What is the pattern of climatic change in India? Several studies indicate increase in surface temperature following industrialization, population increase and urbanization, declining forest cover, mining, etc. For a country depending on monsoons for successful agricultural activity, it is a saving grace that there is no considerable change in rainfall pattern for the Indian sub-continent as a whole. However, at several places changes in rainfall pattern has been seen and reported. It is worth noting that developing countries like India are in a sort of bind regarding issue of climate change. Per capita energy consumption and release of CO$_2$ and other greenhouse gases in atmosphere by countries like India has been a fraction as compared to developed world. This being the case, now countries like India with one-sixth of world population, of which a significant section is below poverty line, is at receiving end of climate change impact. The social, technological and financial capability of developing countries for disaster awareness to events occurring as a result of climatic changes is not very encouraging. Taking this into consideration Copenhagen Green Fund (CGF) has been constituted to address developing world’s genuine concerns. Taking the
north-south divide into consideration developed world committed to give 30 billions dollars in 2010 and increase it to 100 billion dollars by 2020, to the developed world in order to help developing world align their economic growth trajectory in sync with science of climate control. At Copenhagen and at subsequent meets on climate change, it has been agreed to facilitate transfer of critical green technology to developing world too. However, development on this front is at a slower pace than expected.\textsuperscript{15}

\section*{DILEMMA FACED BY INDIA AND OTHER DEVELOPING COUNTRIES}

Developing countries are caught between the devil and deep sea. On one hand economic development is a prime requirement in order to lift maximum population above poverty line and on the other hand these countries are at receiving end of facing brunt of environmental disasters which are often not of their own making. Faced with such piquant situation, future of energy and environmental policies are debated intensely among policy makers and academics in these countries. Scientists and academics are of opinion that appropriate policy would be to have a balance between developmental goals and protection of climate, so as to concurrently advance both critical issues.\textsuperscript{16} This is easier said than done as trends indicate.

According to B. Sudhakara Reddy and Gaudenz B. Assenza, (2009), since the industrial revolution from 1750s, developing economies with 80\% of world population have contributed just a fifth to collective GHG emission. Having suffered pangs of colonial brunt for centuries most developing economies have started industrializing their economies only in post World War II period.\textsuperscript{17} Unlike developed world, these countries are releasing pollutants into atmosphere (though at an increasingly rapid rate) only from post-colonial period i.e. from 1950s. On other hand emission of pollutants by developed countries is from advent of industrial revolution in mid-eighteenth century.\textsuperscript{18} Developing countries like China, Brazil and India have per capita emission far less than world average. However, presently developing countries (mainly China and India) are witnessing substantial swell in emission, while that from developed countries is relatively at slower pace.\textsuperscript{19}

The scenario is fast evolving. BRICS countries itself have currently about half the world population. With their economies advancing at a higher rate consumption of goods and services is increasing in these countries with increasing pressure on scare resources. International Energy Agency (IEA) estimates that over two-thirds of total energy consumption in the world will be by developing economies by 2030.\textsuperscript{20} This is really alarming. Current scenario is that GHG emission of China is more than that of US. India is also likely to outpace Russia in GHG emission to take third position. Presently over 50\% of total emission in the world is coming from less developed countries, largely due to use of outdated technology. By end of this century it is presumed that current developed world will contribute only one-fourth of total emissions. Even if we presume that GHG emission in developed countries is reduced to zero and emission in developing economies continues at current rate than it would mean a scenario of world facing prospect of global warming of 3°C by end of 21\textsuperscript{st} century. Experts working with models that forecast future climate changes through computer simulations indicate that rise in temperature of 3°C would mean a cataclysmic level for global environment and people in poor countries even when they
are least responsible for the change. (Corina Haita, 2012, B. Sudhakara Reddy and Gaudenz B. Assenza, 2009)

Developing economies contribute substantially to global warming and will continue to do so is discussed openly as a matter of fact at all important global meets. However, what is of greater concern is the developing world's vulnerability to climate change impact. As disasters mock the world frequently it is feared that millions from developing and poor countries stare at the prospect of food and (clean) water shortage. As carbon dioxide emission increases climate change is going to put people health and life in these countries to greater risk. Geographically too developing countries are in a not so advantageous position to face climate change shock. Recent quake in Nepal (2015) is best example of what natural disasters can and may do in developing economies. Besides the death toll the destruction of property and heritage is of immeasurable value. For land-locked Himalayan nation, humanitarian aid and restorative help from India is critical to meet situation following natural disaster. Likewise most developing countries being situated in tropical and sub-tropical region are likely to face maximum brunt of climate change impact. Indian sub-continent as a whole is largely vulnerable to climate change impact for we have a vast population living below poverty line surviving with meager resources. This vast majority even when they are least responsible for climate change face prospect of suffering misery from climate change impact as and when catastrophe strikes.

If world economies continue to grow at current pace in an unregulated manner with outdated technologies, it is feared that GHG emissions would heat the planet by 3ºC in the twenty first century. Even if temperature rise is less, say between 1-2.5ºC there will be serious effects on developing countries situated in tropical and sub-tropical regions. Unseasonal rains, sporadic floods in some regions and droughts in other areas are leading to reduction in production of food crops. This results in hunger for people dependent on agriculture for survival. People in these regions are also susceptible to spread of climate sensitive diseases such as malaria and other tropical diseases. As water table goes down, people in India are increasingly using bore wells to draw water. Arsenic and fluoride related health issues and deformities for these people are not uncommon. India has a vast coastline and coastal communities face prospects of inundation of low lying coastal areas and destruction resulting from tropical cyclones. Numerous small islands in Indian Ocean and worldwide face prospects of going under water as sea level rises steadily. The rate of extinction of large number of plant and animal species is also unprecedented with serious ramification for survival of life on earth itself. More than war, the world is facing a serious threat from climate change impact. It is a fact that in India, high inflation in 2009-10, besides global economic factors not unrelated to global climate change, was also largely due to drought like situation and quantum jump in prices of grains and pulses hit common man very hard indeed. Availability of safe and adequate water is another major problem affecting quality of life for both rural and urban population across India.

Aim of this paper is to study impact of climate change on water resources in India and to make some policy suggestions to address problem. Water is a basic human need and health and hygiene is dependent of consumption of safe water free from biological waste, chemical and toxic contaminants, oil, sediments, heavy metals,
etc, which are harmful. As compared to developed countries in the West, per capita water utilized by people in developing world is meager. While a large section of residents in developing world do not have continuous safe water supply to their homes, it is women who walk for miles to get water, putting at risk their safety and of their daughters left alone at home. In fact access to safe drinking water at home (even in slum areas) is desired by people for more than anything the safety of our daughters. For as mothers travel long distances to fetch water, their daughters left alone at home are often at great risk of being molested or raped. Quality time which otherwise would have been utilized for productive economic activity is lost in fetching gallons of water from far off distance.

It is estimated that approximately a third of the world population may be forced to dwell in water scarce regions in near future. It is predicted that as world continues to use alternate sources of energy, war and disputes over ‘black gold’ that is oil are likely to be fewer. However, war and disputes and struggles between peoples for control over water bodies are likely to increase. In Indian subcontinent southern states are often at loggerheads in summer and disputes are not infrequent over matters related to water. It would not be an overestimation to state that at least a billion people round the world lack access to safe water, besides, millions die year after year due to water borne diseases.

In India, a third of urban households and 90% in the countryside depend on untreated surface or ground water for daily consumption and other use. In present century, efforts are ongoing by local governing bodies to supply treated water to inhabitants, however, adverse impact of untreated water use is still very alarming by any standards. Conservative estimates state that a fifth of communicable diseases in India is due consumption of unsafe water. Despite significant scientific achievement our heads hang in shame when India faces very high mortality rate due to diarrhea among children under five years of age. This underscores urgent steps for integrated approach for prevention of water borne communicable diseases among children specially and general populace at large.

With increasing deforestation, heavy siltation and drying of rivers, receding glaciers in Himalayas and elsewhere, natural recharge through aquifers of ground water sources is adversely affected. Water tables in north Indian plains are ever declining affecting security of food production for teeming millions. It is also not possible to reverse loss of natural resources. The problem is compounded by the fact that in the post-independence period, India has witnessed a population spurt. There has been a three fold increase to over 125 crores with 30 crores subsisting below poverty line. This has meant that availability of water per person has declined four fold from 3000m$^3$ at independence to just 800m$^3$ currently. It is alarming that as India’s population is forecasted to grow till 2050 at least, we are fast approaching minimum requirement of 500m$^3$ of water per person. Worse is pace of urbanization without basic requirement of water in cities. A few years back a study carried out to access the requirement of water in national capital Delhi and it was reported that population is already two times its carrying capacity. People are in fact passing sleepless night to catch trickle flowing down taps in dead of night. Stress, hypertension, and depression faced by urbanites due to day to day water problems needs to be studied from a
holistic perspective. Long queues near public taps are a common sight. Similarly water tanker mafias rule the roost in most cities and water business thrives in an utterly unregulated manner. The question for urban planners in present times is to devise ways and means to supply safe water to cities when the said resource is becoming scarce by the day.

**LOOMING IMPACT OF CLIMATE CHANGE**

Our planet is covered largely by water bodies to the extent of 70% of its surface area, of which 97% is salty and unsafe for drinking. 2% is in the form of snow and ice. This would mean that humans have less than 1% to cultivate crops, for industrial and domestic purpose. Two-thirds of our fresh water resources are used to grow food. As world population continues to grow the demand for fresh and safe water increases by the day. Leaving aside water locked in form of glaciers rest of fresh water is in aquifers which humans everywhere are draining much more quickly than natural recharge rate.

Humans seem to stare at disaster as climate alters at a fast pace. Twentieth century has witnessed too many weather related calamities. Humans seem to believe in myth of earth’s unbounded generosity with regard to natural resources. Activities like digging canals, building dams, pumping water from aquifers, diverting rivers, uncontrolled mining, etc have all gone unabated unmindful of its impact on scarce fresh water sources. In regions which are densely populated water tables have plummeted. Ecologist Garrett Hardin well researched and thoughtful paper in 1968 titled ‘Tragedy of Commons’ which required reading by biology students ever since. It addresses problem that can be solved only by a ‘change in human values or ideas of morality’ in situations where rational pursuit of individual self-interest leads to collective ruin. Cowherds who share commons for pasture eventually increase cattle gradually until it leads to destruction of pastures through overgrazing. Similar tragedy is now happening with water as well because of its indiscriminate and unregulated use and waste. What is the way out? Communities should agree to self-imposed limits arrived at through consensus. This though it seems, unthinkable and improbable, seems to be only right thing to do. Community living on lines of clanship which was norm for thousands of years could be replicated by way of making housing societies in urban areas and hamlets in rural areas share resources on mutually beneficial principles.29

We need to realize that water as commons is very crucial for survival of flora and fauna. In the past when human population was less watercourses were available in abandon and idea of saving water for posterity seemed as worthless as providing it in bottles. To the common man as also to the scientific community water mirrors climate and climate change.30 It is observed that many regions face flash floods while in other places there are severe droughts. As warming increases intensity of rains also increases due to the fact that hot air holds more water molecules than cold. As global warming increases evaporation also increase. Often many coasts face super-storms round the world due to super-warmed air above ocean, likes of which we have never seen earlier. Cyclones have destroyed many places in just over a decade in present century affecting growth and life. Consequence of enhanced evaporation is seen in dry farmlands in many parts of Indian mainland where parched land is a common site. Droughts are common so too are withering crops and dying animals as everywhere groundwater in aquifers is being drained faster than natural state of recharge.31
Himalayas are intricately with life and civilizations in India. However, today Himalayan glaciers which have sustained civilization in Indo-Gangetic plains for thousands of years are dwindling at a very rapid rate. In the last half century there has been over 40% decline in volume of Himalayan ice. Consequently most north Indian rivers have a decrease in summer discharge. These observations lead us to infer that these changes are a consequence of global warming. It is suggested by some experts that it is only a part of low frequency climate variability inherent to climatic systems. However repeated disasters indicate that changes effectuated by mankind have begun to haunt.

Possible brunt of climate change on water resources include: vanishing of water bodies due to enhanced rate of evaporation, intensive precipitation causing geographical changes (as seen during Uttarakhand flashfloods in 2013 when skies opened up causing massive landslides), frequency and severity of droughts and floods, etc. Projections made through use of computer simulation models indicate either increase in rainfall in some parts of India and drought like situation in other areas as a result of green house gases emission. Year after year as farmers commit suicides either because their standing crops are destroyed by flash floods or wither due to drought like situation is to agree with Barbara Kingsolver, who writing in National Geographic deepest dread of humans in modern times is peril of having too little or too much water. Yet politics of and politicking over farmer deaths due to crop failure continues shamelessly year after year.

Therefore, climatic change has significantly altered soil moisture, groundwater recharge and incidence of flood or drought experience and groundwater level in different areas, leading to forced migration in many areas. In India groundwater has been largely used for domestic and irrigation purposes with agricultural production even in 21st century significantly being dependent on it. Groundwater use in India is substantial and it contributes to 9% of the nation’s Gross Domestic Product (GDP). Electricity used and power consumed to draw water from deep groundwater sources is quite substantial for country as a whole. If better and cost effective methods are developed and put to use then we would be in a position to contribute in no small measure to save burning of fossil fuel.

Without doubt water is critical resource for farmer and agricultural sector is largest consumer of water resources in developing countries. It is imperative that guaranteed water supply is essential for sustainable agriculture. In most parts of India farmers make imprudent use of water and level of utilization of water in farms and agricultural fields is poor. Studies indicate that application and use-efficiencies of water by farmers in general in different parts of India have been quite low. According to Samanpreet Kaur, Satvinder Singh and Harjit Singh Gulati, (2009), most irrigation projects run at very low down efficiency of just 30-40% and loss of water either during conveyance and use is very high. Cropping pattern in India which is rice/wheat-based is such that crops require application of water in large quantities. Farmers are also largely unaware of profligate use of water for agricultural purposes and are either reluctant or unable to use suitable paraphernalia for regulated use of water in most parts of India causing low water use efficiency at field level. Consequently amount of
waste of water at field level is in range of approximately 60-70% which is unacceptable by any standards in times of precarious water shortage staring at us. Need of hour is to initiate urgent measures for efficient and astute use of precious water. Otherwise it is hard to carry on agricultural productivity at sustainable levels. Colleges and students having a course in environmental education should be geared to give practical demonstration to farmers on efficient use of water. For this perhaps colleges and universities could devise procedures to ask student undergoing course in environmental education to map the extent to which there is inefficient use of water for domestic as well as agricultural purpose.

Scientific community is aware that climatic change is exerting heavy stress on water resources in Indian subcontinent. Every year about 45% of average rainfall (including snowfall) gets wasted with rivers emptying large volume of water in Arabian Sea on one side and Bay of Bengal on other. Government is promoting rain-water harvesting schemes to arrest the run-off and to augment groundwater table. However need of the hour is for intellectual community in colleges, universities and science research institute to collaborate with students (your young human resources) in order to map effect of possible climate change on rainfall patterns, evaporation and temperature in different areas and on water bodies as rivers, springs, lakes, ponds, etc. If every college, university and science research institute could also promote rain-water harvesting on their campuses along with support of community and industrialist then its spill-over on generating interests among general public will be use and benefit immense. A massive exercise replicating Swach Bharat Abhiyan (Clean India Mission) to carry out large-scale afforestation on sustained basis for a decade or two will yield better result of country as a whole.

Undoubtedly there is uncertainty with respect to prediction of climate change at global level. Reservations in this regard may vary at national, regional and local levels. It is indeed a challenge for researchers of climatic change to deal with uncertainties and provide more accurate predictions to policy makers, planners, and disaster management experts so that we are not caught napping whenever calamity comes calling. In absence of such predictions it is difficult to prepare for extreme weather events. Variations in temperatures and monsoons bring about variation in rainfall patterns. And if these variations cannot be predicted in advance it can lead to heavy losses especially to small farmers who are highly vulnerable. As experienced in 2009, neither government nor farming communities were prepared in India to face severe drought which affected more than 200 districts across country. Situation has hardly improved since.

Slowly droughts or floods are become common feature in India, leading to decrease in water-supplies even when water demand is increasing. This leads to deterioration in quality of freshwater bodies, and strains already (very) fragile equilibrium between supply and demand. Even in areas where there is increase in rainfall it often occurs not at times when most required by farming community or when it is not required leading to flood laying waste standing crops.

Indian National Water Mission which outlines comprehensive framework to tackle issue of climate change (2008), emphasizes on following: ensure Integrated
Water Resources Management (IWRM) all over the country so that we preserve water, decrease wastage, and strive towards fair distribution of water; strive to decrease misuse of water to the extent of at least 15% by developing regulatory mechanism in order to decide on matters as people’s requirements and cost; recycle waste water in cities (perhaps through reverse osmosis and ultraviolet disinfection); encourage appropriate ways and means at basin level to deal with river flows and unpredictability in rainfall due to climate change; augment surface and ground water storage capacity which is to be achieved through rainwater harvesting and with efficient management of infrastructure developed to minimize rain water run-off and/or evaporation; encourage people to make use of water positive technologies and large scale use of sprinklers, drip irrigation and ridge and furrow irrigation systems. Water positive technologies could be used based on appropriateness but with the larger goal of achieving as much water use efficiency as possible then abysmally current low levels. In 2009, J. Sarala Devi, Benny Joseph, K. Karunakaran, B. Anuradha and K. Rama Devi examined people’s ‘willingness to pay’ for water and concluded that affordability besides a host of other considerations were of prime concern. Communication and community involvement is of prime consideration to promote high water use efficiency with accrual benefits to users.43

While India is not lacking in policies, it is people at individual level and respective state departments that need to implement most of measures. At national level, responsibility would be to help states set up basin level strategies.44 Respective states have to take up development and implementation of adaptation measures, besides ensuring co-operation for a basin level management. Universities and Higher Education Institutions (HEIs) can indeed play an important role in helping to implement goals of National Water Mission for benefit of people. NSS volunteers and NCC cadets besides other students can help in this regard. HEIs should help popularize conservation of water resources and take measures for preventing depletion of water resources. Our survival depends on how well we conserve and manage our common resources and water is ultimate commons.

CONCLUSION
There is felt need to protect and preserve our common resources like fresh water bodies as rivers, springs, lakes, ponds and wells for beneficial use of posterity. Realizing that water bodies were commons Konkani community used to say: ‘baddi katrun kuddke korum-i, udok katrun korum iet gi? (You can cut stick into bits, but can water be cut likewise?). When human population was a fraction of what it is today watercourses seemed abundant and idea of protecting water was unthinkable. Hundred years back talking of bottling and marketing water for commercial gain would have perhaps invited scorn from others. Today situation is different. Other countries are putting into force laws for protection of commons. In India situation is not very encouraging. If the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act which was passed in 2006, is enforced in letter and spirit than it would perhaps help country to avoid depletion and help preserve our resources including water courses for future generations. It is important that we move positively towards conservation of our water resources.
A century earlier Svante August Arrhenius had discussed the problem of warming due to atmospheric CO₂. Today, we are concerned about the increase in CO₂ and other greenhouse gases warming the planet with grievous cost. Development paradigm promoting GDP growth needs questioning and we need to pursue GNH instead. Growth by caring for our commons would undoubtedly give better returns in the long run. Society seems to be living in self-denial being overtly unconcerned with global warming. However, TRPs (Television Rating Points) that news channels get while covering catastrophic climatic events in different parts of the country and world over seems to indicate that deep inside humans have a lurking fear about impending apocalypse. Despite encouraging signs, ignorance, disinterest, apathy and opposition still rules the roost in large parts of the country. It is here that HEIs (Higher Educational Institutions) have a larger role to play to address the issue. It was in this light that Environmental Studies are mandated to be compulsory taught in educational institutions. Academic Audit is required to assess if teaching Environmental Studies have led to any meaningful change in the way we deal with our environment and delineate corrective steps.

Population at large is aware of global warming and many are in favor of implementing global environmental mitigation policies. It is intriguing that though we are aware of the grievous nature of the problem most do not take it as a serious issue. Moreover, very few consider global warming personally concerning to commit to take corrective measures in a sustained manner. There is a requirement for a psycho-social study to examine people’s behavior towards environmental conservation and protection. We also need to be more proactive in communicating potential disastrous effects of climate change so that we can mobilize a wider audience. Universities and HEIs should play an effective role in making people aware of the problem of global warming and help people implement environmental mitigation policies.

NOTES AND REFERENCES

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