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Investigating the Fault Line between Scientific Consciousness and Public Perception on Climate Change: A Critical Concern for Future Negotiations

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Abstract
Despite overwhelming scientific evidence of human contribution to detrimental effects of global climate change, there is an apparent decline in public acceptance to these facts. This situation has brought out an alarmingly downturn of momentum of people's engagement in dealing with the rising challenges of climate change. This paper adds to the literature by exploring the gap between scientific consciousness and public perception as well as looking into the problem of informing and engaging the common public as an important stakeholder. This issue is likely to be an important constituent for future global climate negotiations. The paper further analyzes Indian initiatives for climate change policies to proactively engage people for a sustainable future. This review argues for future research to focus on the domain of social constructionist paradigm of local climate in translating science to action to overcome the gaps between scientific consciousness and public perception.
Key words: Climate change, scientific consciousness, public perception, climate negotiation and India's climate policy

Introduction

The fiasco at Copenhagen summit in December 2009 without an agreement on a post Kyoto regime induced bitter conflict among major powers. Subsequently, United Nations sponsored climate summits at Cancun, Durban, and Doha concluded negotiating secondary issues without legally binding emission targets. The absence of new carbon cuts in the Doha summit may lead to a catastrophic climate change. Recent research has revealed that global temperature is likely to increase 3°C or 4°C within this century has led to alarm ahead of the summit (Parry 2009, New 2011). The world leaders neither have political will nor mandate for ambitious action plan for safer and equitable world as seen from Doha Climate gateway because a strong legally binding agreement was not reached yet. Increasing scientific evidence of anthropogenic interference combined with projected climate change demands urgency in tackling the global crisis (IPCC 2007, Hansen et al. 2007, Kerr 2009, Smith et al. 2009). But, there is surprisingly low acceptance of these scientific results. The erosion of public trust in climate change is dipping down since the greatest economic "downturn" in many regions across the globe (Riddell and Webster 2009, Pew Research Center 2009, Gallup 2010). This crisis posed a critical question about effective strategies to mitigate and adapt that will save the world from "apocalypse fatigue" (Nordhaus and Shellenberger 2009).

It is imperative to note that there remains a wide gap between claims made by scientific world and belief of people in general on climate change. These discrepancies might have resulted into world leader's unwillingness to impose effective measures to slow down climate change because public is not in mood to pay the cost. It shows that public opinion is far behind the scientific evidence which may cause massive damage in coming days. Poor translation of scientific consciousness of climate change into active engagement can certainly postulate that tipping perception gap must have played a primary role in decisions to refrain from people's engagement in addressing and embracing the fact and consequences of climate change. This growing perception gap has forced the world scientific community for rebuilding credibility of science among the public at large. The present study examines the existing literature on public understanding of climate change and their attitude towards active engagement both globally and in the India. Further it investigates and analyzes factors bridging the perception gap between public opinion and climate science.

Reading line between scientific consciousness and public perception

The climate issue has sparked a public debate and has caused scientists pitting against each other on facts, such as, whether anthropogenic interference dominate the planetary emission of thermal radiation to space causing global temperature rise or not. At least 97% of scientific publications agree with the fact that global warming is primarily human induced (Qin et al. 2007, Anderegg et al. 2010). Again, surveys from 34 countries in 2008 have revealed that climate change is happening at greater pace in modern time (Bray and Storch 2008). The overwhelming scientific evidences from 5000 articles published in auspice of Fourth Assessment Report Working Group of the Intergovernmental Panel on Climate Change (IPCC) highlighted two key statements unanimously (Qin et al. 2007, Bray and Storch 2008). (a) "Warming of the climate system is unequivocal, as is

now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (p. 5). (b) "Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic green-house gas concentrations (p. 10)." Further, these remarks are supported by recent works predicting significant rise in global temperature (Figure- 1) unless immediate action is taken to reduce the emission of greenhouse gases (Rockström et al. 2009, Allison et al. 2009, Richardson et al. 2009, Meinshausen et al. 2009).

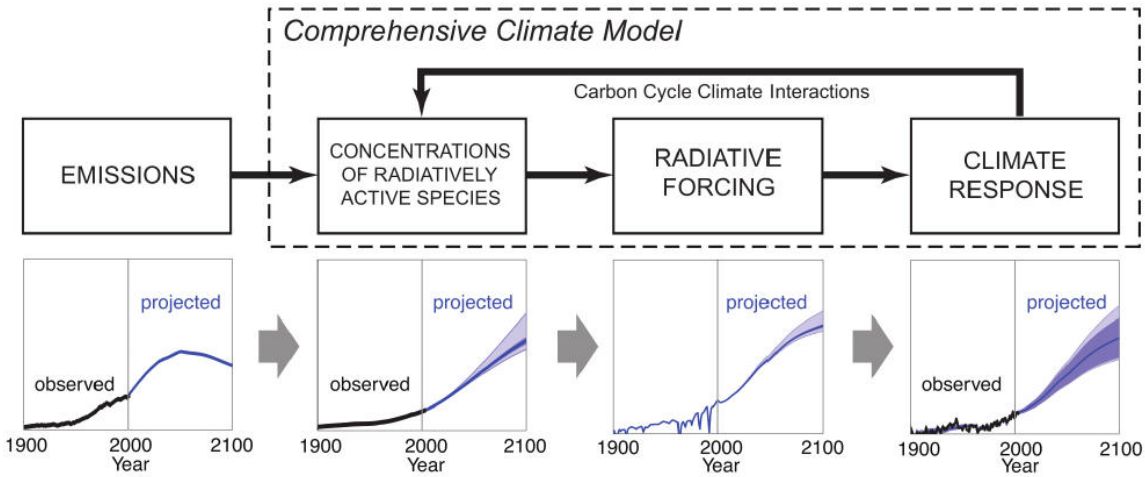
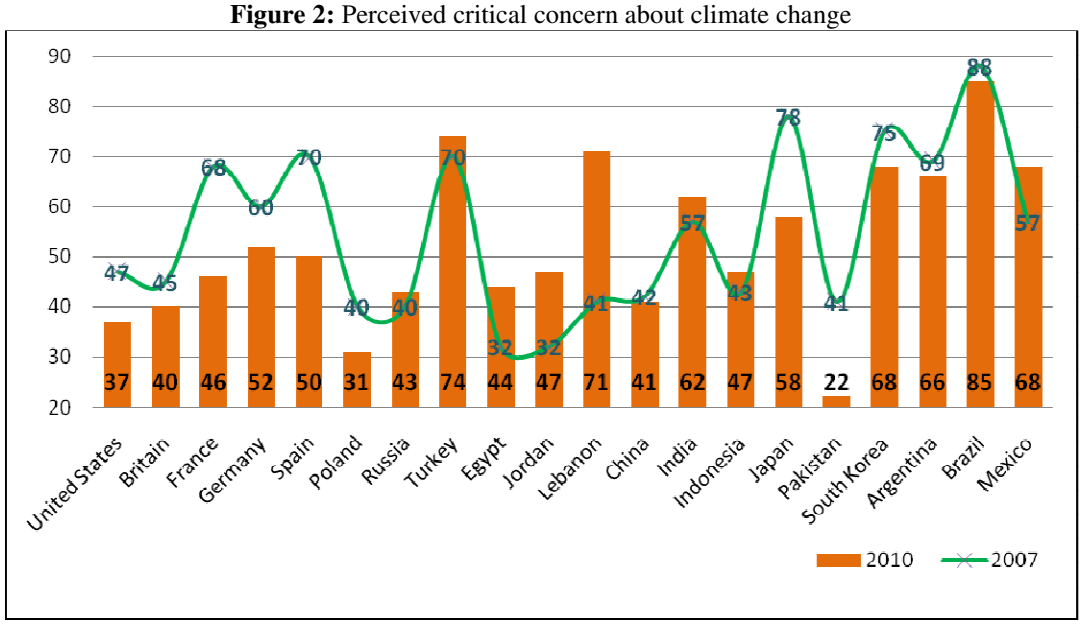


Figure 1: Meehl et al., 2007, "Global Climate Projections", Ch. 10 in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC (S. Solomon et al., Eds.). Cambridge: Cambridge Univ. Press.

In fact, the above strong consciousness among scientific community is not translated into public acceptance. The public receive news about climate are filtered by media highlights, skeptical views and controversies. According to Pew Global Attitudes Survey conducted in 2006, the awareness level about global warming is quite high in several developing countries as compared to developed world. The physical evidence of climate change is well documented (increasing temperature, shrinking glaciers, changing ecosystems and rising sea level) and projections of future global temperature change but acceptance of these evidence among public is declining all around the world (IPCC 2007, Kowalok 1993, Karl and Trenberth 2003). The perceived seriousness of climate change is dipping down from 2007 to 2010 in many countries as per the opinion survey conducted by Pew Research Center (Figure- 2). Surprisingly, alarming decline is noted in two largest emitters of greenhouse gases – China and USA – from 42 and 47 per cent to 41 and 37 per cent respectively. The above opinion survey has been validated by wide spread evidence derived by national public opinion survey pointing about the happening, urgency and concern of climate change have deteriorated in last few years (Gallup 2010, Pew Research Center 2006, Pew Research Center 2007, Saad 2009, Jowit 2010, Newport 2010, McCright and Dunlap 2010, Weber and Stern 2011). Similar trends are noted in countries like United Kingdom, Germany and Australia where traditionally stronger awareness level was observed than the United States (BBC 2010, The Local 2013). The decline in public trust about climate is matter of critical concern and requires further exploration.

Figure 2: Perceived critical concern about climate change



Data Source: Pew Global Attitudes Project, 2007 & 2010

Tracing gap between science and legitimizing action

The complexity in understanding climate science is beyond the grasp of common people. This brings many uncertainties to their mind regarding projection of future climate change which is hard to explain. Norgaard (2011) conceptualized this complexity as "social organization of denial" where general public collectively and implicitly have low concern about information provided by scientific world to avoid confronting fear of uncertain future. Why there is an erosion of trust between climate science and public perception when large scale preventive action is needed to mitigate the impact? The wide spread confusion among public are intertwined with modern consumer life styles. Hence to address the gap require investigating social, political and economic norms and interests of masses. An attempt has been made in forthcoming sections to describe and explain causes of division in public opinion on climate change.

Paradigm shift

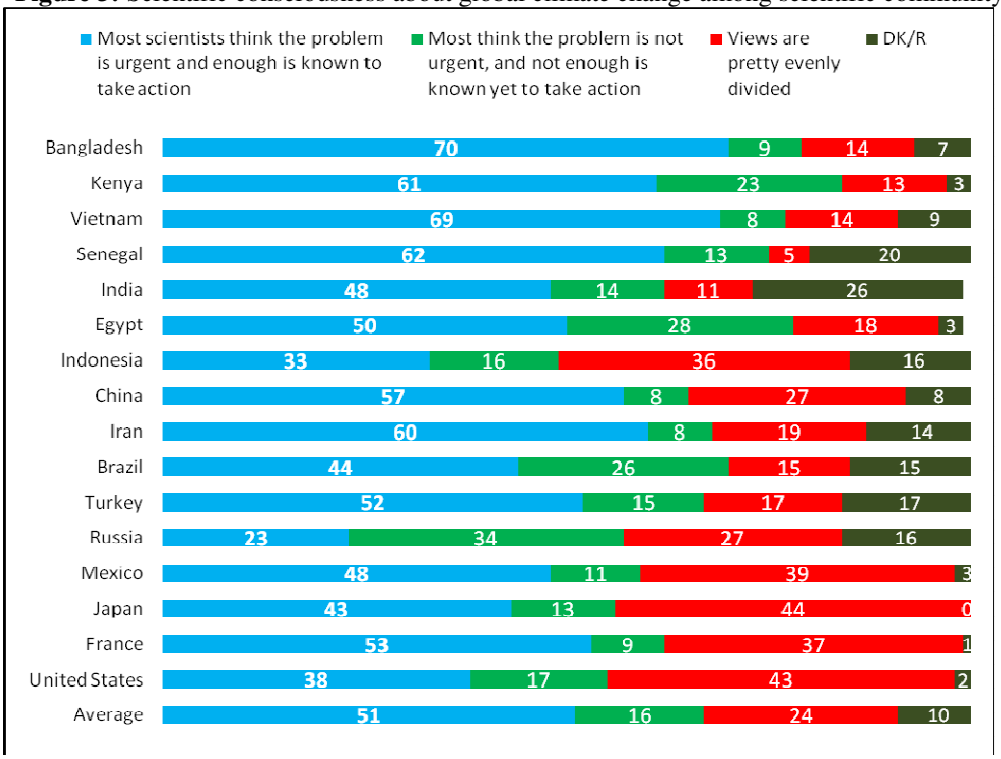
The discrepancy between scientific consciousness and public perception about change is not unusual in history. According to Thomas Kuhn it is another scientific revolution whereas Steven Sherwood says that public discussion about climate change is rather similar to another paradigm change that rocked the world. It is more or less similar to heliocentric model of the solar system given by Nicolaus Copernicus in 1543, showing that the earth revolves around the sun which caused massive backlash from political and religious powers and public opinion leant toward snapshot that earth is the center of the universe suggested by Claudius Ptolemaeus in 2nd century. It has been inferred that a similar pattern of process of scientific understanding and public acceptance for both climate change and Copernican revolution i.e. empirical observations shake long-held scientific beliefs (O'Connor et al. 1999). The scientific consciousness about heliocentrism took hundred years to be accepted among scientists and took another two hundred years to be accepted broadly by public and elite powers. The idea of global warming (atmospheric greenhouse gas concentrations can cause significant climate change) was first documented by renowned physicist John Tyndall in 1864. Further, Nobel laureate Svante Arrhenius made quantitative assessment of future warming by burning coal in 1896. These predictions were further validated and promoted by Guy Callendar in the late 1930s but it was difficult for scientific community to accept that human beings can influence the climate of the whole planet. By 1970, the scientific community found it difficult to dismiss the concept of anthropogenic interference of climate change as growing number of research works in climate science emphasized on likelihood of future warming (Sherwood 2011, Weart 2003). Hence it took roughly 100 years to develop scientific consciousness among scientific communities to accept climate change. It is the time for developing a clear public consensus as we don't have privilege of another 100 years. It is time to act where effective communication is utmost essential.

Climate skepticism

The theory of global climate change faces an array of counter arguments from interpretation of data regarding ice cores, alternative drivers of climate change, natural global warming and cooling in distant past. Several models proposed by scientists are incapable of simulating important aspects of current climate change. Contesting views

are not surprising in science but a large gulf between scientific communities about the reality of climate change is disturbing (Figure- 3). The World Public Opinion 2009, conducted in 16 countries, shows striking diversity of the views as 16 per cent climate scientists opined that problem is not urgent whereas 24 per cent were evenly divided. A number of these scientists used this platform and waged a campaign against climate change for decade to sow doubts about science by crafting simple and clear message to public and perhaps eroding scientific consciousness in public perception (Peterson et al. 2008, Gelbspan 1998, Gelbspan 2004, Hoggan 20009, Oreskes and Conway 2010).

Figure 3: Scientific consciousness about global climate change among scientific community



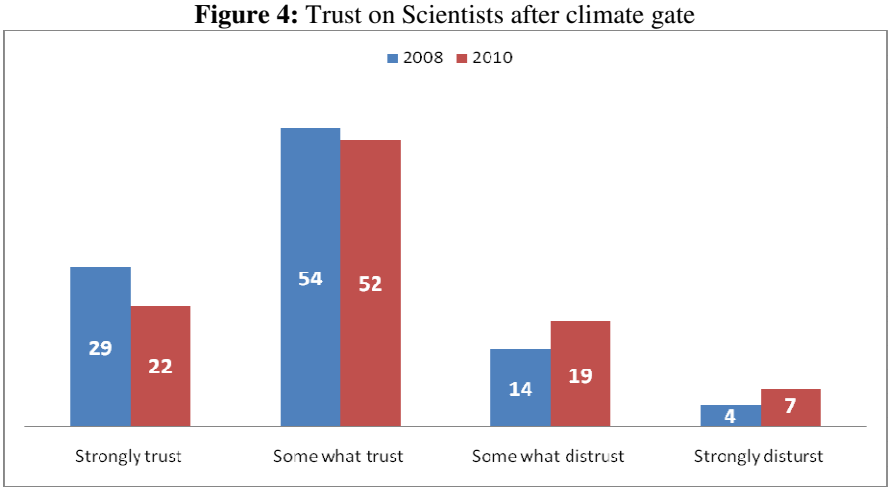
Data Source: World public opinion, 2009. DK/R: Do not know/ Refused

According to Somerville and Hassol (2011) every year new evidence is accumulated about sensitivity of climate change through earth's history but climate skepticism seem to be growing rather than shrinking. In recent times, more controversial debates are growing about climate change than climate science helping to shape public perception. The answer can be found in deep social, cultural, ideological views of definition of problem and also examining the possible solutions (Somerville and Hassol 2011, Norgaard 2006, Goodall 2008). Neglecting climate skeptic movements not only hinders our ability to understand the declining trend of public opinion towards climate change but also lead to continued polarization of climate legislative debate on reduction of greenhouse gases (Gray and Stites 2011). It is not wrong to say that if we have to counter the skepticism movement actively the uncertainty among public need to be divided on physical evidence provided by scientific community.

Climate gate

These gaps are further compounded by climate gate scandal of Climatic Research Unit (CRU) at the University of East Anglia for unauthorized release of 1000 confidential email from leading climate scientists about the 'tricks' employed to allegedly 'hide the decline' in warming over the last half century as recorded by some tree ring records (Hoffman 2011, New York Times 2009). Few of these emails were used by critics to make allegation against American and British scientists to manipulate their data to make the result worse about global warming. As the consequence of climate gate combined with errors identified in 4th Assessment report forced United Nation for an independent review of IPCC review process (Sunday Times 2010, BBC 2010, US Senate 2010). These two episodes not only tarnished the image of IPCC and scientific community but also widened confusion among people at large.

Figure 4: Trust on Scientists after climate gate



Source: Adapted from Leiserowitz et al., 2010

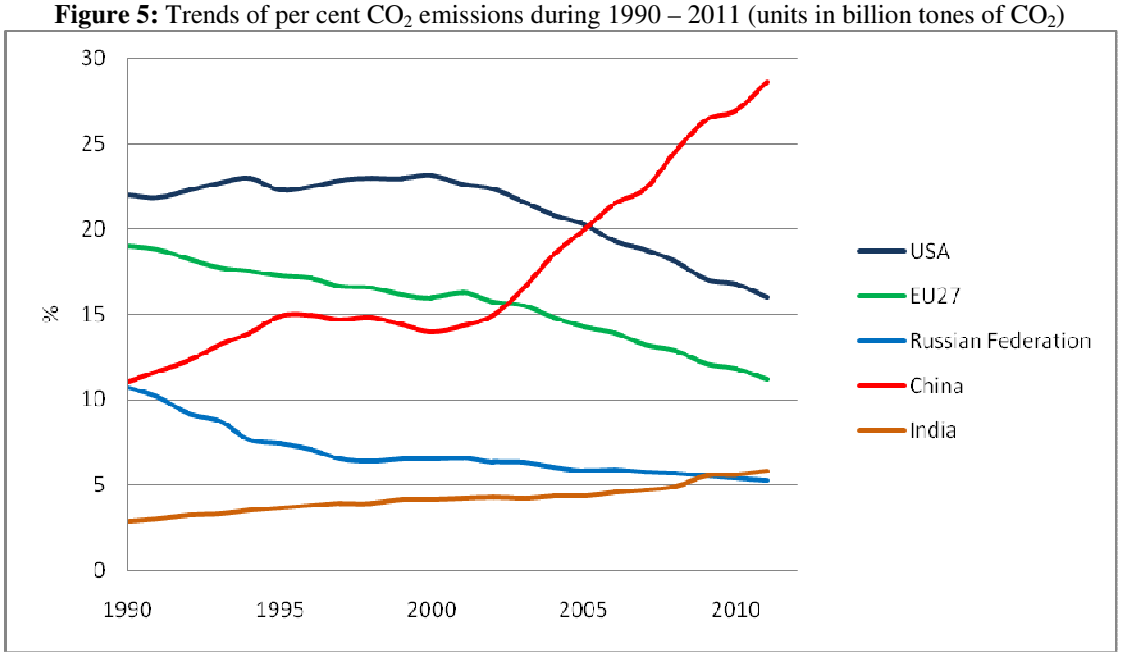
The survey conducted by Leiserowitz et al. (2010) found decline in public beliefs on the happening of climate change and also erosion of public trust on scientific community for information pertaining to global warming. Neither the scientific community nor the IPCC were effective in addressing these issues. This incident illustrates the communication gap between scientific community and key stakeholders engaged in climate policy making process. The scientific community has to have effective dialogue by developing more effective publication skills. On account of these events people opine that scientists are misquoting the facts for vested interests.

Economic slowdown and cold winter

The acceptance of climate change is driven by economic insecurity caused by rescission. In economic hardship people reject scientific facts related to climate change as addressing such issues might harm the economy (Oreskes and Conway 2010, Scruggs and Benegal 2012). The immediate economic interests dominate the fact of climate change. These economic interests do not alter the facts but they do create a situation where climate change issue is pushed back. The other relevant event for lagging belief in climate change is short term weather pattern (Downs 1972).[48-50] The cooler weather in Europe and Eastern United States may be the cause of declining concerns about climate change(Li et al. 2011, Woods Institute for the Environment 2010).[51-53] Further Scruggs and Benegal (2012) [46] suggested that popular alternative explanations for declining support such as partisan politicization, biased media coverage, fluctuations in short-term weather conditions are unable to explain the suddenness and timing of opinion trends. They believe that crisis of confidence about climate change will rebound back after labour markets improve.

India's policy on climate change: India has 17 percent of world population and is fourth largest economy in the world but contribution of anthropogenic green house gases is quite low as compared to other larger emitter like China and USA. In absolute term it ranks fourth according to total CO_2 emission due to sheer amount but it is at the bottom of the list in terms of per-capita emission (Griggs and Kestin 2011). The low per-capita emission may be reflection of lack of access to electricity to a large section population, limited industrialization and major dependence on agriculture. The western negotiators and lobbyists pressurized India to accept mitigation obligation by bracketing it with China while CO_2 emission of India is $1/5^{th}$ in absolute terms and $1/4^{th}$ in per-capita compared to China (Figure- 5). The other argument given by researcher for urgency to negotiate India's vulnerability to climate change: "India is more vulnerable to climate change than the US, China, Russia and indeed most other parts of the world (apart from Africa) (Olivier et al. 2012, Nordhaus & Boyer 2000, Mendelsohn et al. 2006, IMF 2008). The losses would be particularly severe, possibly calamitous, if contingencies such as drying up of North Indian rivers and disruption of Monsoon rains came to pass. Consequently, India has a strong national interest in helping to secure a climate deal." It's unscientific to cap the emission at current level because it will not only deprive India to eradicate poverty but availability of per-capita energy will also decline unless clean energy becomes available massively. It can be inferred from the Figure- 5 that even if India will entirely remove greenhouse gases from fossil fuel, the result on global warming will be camouflaged.

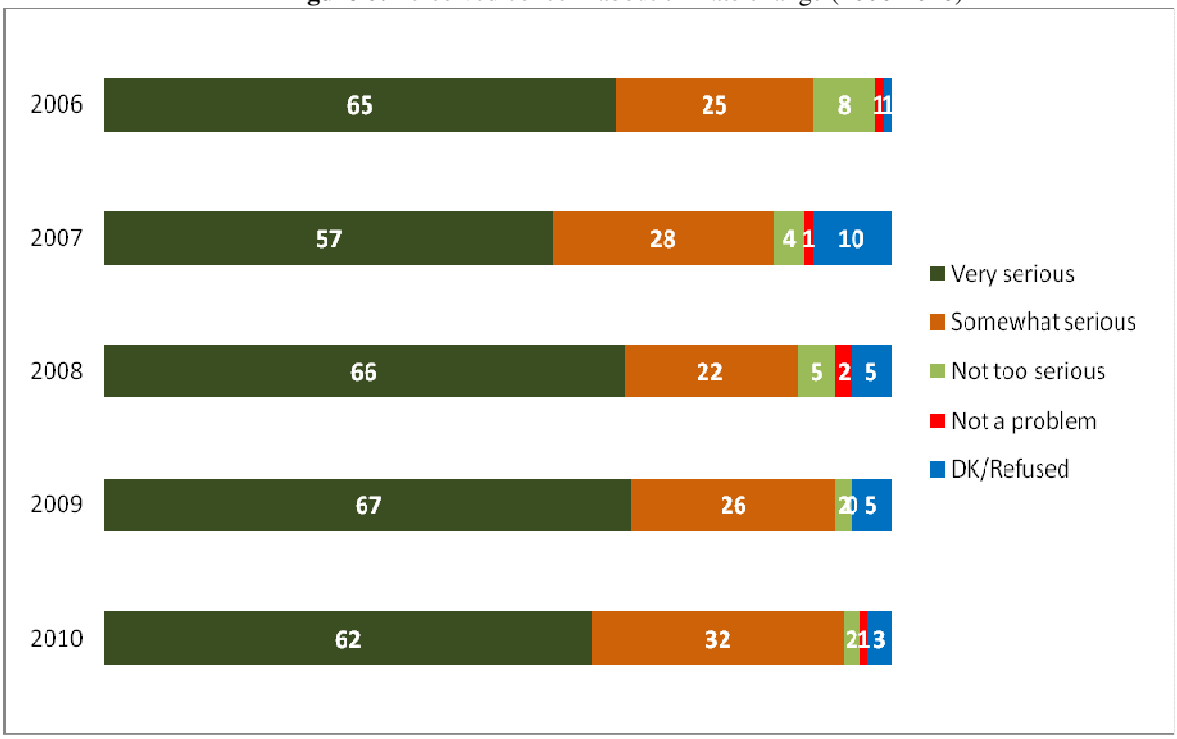
Figure 5: Trends of per cent CO_2 emissions during 1990 – 2011 (units in billion tones of CO_2)



Data Source: Trends in global CO_2 emissions; 2012 Report, PBL Netherlands Environmental Assessment Agency

The pattern of public attitudes in India towards climate change generally remains same as in the majority of countries surveyed by different opinion polls. A few supposed errors in the last IPCC Report (AR4) quoted lines "Glaciers in the Himalaya are receding faster than in any part of the world and if the present rate continues, the likelihood of them disappearing by the year 2035 and perhaps sooner is very high if the Earth keeps warming at the current rate" (Working Group 2, page 493) generated huge controversy in India. The Himalayan glaciers gate created lot of distortions and professional spins not only among scientific community and public but also discredited climate science in India. Despite these errors, majority of Indians (70 to 73 %) perceive climate change as serious problem and believe that if remains unchecked, it will affect food production, flora and fauna adversely. This will also increase likelihood of natural disasters as surveyed by different world opinion polls. A clear majority of Indians favour the specific steps of preserving and expanding forested areas (75%), limiting the rate of constructing coal fired plants (67%), increasing fuel efficiency requirements for transport (61%), and reducing government subsidies that favour private transportation (57%) (Joshi and Patel, 2009). It can be argued that public awareness about climate change is quite high but have low level of understanding about the reasons and solutions to climate change (Figure 6). Poor personal engagement of people in India to address climate change suggests that public perception plays significant role in making decisions to engage or not.

Figure 6: Perceived concern about climate change (2006-2010)



Data Source - Pew Global Attitudes Project, 2007, 2008, 2009, 2010 & Global Scan, 2006

The uncertainty in understanding climate change called for successful adaptation and mitigation of possible extreme weather events for inclusive development but it can only be achieved if growth rate in India remains high for next two decades. The fundamental basis of India's domestic and international commitments about climate change for sustainable world can be drawn from National Action Plan on Climate Change (NAPCC), a concrete plan to tackle climate change at domestic level. It consists of eight national missions in the form of adaptation and mitigation such as solar energy, energy efficiency, sustainable agriculture and strategic knowledge to evolve a framework for sustainable development. Moreover, the Prime Minister announced that per-capita emission level of India will not exceed the developing countries' emission (World Development Report 2010, Rajamani 2007, Singh 2008). The critiques doubt the NAPCC at conceptual level and also its implementation at the state level. However, it is premature to comment on effectiveness of the national policies of climate change which is believed to lead India towards sustainable development pathway. The complexity of these issues is beyond doubt and requires more intense research and debate among different stakeholders to maneuver towards a sustainable future.

Conclusion

The present study concludes that scientific consciousness developed in last few decades about human induced climate change is not translated into effective public perception which is the reason for significant decrease of public acceptance. The heliocentric model did not kill anyone directly but climate change has already started rephrasing this sentence. The scientific community cannot go for ugly rephrasing. The divided debate is waiting for another scientific revolution and paradigm shift. It calls for urgent integrated action to limit anthropogenic greenhouse gases. But limited public understanding about happening and challenges urge scientific community for effective communication strategy. The combination of climate scandals and errors are the cause of growing distrust of scientific world about climate change (Leiserowitz 2010. But scientific information still has strong credibility among public which needs to be maintained. The scientific community has to play critical role in bridging the gap between scientific consciousness and public perception and need to engage more effectively with policymakers, business community, media and the public at large (Marin and Berkes 2013). Science has to use all communication channels, techniques, and tricks for effective communication to hasten public consensus and also requires a radical change in public perception translated into personal engagement to save earth from vagaries of warming. Findings of the study emphasize on the urgency of future research to bridge the gap and to drive the society to cuddle a sustainable and enduring low carbon future. The scientific community has to produce more effective and credible scientific information about climate change tracking metrological pattern, forecasting impact and calculation of risk at local level. More studies are required in mapping the social

constructionist paradigm for attitude formulation in local populations about climate change. Is there any a pattern of relation between local perception and scientifically measured local weathers? What is importance of localized weather experience and broader social, cultural and ideological phenomena in predicting public acceptance of these variations? A combination of exposure and experience at finer spatial scale will contribute to effective communication strategies and types of adaptation and mitigation strategies that could be followed by public support.

- Educating public about risk of climate change drawn from local knowledge and experiences about their environment could be immensely useful. A productive model of blending scientific knowledge with local experience will not only help in rebuilding trust among people but will also replace skepticism, partisanship, and social division about climate change. The information and strategies are critical in translating public perception to personal engagement to tackle variation of weather at local level. Tailoring of targeted climate information facilitating an equitable structural setting to foster public commitment in addressing such issues by changing their life styles is a big challenge.
- Further investigation is needed to understand the role of leadership in the form of political action at national and local levels for reshaping the discrepancies in public opinion about climate change. Precisely, effectiveness of management of climate actions and enactment of adaptation and mitigation plans would be critically important. It will be interesting to examine how public perception gets its due importance in the process of decision making.
- Future engagement at national and global level requires more methodical studies on the issues focusing gap and similarity at global, regional and local scale. More longitudinal tracking in coming days will enable to overcome the limitation of data comparability across surveys. Indicators derived from refined studies will certainly help engaging global leaders for commitment to reduce the impact of climate change in coming days. The implication of this study is to rebuild crisis of confidence about people's scientific understanding of climate change and help the scientific community to appreciate how far they are from hastening the public consciousness to act.

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