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Climate And Environmental Changes: Restrospect And Prospect

Pradeep Prajapati
Gujarat University

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2. CLIMATE AND ENVIRONMENTAL CHANGES: RESTROSPECT AND PROSPECT

Dr.PRADEEP PRAJAPATI, Professor, Department of Economics, Gujarat University,Ahmedabad.

ABSTRACT

Discussion on problems of climate and environmental changes i.e. global warming has inundated in recent years. Every major newspaper publishes multiple editorials or op-ed pieces on the topic, the broadcast media and researchers regularly discuss the issue, and thousands of Web pages and blogs provide definitions and information and suggest causes and consequences of action and inaction. Under the situation why are we adding to congestion on the subject?

Because the analysis of past has much to contribute, especially in understanding prospects of adapting to climate change, which has received relatively little study and comment relative to the standing it should take in the debate [Gary D. Libecap and Rechard H. Steckel, 2011].

At the outset, it is to be noted that in the present paper science of climate change is not evaluated as author is not the expertise to contribute on this matter but the paper respond to economic effects of the climate and environmental changes.

INTRODUCTION

Climate change, an environmental problem was exposed by scientists and explore by economists in relation to its far reaching economic consequences. It was realizing after penetrate studies that humanities is at peril with rapidly growing world economy with excessive exploitation of natural resources and nature itself. The resultant effects were realized by human being and non-human beings and it turned out to be threat to planet's finite resources and the consumption.

In 1972, UN conference on Human Environment in Stockholm, serious thought was given and it was warned that the community of senseless growth would result into drastic economic and political consequences. Moreover it was realized in the conference that humanity would be at peril in the sense that scarcity of minerals and ores would make it difficult to maintain the level of economic activity for sustainable development.

The climate change is a serious environmental problem for it distort the functioning of Earth's ecosystem, the biodiversity and the ability of the atmosphere to absorb green house gases (GHGs) emitted by humanity from fossil fuels and other agricultural and industrial processes. It must be noted that these threats are human-induced climate change, resulting from the building of GHGs including carbon dioxide, methane, nitrous oxide and some other industrial chemicals.

The scientific process of climate change explains that earth's energy balance is strucked. The imbalance of energy in planet is caused by several gasses like GHGs: Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O and industrial chemicals called as Hydro Fluorocarbons (HFC's), Per Fluorocarbons (PFC's) and Sulphur hexafluoride (SF_6). Another major GHG is water vapour (H_2O), which, like CO_2, traps infrared radiation and thereby warns the planet. The first kind of GHGs (CO_2, CH_4, N_2O and HFCs) is all directly emitted by human activity. Water is only indirectly affected by human activity. As per planet warms, the water vapour in the atmosphere tends to increase, and this increase causes an additional greenhouse effect, meaning an additional rise in temperature.

The built-up GHGs destroy our food crops and farm system, locations of plants and animals, the location of cities, key infrastructure, and public health. In brief a fairly stable temperature of earth becomes unstable.

It is predicted that the temperature increase by the end of the century compared with the pre industrial average temperature could be as much as 4-7o C and this would be very likely to have devasting effects in many ways. Precisely it includes food, water, ecosystem, extreme weather events, and major irreversible changes to earth's physical system.

ENVIRONMENTAL EFFECTS

The inherent variability of regional climates in the past and projections of the future suggest that climate change poses serious and potentially dramatic challenges to the any economy. In part, the magnitude of these challenges depends upon the nature of the overall weather response to the build-up of Green House Gases (GHG). The economic impact of which depends on the time frame under which climate changes occur. As with temperature projections, there is no consensus on a specific time period for major economic damages to materialise. One possibility is that they are small and isolated for twenty to fifty years, after which they are cumulatively larger. If this is correct, then may make sense for modest emissions abatement programs initially while the economy begins to adjust, more technology and learning are developed, and more information is generated [National Academy of Sciences, 2008, Nordhaus, 2008 and Kousky, Rostapshove, et. al., 2009].

Temperature:

A sustained wet-bulb temperature exceeding 35° is a threshold at which the resilience of human systems is no longer able to adequately cool the skin. A study by NOAA from 2013 concluded that heat stress will reduce labor capacity considerably under current emissions scenarios [John P. Dunne; Ronald J. Stouffer; Jasmin G. John, 2013]. There is evidence to show that high temperatures can increase mortality rates among foetuses and children. And the health impacts and risks of higher temperatures also reduce learning and worker productivity, which can impact a country's economy and development.

Water:

The freshwater resources that humans rely on are highly sensitive to variations in weather and climate. In 2007, the IPCC reported with high confidence that climate change has a net negative impact on water resources and freshwater ecosystems in all regions. The IPCC also found with very high confidence that arid and semi-arid areas are particularly exposed to freshwater impacts.

As the climate warms, it changes the nature of global rainfall, evaporation, snow, stream flow and other factors that affect water supply and quality. Specific impacts include:

- Warmer water temperatures affect water quality and accelerate water pollution.
- Sea level rise is projected to increase salt-water intrusion into groundwater in some regions. This reduces the amount of freshwater available for drinking and farming.
- In some areas, shrinking glaciers and snow deposits threaten the water supply. Areas that depend on melted water runoff will likely see that runoff depleted, with less flow in the late summer and spring peaks occurring earlier. This can affect the ability to irrigate crops.
- Increased extreme weather means more water falls on hardened ground unable to absorb it, leading to flash floods instead of a replenishment of soil moisture or groundwater levels.
- Increased evaporation will reduce the effectiveness of reservoirs.
- At the same time, human demand for water will grow for the purposes of cooling and hydration.

Under these facts a major question, then, is how adaptable is the economy?

- Agriculture would be particularly vulnerable if temperature and precipitation become more erratic with larger swings.
- Electricity demand and pressure on utilities also likely would increase.
- Human beings/Health would be affected;

And, ultimately,

- Growth rate of GDP would be affected.

EFFECTS ON AGRICULTURE IN INDIA

In India, average food consumption at present is 550 g per capita per day, whereas in China and USA are 980 and 2850 g, respectively. The country faces major challenges to increase its food production to the tune of 300 mt by 2020 in order to feed its ever-growing population which is likely to reach 1.30 billion by the year 2020. To meet the demand for food from this increased population, the country's farmers need to produce 50% more grain by 2020. The total gross irrigated area has more than quadrupled from 22.6 million ha in 1950–51 to 99.1 million ha in 2011-2012. Although, agriculture contributes 14% in the Gross Domestic Product (GDP) in India, 64% of the population depends on agriculture for their livelihood. Over the years, demand for water has increased due to urbanization, increasing population, rapid industrialization and other developmental initiatives. In addition, changes in cropping and land-use patterns, over-exploitation of groundwater and changes in irrigation and drainage have modified the hydrologic cycle in many climate regions and river basins of India. Availability of water is the most important factor in agricultural production. Water quality and quantity are serious constraints for agriculture in most parts of India. Agriculture must adapt to changing climatic conditions by tapping water resources and developing improved water management approaches. Simultaneously, there is also need to develop and implement technologies and policies which will help in reducing and mitigating greenhouse gas emissions. Therefore, assessment of the availability of water resources is future national requirement and expected impact of climate change and its variability is critical for relevant national and regional long-term development strategies for sustainable development [Rohitashw Kumar and Harender Raj Gautam, 2014].

India is home to 16% of the world population, but only 4% of the world water resources. Agriculture is directly dependent on climate, since temperature, sunlight and water are the main drivers of crop growth. While some aspects of climate change such as longer growing season and warmer temperatures may bring benefits in crop growth and yield, there will also be a range of adverse impacts due to reduced water availability and more frequent extreme weather conditions. These impacts may put agricultural activities at significant risk. Climate change has already caused significant damage to our present crop profile and threatens to bring even more serious consequences in the future (WHO, 1992). Wheat yields are predicted to fall by 5-10% with every increase of 1°C and overall crop yields could decrease up to 30% in South Asia by the mid-21st century. India could experience a 40% decline in agricultural productivity by the 2080s. Rise in temperatures will affect wheat growing regions, placing hundreds of millions of people at the brink of chronic hunger.

According to Subhojit Goswami, 2017, climate change has about 4-9 per cent impact on agriculture each year. As agriculture contributes 15 per cent to India's GDP, climate change presumably causes about 1.5 per cent loss in GDP.

Overall impacts on agriculture are [VUM Rao, 2012];

- Negative impact on rice, wheat and horticulture
- Neutral or positive on some crops like soybean, groundnut, coconut, potato in some zones
- Impact on livestock and fisheries still to be better understood
- Short term impacts in 10-15 years (in the range of 4- 6%) but long term impacts could be as high as 25%
- Short term impacts can be addressed through better deployment of existing g technologies backed by few policy initiatives while long term impacts require strategic research on a long term and a major policy changes

Climate change may dramatically impact habitat loss, for example, arid conditions may cause the deforestation of rainforests, as has occurred in the past [Sahney, S., Benton, M.J. & Falcon-Lang, H.J., 2010].

Food Insufficiency in the World and in India too, is a major challenge [Pradeep Prajapati, 2017]: Already there is a very serious problem of food insufficiency in the world including India, leading to MAL-NEUTRITION because of insufficient production of Cereals and Pulses which provide Calories and Protein accordingly. This has happened because growth rate of output of agriculture is not stable in India and agricultural productivity was also very low. The higher growth rate is not achieved by technical change – seeds, water economization and soil reclamation – in agriculture. And when productivity is going to be decline further because of climate change it is high time to re-think on Land Reforms – i.e. ownership of land so as to increase agricultural productivity and accordingly to have higher growth rate.

EFFECTS ON ELECTRICITY DEMAND AND PRESSURE ON UTILITIES IN INDIA

There is a positive relationship between temperature and electricity demand over the year as the electricity demand is positively related to temperatures in summer and negatively related to temperatures in winter. Therefore, climate change is expected to reduce electricity consumption in winter and increase electricity consumption in the summer. Also, climate change will affect electricity demand by changing how people will respond along both intensive and extensive margins of adjustment. For instance, in the short run, during summer, people may adapt by using existing cooling equipment more intensively on a hot day while, in the long run, they may choose to buy an air conditioner to mitigate expected reduction in comfort due to changed climate. Thus, while the long-term climate will determine the stock of equipment in different regions, the daily weather or temperature determines the utilisation of the equipment for heating or cooling.

To capture both intensive and extensive adjustments due to climate change, Eshita Gupta (2012, 2014) estimated the impact of daily weather as well as of long-term climate on electricity demand for 28 Indian states during the period 2005-2009 and found that a 1°C increase in temperature in summer increases expected daily electricity demand by 1.5% (as a result of greater usage of cooling equipment) while a 1°C increase in temperature in winter reduces electricity demand by about 0.2% (due to lower usage of heating equipment) at the sample average of income and climate. An increase in temperature in summer has an impact on electricity consumption which is seven times the size of the impact of an equivalent increase in temperature on electricity consumption in winter.

She also found that the interaction of income with the construct cooling degree Index (CDDI) and construct cooling degree days CDDs in summer has a much higher impact on electricity demand than the interaction of income with the heating degree day Index (HDDI) and heating degree days (HDDs) in winter. As income determines how people adapt to climate change, both global warming and income growth will have asymmetric effects on electricity consumption in summer and winter.

In short, while population and income growth have accounted for most of the electricity consumption growth in India, global climate change is expected to further add to it as people will adapt by buying energy-intensive equipment such as air conditioners and air coolers.

Income growth influences climate sensitivity of electricity demand

She also found that the climate sensitivity of electricity demand in India is likely to be significantly influenced by income growth. Between 2009 and 2030, India´s GDP will double if it grows at 4% per year, and treble if it grows at 6% per year. In a reference scenario with no climate change, electricity demand in India is expected to surge by 105% with 4% GDP growth and by 224% with 6% GDP growth by 2030. If average temperatures in India increase by 1°C during this period, then the demand for electricity is likely to increase by 119% with 4% GDP growth per year, and by 252% with 6% GDP growth per year, by 2030. Thus, as a result of climate change, electricity demand is estimated to be 6.9% higher than in the reference scenario with 4% GDP growth per year and 8.6% higher than in the reference scenario with 6% GDP growth per year, by 2030. This reflects the fact that the estimated marginal effect of hotter climate is greater when incomes are higher.

Over 50% of the impact of climate change on electricity demand is due to extensive adjustments in cooling and heating requirements. Thus, electricity demand models that do not account for extensive adjustments are likely to underestimate the impact of climate change on electricity demand. This is particularly true for developing countries such as India where, unlike developed countries, the penetration of cooling/ heating technologies is very low at present. In a warmer and richer economy in the future, there is bound to be rapid adoption of energy-using equipment in India. This particularly highlights the importance of potential interactions between increasing CDDs days and increasing incomes, and the impact of the resulting long-term adjustments (such as the higher penetration of air cooling devices) on the electricity sector.

Overall, research in economic history reveals both how closely twined are climate, weather, and the economy and how remarkably resilient and adaptive is economy.

This is a valuable insight both because it suggests adjustments are likely to occur as new information, new learning, and new technologies emerge and because it augments contemporary climate change studies that typically rely upon either simulations or very limited data sets. Adaptation takes time, and history is the best provider of information about how it has unfolded over time.

Any economic analyses of climate change focus of a relationship that translates changes in temperature (and possibly changes in precipitation and other climate-related variables) to economic losses. Economic losses, would of course, include losses of Gross Domestic Product (GDP) and consumption that might result from reduced agricultural productivity or from dislocations resulting from higher sea levels but also the monetary-equivalent costs of possible climate-related increases in morbidity, mortality, and social disruption.

ENERGY SECTOR

a) Oil, coal and natural gas:

Oil and natural gas infrastructure is vulnerable to the effects of climate change and the increased risk of disasters such as storm, cyclones, flooding and long-term increases in sea level. Minimising these risks by building in less disaster prone areas can be expensive and impossible in countries with coastal locations or island states. All thermal power stations depend on water to cool them. Not only is there increased demand for fresh water, but climate change can increase the likelihood of drought and fresh water shortages. Another impact for thermal power plants, is that increasing the temperatures in which they operate reduces their efficiency and hence their output. The source of oil often comes from areas prone to high natural disaster risks; such as tropical storms, hurricanes, cyclones, and floods. An example is Hurricane Katrina's impact on oil extraction in the Gulf of Mexico, as it destroyed 126 oil and gas platforms and damaged 183 more [Dr. Frauke Urban and Dr. Tom Mitchell, 2011].

However, previously pristine arctic areas will now be available for resource extraction.

b) Nuclear:

Climate change, along with extreme weather and natural disasters can affect nuclear power plants in a similar way to those using oil, coal, and natural gas. However, the impact of water shortages on nuclear power plants cooled by rivers will be greater than on other thermal power plants. This is because old reactor designs with water-cooled cores must run at lower internal temperatures and thus, paradoxically, must dump more heat to the environment to produce a given amount of electricity. This situation has forced some nuclear reactors to be shut down and will do so again unless the cooling systems of these plants are enhanced to provide more capacity. Nuclear power supply was diminished by low river flow rates and droughts, which meant rivers had reached the maximum temperatures for cooling. Such shutdowns happened in France during the 2003 and 2006 heat waves. During the heat waves, 17 reactors had to limit output or shut down. 77% of French electricity is produced by nuclear power; and in 2009 a similar situation created a 8GW shortage, and forced the French government to import electricity. Other Cases have been reported from Germany, where extreme temperatures have reduced nuclear power production 9 times due to high temperatures between 1979 and 2007.

In particular:

- The Unterweser nuclear power plant reduced output by 90% between June and September 2003.
- The Isar nuclear power plant cut production by 60% for 14 days due to excess river temperatures and low stream flow in the river Isar in 2006.

Similar events have happened elsewhere in Europe during those same hot summers. Many scientists agree that if global warming continues, this disruption is likely to increase [Frauke Urban and Tom Mitchell, 2011].

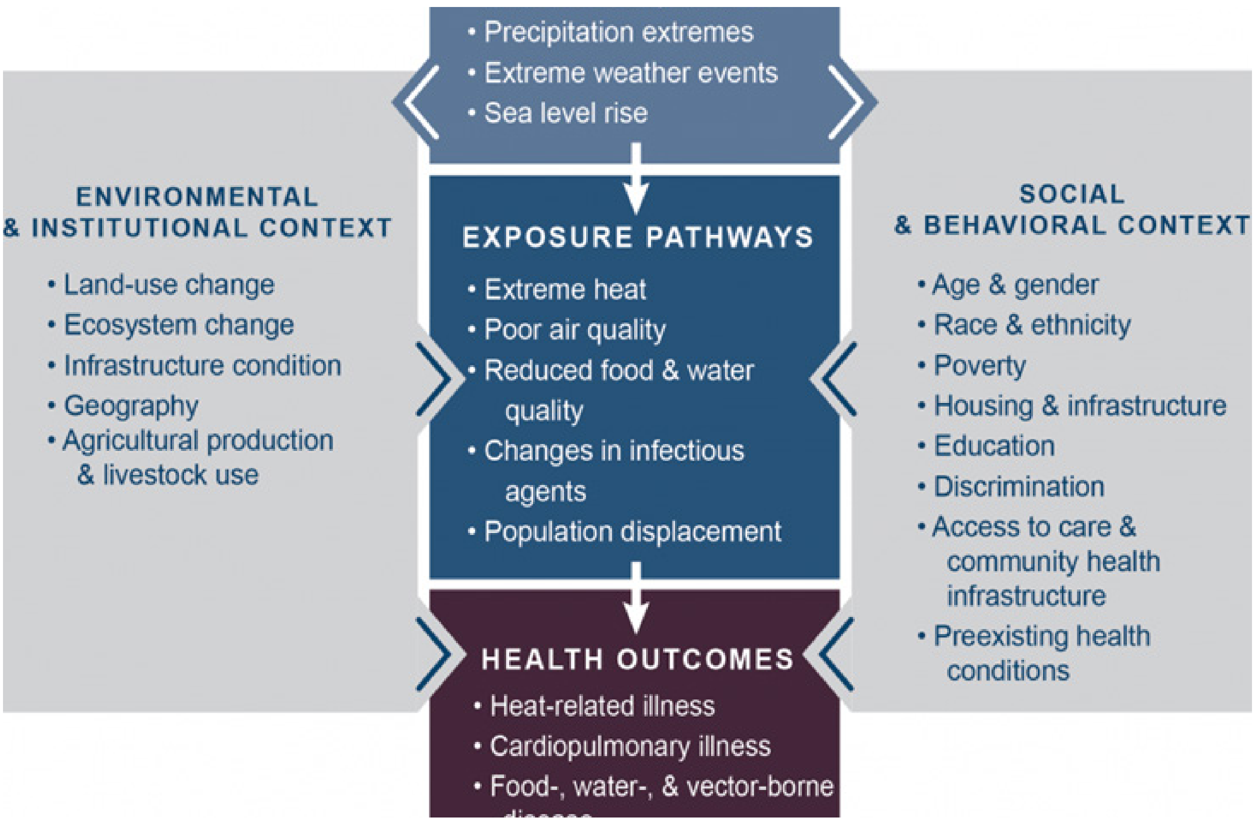
c) Hydroelectricity:

Changes in the amount of river flow will correlate with the amount of energy produced by a dam. Lower river flows because of drought, climate change, or upstream dams and diversions, will reduce the amount of live storage in a reservoir; therefore reducing the amount of water that can be used for hydroelectricity. The result of diminished river flow can be a power shortage in areas that depend heavily on hydroelectric power. The risk of flow shortage may increase as a result of climate change. Studies from the Colorado River in the United States suggests that modest climate changes (such as a 2 degree change in Celsius that could result in a 10% decline in precipitation), might reduce river run-off by up to 40%. Brazil in particular, is vulnerable due to its having reliance on hydroelectricity as increasing temperatures, lower water flow, and alterations in the rainfall regime, could reduce total energy production by 7% annually by the end of the century [Frauke Urban and Tom Mitchell, 2011].

EFFECTS ON HUMAN BEINGS

Effects of climate change on human beings are explained in form of following chart first.

CHART - 1



This Chart - 1 demonstrates the interactions among climate drivers, health impacts, and other factors that influence people's vulnerability to health impacts.

i) Health Impacts:

A fundamental global environmental change, affecting physical systems and ecosystems, will affect human health in many ways. However, many details are debated. What health effects will occur? When will they take place? Will there be both beneficial and adverse effects?

The climate-health relationships that are the easiest to define and study are those in relation to heat waves, the physical hazards of floods, storms, and fires, and various infectious diseases (especially those that are vector-borne). Other important climatic risks to health, from changes in regional food yields, disruption of fisheries, loss of livelihoods, and population displacement (because of sea-level rise, water shortages, etc) are less easy to study than these factors and their causal processes and effects are less easily quantified.

ii) Infectious diseases:

Transmission of infectious disease is determined by many factors, including extrinsic social, economic, climatic, and ecological conditions and intrinsic human immunity. Many infectious agents, vector organisms, non-human reservoir species, and rate of pathogen replication are sensitive to climatic conditions. Both salmonella and cholera bacteria, for example, proliferate more rapidly at higher temperatures, salmonella in animal gut and food, cholera in water. In regions where low temperature, low rainfall, or absence of vector habitat restricts transmission of vector-borne disease, climatic changes could tip the ecological balance and trigger epidemics. Epidemics can also result from climate-related migration of reservoir hosts or human populations. In many recent studies investigators have examined the relation between short-term climatic variation and occurrence of infectious disease—especially vector-borne disease. Studies in south Asia and South America (Venezuela and Columbia) have documented the association of malaria outbreaks with the ENSO cycle.

Increased notifications of (non-specific) food poisoning in the UK and of diarrhoeal diseases in Peru and Fiji have accompanied short-term increases in temperature. Further, strong linear associations have been noted between temperature and notifications of salmonellosis in European countries and Australia, and a weak seasonal relation exists for campylobacter.

It is critical that adaptation and mitigation decisions and policies be developed with a sound basis in the best current science on climate change and its effects. There are gaps in our understanding of the relationship between climate change, the environment, and human health. In its 2010 report, A Human Health Perspective on Climate Change (Full Report) , the NIEHS-led Interagency Working Group on Climate Change and Health identified major research areas that need to be further explored and understood. These include the following:

- Asthma, Respiratory Allergies, and Airway Diseases
- Cancer
- Cardiovascular Disease and Stroke
- Effects of Heat
- Food borne Diseases and Nutrition
- Human Developmental Effects
- Mental Health and Stress-Related Disorders
- Neurological Diseases and Disorders
- Vector borne and Zoonotic Diseases
- Waterborne Diseases
- Weather-Related Morbidity and Mortality

iii) Displacement and Migration:

Climate change causes displacement of people in several ways, the most obvious—and dramatic—being through the increased number and severity of weather-related disasters which destroy homes and habitats causing people to seek shelter or livelihoods elsewhere. Effects of climate change such as desertification and rising sea levels gradually erode livelihood and force communities to abandon traditional homelands for more accommodating environments. This is currently happening in areas of Africa's Sahel, the semi-arid belt that spans the continent just below its northern deserts. Deteriorating environments triggered by climate change can also lead to increased conflict over resources which in turn can displace people.

The IPCC has estimated that 150 million environmental migrants will exist by the year 2050, due mainly to the effects of coastal flooding, shoreline erosion and agricultural disruption. However, the IPCC also cautions that it is extremely difficult to measure the extent of environmental migration due to the complexity of the issue and a lack of data.

According to the Internal Displacement Monitoring Centre, more than 42 million people were displaced in Asia and the Pacific during 2010 and 2011, more than twice the population of Sri Lanka. This figure includes those displaced by storms, floods, and heat and cold waves. Still others were displaced drought and sea-level rise. Most of those compelled to leave their homes eventually returned when conditions improved, but an undetermined number became migrants, usually within their country, but also across national borders.

Asia and the Pacific is the global area most prone to natural disasters, both in terms of the absolute number of disasters and of populations affected. It is highly exposed to climate impacts, and is home to highly vulnerable population groups, who are disproportionately poor and marginalized. A recent Asian Development Bank report highlights "environmental hot spots" that are particular risk of flooding, cyclones, typhoons, and water stress.

Some Pacific Ocean island nations, such as Tuvalu, Kiribati, and the Maldives, are considering the eventual possibility of evacuation, as flood defence may become economically unrealistic. Tuvalu already has an ad hoc agreement with New Zealand to allow phased relocation. However, for some islanders relocation is not an option. They are not willing to leave their homes, land and families. Some simply don't know the threat that climate change has on their island and this is mainly down to the lack of awareness that climate change even exists. In Vutia on Viti Levu, Fiji's main island, half the respondents to a survey had not heard of climate change. Even where there is awareness many believe that it is a problem caused by developed countries and should therefore be solved by developed countries [Betzold, Carola, 2015].

Governments have considered various approaches to reduce migration compelled by environmental conditions in at-risk communities, including programs of social protection, livelihoods development, basic urban infrastructure development, and disaster risk management. Some experts even support migration as an appropriate way for people to cope with environmental changes. However, this is controversial because migrants – particularly low-skilled ones – are among the most vulnerable people in society and are often denied basic protections and access to services.

Climate change is only one factor that may contribute to a household's decision to migrate; other factors may include poverty, population growth or employment options. For this reason, it is difficult to classify environmental migrants as actual "refugees" as legally defined by the UNHCR. Neither the UN Framework Convention on Climate Change nor its Kyoto Protocol, an international agreement on climate change, includes any provisions concerning specific assistance or protection for those who will be directly affected by climate change [Ferris, Elizabeth, 2007].

In small islands and megadeltas, inundation as a result of sea level rise is expected to threaten vital infrastructure and human settlements. This could lead to issues of statelessness for populations in countries such as the Maldives and Tuvalu and homelessness in countries with low-lying areas such as Bangladesh.

The World Bank predicts that a "severe hit" will spur conflict and migration across the Middle East, Central Asia, and Africa [Lois Parshley, 2016].

iv) Security:

Climate change has the potential to exacerbate existing tensions or create new ones — serving as a threat multiplier. It can be a catalyst for violent conflict and a threat to international security. A meta-analysis of over 50 quantitative studies that examine the link between climate and conflict found that "for each 1 standard deviation (1σ) change in climate toward warmer temperatures or more extreme rainfall, median estimates indicate that the frequency of interpersonal violence rises 4% and the frequency of intergroup conflict rises 14%" [Burke, Marshall; Hsiang, Solomon M.; Miguel, Edward, 2015; and Hsiang, S. M.; Burke, M.; Miguel, E., 2013]. The IPCC has suggested that the disruption of environmental migration may serve to exacerbate conflicts, though they are less confident of the role of increased resource scarcity. Of course, climate change does not always lead to violence, and conflicts are often caused by multiple interconnected factors.

A variety of experts have warned that climate change may lead to increased conflict. The Military Advisory Board, a panel of retired U.S. generals and admirals, predicted that global warming will serve as a "threat multiplier" in already volatile regions. The Centre and the Centre for a New American Security, two Washington think tanks, have reported that flooding "has the potential to challenge regional and even national identities," leading to "armed conflict over resources." They indicate that the greatest threat would come from "large-scale migrations of people — both inside nations and across existing national borders." [Kurt M. Campbell; Jay Gulledge; J.R. McNeill; John Podesta; Peter Ogden; Leon Fuerth; R. James Woolsey; Alexander T.J. Lennon; Julianne Smith; Richard Weitz; Derek Mix, 2007]. However, other researchers have been more sceptical: One study found no statistically meaningful relationship between climate and conflict using data from Europe between the years 1000 and 2000.

The link between climate change and security is a concern for authorities across the world, including United Nations Security Council and the G77 group of developing nations. Climate change's impact as a security threat is expected to hit developing nations particularly hard. In Britain, Foreign Secretary Margaret Beckett has argued that "An unstable climate will exacerbate some of the core drivers of conflict, such as migratory pressures and competition for resources." The links between the human impact of climate change and the threat of violence and armed conflict are particularly important because multiple destabilizing conditions are affected simultaneously.

EXPERTS HAVE SUGGESTED LINKS TO CLIMATE CHANGE IN SEVERAL MAJOR CONFLICTS

- War in Darfur, where sustained drought encouraged conflict between herders and farmers
- Syrian Civil War, preceded by the displacement of 1.5 million people due to drought-induced crop and livestock failure
- Islamist insurgency in Nigeria, which exploited natural resource shortages to fuel anti-government sentiment
- Somali Civil War, in which droughts and extreme high temperatures have been linked to violence

Additionally, researchers studying ancient climate patterns (paleoclimatology) have shown that long-term fluctuations of war frequency and population changes have followed cycles of temperature change since the preindustrial era [Zhang, D.; Brecke, P.; Lee, H.; He, Y.; Zhang, J., 2007]. A 2016 study finds that "drought can contribute to sustaining conflict, especially for agriculturally dependent groups and politically excluded groups in very poor countries. These results suggest a reciprocal nature–society interaction in which violent conflict and environmental shock constitute a vicious circle, each phenomenon increasing the group's vulnerability to the other." [Uexkull, Nina von; Croicu, Mihai; Fjelde, Hanne; Buhaug, Halvard, 2016-11-01]

v) Social Impacts:

The consequences of climate change and poverty are not distributed uniformly within communities. Individual and social factors such as gender, age, education, ethnicity, geography and language lead to differential vulnerability and capacity to adapt to the effects of climate change. Climate change effects such as hunger, poverty and diseases like diarrhea and malaria, disproportionately impact children; about 90 percent of malaria and diarrhea deaths are among young children. Children are also 14–44 percent more likely to die from environmental factors, again leaving them the most vulnerable. Those in urban areas will be affected by lower air quality and overcrowding, and will struggle the most to better their situation.

vi) Social effects of extreme weather:

As the World Meteorological Organization explains, "recent increase in societal impact from tropical cyclones has largely been caused by rising concentrations of population and infrastructure in coastal regions." Pielke et al. (2008) normalized mainland U.S. hurricane damage from 1900 to 2005 to 2005 values and found no remaining trend of increasing absolute damage. The 1970s and 1980s were notable because of the extremely low amounts of damage compared to other decades. The decade 1996–2005 has the second most damage among the past 11 decades, with only the decade 1926–1935 surpassing its costs. The most damaging single storm is the 1926 Miami hurricane, with $157 billion of normalized damage [Pielke, Roger A., Jr.; Gratz, Joel; et al., 2008].

The American Insurance Journal predicted that "catastrophe losses should be expected to double roughly every 10 years because of increases in construction costs, increases in the number of structures and changes in their characteristics." The Association of British Insurers has stated that limiting carbon emissions would avoid 80% of the projected additional annual cost of tropical cyclones by the 2080s. The cost is also increasing partly because of building in exposed areas such as coasts and floodplains. The ABI claims that reduction of the vulnerability to some inevitable effects of climate change, for example through more resilient buildings and improved flood defences, could also result in considerable cost-savings in the long term.

vii) Human Settlements:

A major challenge for human settlements is sea-level rise, indicated by ongoing observation and research of rapid declines in ice-mass balance from both Greenland and Antarctica. Estimates for 2100 are at least twice as large as previously estimated by IPCC AR4, with an upper limit of about two meters [Pielke, Roger A., Jr.; Gratz, Joel; et al., 2008]. Depending on regional changes, increased precipitation patterns can cause more flooding or extended drought stresses water resources.

vii-a) Coasts and low-lying areas:

For historical reasons to do with trade, many of the world's largest and most prosperous cities are on the coast. In developing countries, the poorest often live on floodplains, because it is the only available space, or fertile agricultural land. These settlements often lack infrastructure such as dykes and early warning systems. Poorer communities also tend to lack the insurance, savings, or access to credit needed to recover from disasters.

In a journal paper, Nicholls and Tol (2006) considered the effects of sea level rise:

The most vulnerable future worlds to sea-level rise appear to be the A2 and B2 [IPCC] scenarios, which primarily reflects differences in the socio-economic situation (coastal population, Gross Domestic Product (GDP) and GDP/capita), rather than the magnitude of sea-level rise. Small islands and deltaic settings stand out as being more vulnerable as shown in many earlier analyses. Collectively, these results suggest that human societies will have more choice in how they respond to sea-level rise than is often assumed. However, this conclusion needs to be tempered by recognition that we still do not understand these choices and significant impacts remain possible.

The IPCC reported that socioeconomic impacts of climate change in coastal and low-lying areas would be overwhelmingly adverse. The following impacts were projected with very high confidence:

- Coastal and low-lying areas would be exposed to increasing risks including coastal erosion due to climate change and sea level rise.
- By the 2080s, millions of people would experience floods every year due to sea level rise. The numbers affected were projected to be largest in the densely populated and low-lying mega-deltas of Asia and Africa; and smaller islands were judged to be especially vulnerable.

A study in the April 2007 issue of Environment and Urbanization reports that 634 million people live in coastal areas within 30 feet (9.1 m) of sea level [McGranahan, G.; Balk, D.; Anderson, B., 2007]. The study also reported that about two thirds of the world's cities with over five million people are located in these low-lying coastal areas.

vii-b) Cost:

The scientific evidence for links between global warming and the increasing cost of natural disasters due to weather events is weak, but, nevertheless, prominent mainstream environmental spokesmen such as Barack Obama and Al Gore have emphasized the possible connection [Pielke, Roger, 2015]. For the most part increased costs due to events such as Hurricane Sandy are due to increased exposure to loss resulting from building insured facilities in vulnerable locations. This information has been denounced by Paul Krugman and Think Progress as climate change denial.

vii-c) Insurance:

An industry directly affected by the risks of climate change is the insurance industry. According to a 2005 report from the Association of British Insurers, limiting carbon emissions could avoid 80% of the projected additional annual cost of tropical cyclones by the 2080s. A June 2004 report by the Association of British Insurers declared "Climate change is not a remote issue for future generations to deal with; it is, in various forms here already, impacting on insurers' businesses now." The report noted that weather-related risks for households and property were already increasing by 2–4% per year due to the changing weather conditions, and claims for storm and flood damages in the UK had doubled to over £6 billion over the period from 1998–2003 compared to the previous five years. The results are raising insurance premiums, and the risk that in some areas flood insurance will become unaffordable for those in the lower income brackets.

Financial institutions, including the world's two largest insurance companies: Munich Re and Swiss Re, warned in a 2002 study that "the increasing frequency of severe climatic events, coupled with social trends could cost almost 150 billion US$ each year in the next decade" [UNEP, 2002]. These costs would burden customers, taxpayers, and the insurance industry, with increased costs related to insurance and disaster relief.

In the United States, insurance losses have also greatly increased. It has been shown that a 1% climb in annual precipitation can increase catastrophe loss by as much as 2.8% [Choi, O.; A. Fisher, 2003]. Gross increases are mostly attributed to increased population and property values in vulnerable coastal areas; though there was also an increase in frequency of weather-related events like heavy rainfalls since the 1950s.

vii-d) Transport:

Roads, airport runways, railway lines and pipelines, (including oil pipelines, sewers, water mains etc.) may require increased maintenance and renewal as they become subject to greater temperature variation. Regions already adversely affected include areas of permafrost, which are subject to high levels of subsidence, resulting in buckling roads, sunken foundations, and severely cracked runways.

EFFECTS ON GDP:

Pindyck Robert S (2009) while developing the "damage function" expects warming to affect the growth rate of GDP as opposed to the level i.e. he assumes that in the absence of warming real GDP and consumption would grow at a constant rate but warming will reduce this rate, for three reasons:

First, some effects of warming are likely to be permanent; for example, destruction of ecosystems from erosion and flooding, extinction of species, and deaths from health effects and weather extremes. If warming affected the level of GDP directly it would imply that if temperature rise but later fall, for example, because of stringent abatement or geoengineering, GDP could return to its but-for path with no permanent loss.

Second, resources needed to counter the impact of higher temperatures would reduce those available for research and development (R & D) and capital investment, reducing growth. Adaptation to rising temperatures is equivalent to the cost of increasingly strict emission standards, which, as Stokey (1998) has shown with an endogenous growth model, reduces the rate of return on capital and lowers the growth rate.

And third, there is empirical support for a growth rate effect. Using historical data on temperatures and precipitation over the past fifty years for a panel of 136 countries, Dell, Jones, and Olken (2008) have shown that higher temperatures reduce GDP growth but not levels.

CONCLUSION

Climate change is a natural process depends on behaviour of nature which is variable, but it is partly has to do with human-induced pursuit for rapid growth with scientific and technological process. It is a very complex system, and predictability remains a question. The exact connection of the climate scale is an area of active research. What we need to understand is the dynamic processes of nature and human instinct for material progress.

It has been suggested that decarbonisation can reduce CO2 and a deep decarbonisation of the world economy is necessary to remain within the 2oC limit. Since most of the CO2 comes from burning fossil fuels, we therefore need a sharp reduction in the use of fossil fuels or a large-scale system to capture and sequester the CO2 that is used.

If we take into consideration the practical problem-solving approach then each region of the world needs to implement a sensible, economically efficient, deep decarbonisation programme built on the three pillars of energy efficiency, low-carbon electricity and fuel switching.

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