

## Economics of Climate Change: A Stern Review

**Tanu Shivnani**

Research Scholar,  
Jawaharlal Nehru University, Delhi.

Received Aug. 20, 2015

Accepted Sept. 08, 2015

### ABSTRACT

*It is a book review of "Economics of Climate change: A Stern Review". Greenhouse gases (carbon di oxide, nitrous oxide and methane) in the atmosphere are a result of human activities. According to Stern, carbon dioxide concentrations have risen from 280ppmCO<sub>2e</sub> in preindustrial times to 380 ppmCO<sub>2e</sub> today. Doubling of CO<sub>2</sub> emissions would raise the temperature ( also termed as climate sensitivity) by 1degree Celsius but due to feedback effects the temperature would rise by more than 1 degree Celsius. Climate change has especially affected poverty adversely in the developing countries thereby raising the inequality between the developed and developing countries. It would lead to thawing of permafrost will also release methane as peats store large amount of CO<sub>2</sub>. It has also led to melting of glaciers and collapse of ice sheet of Antarctica and Greenland. Warm temperature and ocean acidification has led to low carbon absorption. There has been increase in extinction of species, many species are migrating in order to stay in same climate habitat. There has been early egg laying and flowering. The rising wind speed has led to rise in damages. Temperature increase has led to coral bleaching.*

**Key words:** Greenhouse gases, global warming, emissions, calamities, climate change

### INTRODUCTION

*"Men argue. Nature acts."* – Voltaire

As Climate change is a global problem and demands global attention. Since time immemorial, climate change has been caused by natural or human activities. As Goulder (2006) points out that it is global problem both in terms of its causes and consequences and demands urgent action. It develops overtime. It has been said that greenhouse gases (which comprise of carbon dioxide i.e.CO<sub>2</sub>, methane and nitrous oxide) are result of human activities. GHGs stay in the atmosphere for a long time and incremental impact of one tonne of GHG is independent of its location of origin. Climate change involves uncertainties in terms of impacts, costs of abating climate change and potential size.

It is the rich countries who have undertaken majority of the activities which have led to rapid increase in emissions and poor countries, esp. poor of all the regions, who suffer the most in terms of their geography( since they are located in tropical regions), dependence on agriculture, high rates of poverty, growing population, large inequality, lax rules and regulations, poor health and educational facilities, poor infrastructure, weak governance, political instability and high level of corruption and fewer resources to deal with climate change. Whereas developed countries are located in high latitude regions, have a small fraction of population dependent on agriculture and have sufficient resources to devote for attenuating the effect of GHGs.

We attempt to focus on the rising divide between developed and developing countries in terms of growth, poverty, agricultural productivity, inequality in terms of income, distribution, some aspects of black economy and employment.

### THEORETICAL FRAMEWORK

Climate change has adversely affected humans, environment and ecosystems. Climate change has led to rising temperature, melting glaciers, extreme climate, floods, droughts, collapsing ice sheet of Greenland and Antarctica, rising sea level and depletion of ozone layer (which is a result of rise in greenhouse gases). With the rise of greenhouse gases esp. CO<sub>2</sub> there has been dampening effect on agricultural productivity. There has been an erratic rainfall pattern and rising temperature, which has adversely affected crop productivity. Since majority of the population is dependent on agriculture, which in itself is dependent on vagaries of nature, so climate change has led to a

negative impact on agriculture and hence on livelihood of majority of people living in developing countries. Climate change has led to fall in agricultural productivity which has led to fall in their income and subsequently rise in poverty in developing countries. But on the other hand developed countries because of their good geographical location enjoy high rates of growth of agricultural productivity in certain crops and decreased use of energy.

Though there has been rising urbanisation (which is assumed to lead to rapid growth), but this only creating a pool of reserve army in urban areas who are living in slums. With little flexibility to switch to non agricultural sector, the divide between rich and poor is rising. Rich who are usually associated with non farm sector continue to indulge in pollution intensive profit driven growth while poor indulge in agriculture and informal activities. Similarly developed countries are having large population in non agricultural sector while only a small proportion in agricultural sector, so they indulge in pollution intensive production driven by profit motive with incessant use of natural resources, as pointed out by Hottelling(1932). In these countries, agriculture is also commercialised and mechanised, so they are not much affected by climate change as a result their incomes aren't much affected by climate variability. This leads to rise in inequalities between rich and poor across countries and within a country.

There has been rise in black income because it is rich who bribe the government officials to mend the rules as per their needs and poor also suffer because they also end up paying bribes even to do the right work. For e.g. poor may be needing the wood for fuel purpose for which they may have to bribe the official while rich may bribe the officials to undertake large scale deforestation for construction of buildings (e.g. DLF) and may even obtain land from government at rates less than the market rates and displace the poor and violate environmental laws with the view to earn profits. They are driven by short run vision.

The high rate of emission of green house gases and chlorofluorocarbons has led to formation black hole above the Antarctica region thereby leading to direct exposure of sun and causing various skin and health problems. Climate change has led to rise in natural calamities especially earthquakes (witnessed by Japan recently), cyclone (witnessed in Uttarakhand), Tsunami (witnessed by Andaman and Nicobar Islands, Orissa and various other states), floods (as witnessed by J&K recently) etc thereby leading to rising deaths. The direct effect of rise in emissions of smoke through industrial or any other human activity (like smoking, incessant use of vehicles, dumping wastes in river Ganges etc) and through discharge of waste and smoke in the river and atmosphere is leading to rise in cases of air borne (like asthma, bronchitis etc) and water borne health problems (like typhoid, cholera etc). High air temperature has contributed to rise in deaths from cardiovascular and respiratory diseases especially among the elderly people. High temperature raises the ozone and other pollutants in the air thereby exaggerating the problem. Pollen and other aeroallergen are also higher in the heat thereby triggering asthmatic problems. Changing climate has even affected rainfall pattern thereby affecting the supply of fresh water. This has led to drought and famines. As Bosello(2006) points out, floods have also increased in intensity thereby reducing the fresh water supply and creating ground for insects borne diseases like Malaria, Dengue etc. Rising temperature and changing pattern of rainfall has led to fall in production of staple foods, thereby leading to malnutrition and under nutrition. Due to rising health problems like diarrhoea etc children are unable to maintain a good health as a result of which their learning ability and school attendance has decreased. The rising cases of diarrhoea, typhoid, chikungunya, dengue etc have taken away many lives. There have also been rising mortality due to heat stress.

With poor health related programmes( and health getting deteriorated due to changes in climate), corruption, poor education( which is again affected by climate change through fall in learning abilities due to poor health), low productivity of agriculture (due to fall in rainfall and rising temperature), low productivity of people ( due to poor health facilities, lack of nutrition, etc.), poor infrastructure (which isn't drought or flood resistant) has led to low rates of growth in developing countries. It is only a small fraction of population i.e. rich who have the privilege of

good health facilities, education and higher profits, of which they do not pay taxes by bribing the government officials. While developed countries with their good education and health facilities, high tax GDP ratios, less corruption high agricultural productivity and their better adaptation to climate change has brought them high rates of growth.

### **I. SCIENCE OF CLIMATE CHANGE**

It has been observed that in the early 19<sup>th</sup> century natural factors like solar intensity and volcanic eruptions caused temperature variations across globe, but since past 50 years green house gases (which have been caused by human activities) have played a major contribution to temperature change. Carbon dioxide concentrations have risen from 280ppmCO<sub>2e</sub> in preindustrial times to 380 ppmCO<sub>2e</sub> today.

There has been a movement of various species towards the pole by 6km on an average per decade. There has been early egg laying and flowering due to climate change. Change in temperature and erratic rainfall pattern is due to human activities.

It has been observed that CO<sub>2</sub> and water vapour create heat trapping effect i.e. the infrared radiation released by earth which was supposed to escape into the outer space to some extent is trapped by green house gases, thereby reducing cooling. It has been often discussed that doubling of CO<sub>2</sub> emissions would raise the temperature by 1degree Celsius but due to feedback effects the temperature would rise by more than 1 degree Celsius. As per IPCC Third assessment report said that climate sensitivity i.e. increases in temperature due to doubling of CO<sub>2</sub> emissions would be around 1.5-4.5 degree Celsius.

Climate change esp. increase in temperature and erratic rainfall patterns will reduce CO<sub>2</sub> absorption capacity and release methane in the atmosphere. Some predict future reduction in the tropical rain forests. Thawing of permafrost would release large quantity of methane in the atmosphere. Peats release large amount of CO<sub>2</sub> thereby increasing the greenhouse gases in the atmosphere.

High CO<sub>2</sub> can increase the carbon fertilisation effect of the plants but due to warmer temperature the absorption capacity has reduced. Similarly, in the case of oceans, due to warmer surface temperature and ocean acidification the carbon absorptive capacity of oceans has reduced.

Wetlands and permafrost soils store a large amount of carbon. Therefore, any depletion of these lands will cause an imbalance and release a large amount of greenhouse gases in the atmosphere. If the warming is perforated deep into the oceans then it may lead to imbalance of methane gas composition in the ocean thereby leading to rapid warming.

### **II. ECONOMICS, ETHICS AND CLIMATE CHANGE**

Climate change results from economic activities esp. industry, transport, land use etc. Climate change is a market failure incorporating the characteristics of externality and public good, as pointed out by Pigou (1912). Environmental problems create externality because the cost of climate change on current and future generations is not met by emitter (it is neither corrected through market nor other ways), so they don't have any incentive to reduce emissions. They are also considered public goods, because consumption of one doesn't alter other person's consumption and one cannot exclude those who do not pay for it.(Sameulson, 1954)

Social cost of carbon (SCC) i.e. damage into the infinite future period of an extra unit of greenhouse gas into the atmosphere.SCC rises as stock of GHG rise into the atmosphere or alternately falls with rise in abatement and marginal abatement costs(MAC) rises with level of abatement.SCC depends on future emissions. MAC will fall in future through learning by doing process and this fall in costs is considered in determining SCC. Point of intersection of SCC and MAC will give optimal amount of abatement. But there is an element of uncertainty that abatement which is cheaper today may not be cheaper in the future periods so revision of lower stabilisation target and reduction of SCC may not be appropriate. If there is technical progress, then it makes sense to revise lower stabilisation targets and reduce SCC.

Individual is a utility maximiser based on the consumption of goods and services, while decision maker is a social welfare maximiser.(Sen, 1999) The goods and services include health, education

and environment etc. On the other hand, policy maker designs policy keeping in view future generations, future time periods and risk. But with the single decision maker and single criterion approach of welfare economics may not work well in real life although it can be set as a benchmark for comparison with how different countries will interact. Maximisation of social welfare is maximisation of adding up utilities of consumption. But it will lead to problems of difference of value judgements because poor may value the same goods more than rich, which leads to difference in rankings and therefore would be inconsistent. For e.g. it is difficult to aggregate education, health and environment in income terms as willingness to pay and ability to pay will differ between rich and poor.

Although, one needs to assess the impact of climate change on future generations but less importance is attached to future because of impatience.

There is some amount of risk and uncertainty in accessing costs and benefits. There is uncertainty from emissions to impacts to economic growth to measures to reduce emissions. We incorporate uncertainty through expected utility function i.e. utilities across different states of the world weighted by their probabilities, which may be a risk averse function. As Keynes (1921) points out that risk can be accessed with a probability but uncertainty can't be associated with a probability.

### **III. CLIMATE CHANGE AND ITS IMPACT ON THE ENVIRONMENT**

Impact of climate change on environment can be looked through the effect it has on natural ecological systems, flora and fauna. There has been a rising category of species facing extinction. Golden toad, etc have already extinct and species like white spruce, polar bear etc have begun to show decline. With rise in CO<sub>2</sub> there has been rising ocean acidification which leads to endangering of marine snails, mollusc and other species. There has been a vast migration of species in order to stay within their climate envelop.

As Kumar(2004) points out that with rising temperature polar ice sheet collapse is irreversible. Rising temperature would even lead to El Niño thereby reducing our productivity of crops and raising the probabilities of floods and droughts which will take away many lives.

With the rise in wind speed there will be raising damages like increase in incident of floods etc. due to rise in sea temperature. Damage costs are a cubic function of wind speed. Storms and floods account for 90 percent of costs from catastrophe.

If temperature continues to rise there would be irrecoverable damage to corals through coral bleaching resulting from loss of colourful algae which is necessary for their survival. Mangroves are at risk too.

As Mendelsohn (1994) points out, "higher winter and summer temperatures are harmful for crops; that higher fall temperatures and higher winter and spring rainfall are beneficial for crops; but that higher summer or fall rainfall is harmful."

### **IV. IMPLICATIONS OF CLIMATE CHANGE FOR DEVELOPMENT**

Developing countries are particularly more vulnerable to climate change due to their exposure to low latitude geographical region which curses them with poor rainfall availability and high temperatures. Many developing countries are located in tropical areas which experience extreme climates along with variability in monsoon pattern and high temperature(Nordhaus, 2006). Country like India and others where rainfall occurs once in a year will be particularly vulnerable if rainfall fails thereby affecting the agricultural productivity and leading to adverse rates of growth and development. It has been said that because of poor soils, high crop respiration rates due to warmer temperature, water scarcity and presence of pests will lead to deteriorating conditions of agriculture.

Agriculture which employs majority of the population in developing countries is concentrated in rural areas and around few crops and yields low level of income. Concentration of activities in agriculture makes it difficult and inflexible to switch to non agricultural sector like industry or services.

Humans are to a varying extent are dependent on nature. Poor are dependent on nature for their subsistence income, food security and health. Degradation or destruction of nature will seriously

worsen their conditions. For e.g. more than a billion people are dependent on Amazon rain forests.

With rising population and resource constraints will put more strain on resources. Developing countries witness high rates of urbanisation, which is goes hand in hand with growth and poverty reduction (as less proportion of people will be dependent on agriculture for their livelihood) but most of them are living in destitute conditions with poor public services, lack of access to clean water and sanitation, malnutrition and are prone to environmental hazards and floods. These areas also witness high cases of malaria and other vector borne diseases.

Majority of the population in developing countries is undernourished due to poor diet and repeated infections. Malnutrition also lowers the immune and thereby weakening the resistance to infections. It also lowers people's productivity and mental development. Climate change will increase the cases of malaria leading to high rates of mortality.

Developing countries don't have good water irrigation systems and dams. They don't have proper water management systems to store water to deal with seasonal fluctuations in rainfall. Water tables have depleted in some drought affected areas due to excessive drawing of water which is again a result of subsidised electricity and water prices.(Brown & Lall, 2006)

Poor people have low incomes and limited access to credit and world financial systems to diversify risks, which makes it vulnerable for them to deal with extreme climate.

Developing countries have poor governance and limited resources. They lack education, nutrition, control measures and awareness which make them all the more vulnerable to climate change.

Extreme variations in climate may negatively affect growth and development through lower output and income and affecting health too. Managing the rising death from heat, rising cases of malaria, malnutrition will lead to rising health costs thereby draining away the resources of poor leaving them with little or nothing to save. Environment may lower labour productivity through poor health or damage infrastructure and capital investment, either ways it is going to decrease the output esp. for developing economies which are dependent on agriculture and are unable to switch to non-agricultural activities. Erratic pattern in rainfall has damaging effect in terms of destruction of infrastructure during heavy rainfall and scanty rainfall will affect agricultural output, irrigation and hydroelectricity generation.

Climate change will lead to greater percentage of financial costs for poor countries although absolute amount may be greater for rich countries.

In order to deal with adverse impacts of climate change poor may indulge in low risk crops and this can reduce their average income. They may be forced to sell their assets like land and cattle. This would lead to fall in long term revenue and they would be unable to educate their children. Most of them even reduce their consumption but this will severely affect their health and mental strength. It can lead to irreversible damage in children which will hamper their educational abilities like learning etc. Climate change will severely affect education levels as income and health conditions deteriorate. This is because schooling becomes less affordable as income levels fall and children engage in domestic household activities. While deteriorating health conditions would hamper learning abilities and attendance. Poorly educated farmers will not be able to innovate and process new information.

Climate change is likely to result in greater gender inequalities as work load like collecting water; word etc would rise leaving less time for marketable activities, particularly for those homes which are short of labour. Women and children are mostly employed in agriculture and informal sector and therefore are more vulnerable to climate change.

Climate can increase the fiscal expenditure thereby worsening the budget situation. Government needs to deal with after effects of extreme climate and long run fall in food and water supply. When government falls short of funds it may resort to borrowing which will again have negative effect on growth and development thereby leading to infinite postponement of investment in development. The funds used for emergency purposes are diverted from other productive sources.

Climate change is likely to lower GDP and growth and thereby raising poverty and child mortality. There will mass migration and increase in number of people below poverty line. The rise in child mortality is due to lower expenditure by both public and private sector on health improvement measures like clean water, sanitation etc. It has been observed that with rising sea level coastal areas will be endangered and small islands are at risk therefore all this puts pressure of migration. Lack of resources like clean water, sanitation, malnutrition, drought, floods, and growing population in developing countries will drive migration. But the actual number of migration will depend on how well government equips itself will dealing with disasters and taking precautions to avoid them. But due to rising population and scarce resources migration can create political tension with neighbours. It is said that with adverse growth shocks climate change will negatively influence the employment opportunities.

#### **V. COSTS OF CLIMATE CHANGE IN DEVELOPED COUNTRIES**

With the rise of temperature by 1-2 degree Celsius the impact on certain sectors and regions will be positive but with the increase of 4-5 degree Celsius the impact on overall globe would be damaging. The events of extreme weather would rise. Poor countries suffer the most because they have low resources for abating climate change; they are situated in low latitude geographical location and have high population growth and majority of the population living in unhygienic slums with poor health conditions. All these adverse consequences of climate change would lead to high rates of migration and political instability It is often seen that poor people usually live in high risk areas ( like coastal floodplains) and have poor quality housing ,lack financial resources for insurance cover and are less aware and worst prepared for extreme events like flood, cyclones etc. While the rich countries have enough resources to devote to adaptation; they are situated in high latitude regions and have low population growth.(Tol, 2004)

Water is required for sanitation, good health, used as an input in production and for sustainable development. It has been said that with climate change there will be erratic rainfall and snowmelt patterns which will affect the supply of runoff.As pointed out by Barnett(2005), water availability in high latitude regions will begin to rise while areas like Mediterranean which were already facing water problems would face high shortages due to fall in rainfall and loss of snowmelt water and rising population growth. Developed countries like Australia, South Europe which are situated in lower latitude regions will also face water scarcity due to fall in rainfall. It has been said that increase in water availability during wet season due to melting glaciers and loss of mountain snow may cause floods and also due to lack of storage facility it cannot be managed for dry seasons implying that dry season will encounter water shortages. Also around 50 percent of river flows are not available to humans.(Schlenker, 2005)

Agricultural production of some crops in high latitude region will increase if there is strong carbon fertilisation effect while in lower latitude regions esp. developing countries and developed countries like Australia and South Europe would be witnessing rise in water shortage leading to fall in agricultural productivity due to low carbon fertilisation effect.

Tourism will boost in high latitude regions (like Russia and Canada) esp. in summers but places like Alps and Rockies which attracted tourist for its snow recreation will witness a decline in tourism. Countries like Australia etc will suffer a fall in tourism due to bleaching of Great Barrier Reef.

It has been estimated that there will be huge migration to high latitude countries as low latitude countries suffer from water shortages, extreme events, rising energy prices, increasing health risks and deteriorating agricultural conditions.

Hurricane Katrina, in 2005, led to a loss of 125bn\$ out of which only 60bn\$ was recoverable through insurance. It took as many as 1300 lives and led to some irrecoverable damage.250000 former residents had to be permanently shifted elsewhere.

Similarly European heat wave of 2003 led to exceptionally high temperatures which had caused 35000 deaths across Europe. In Paris alone the death figure was 15000.France had faced severe water and electricity shortages and had witnessed urban heat island effect. It has been said that

Mediterranean and South East England are likely to face increased soil drying and high infrastructural damages.

An increase in hurricane intensity can lead to severe infrastructure damages. In Miami alone, as much as 900bn \$ of capital is at danger. Storms become more powerful as ocean warms.

Rising sea levels would also increase the infrastructural damages thereby raising costs of flood defences on coasts. Sea levels are rising due to melting of Greenland ice sheets caused by rise in GHGs. At 3-4.5 degree Celsius increase in temperature from preindustrial times the ice sheet will begin to melt irreversibly which will lead to rise in sea level. There has been rapid thinning and sustained increase collapse of ice sheets. They will also increase loss of wetlands and raise salt water intrusion into the surface. Parts of North America (facing greater risk of tropical storm too) and Europe face greater risk of rising sea levels which will severely affect population and GDP.

Climate change not only affects GDP directly but it also affects GDP indirectly through financial markets. It has been observed that major financial centres like Mumbai, London, Tokyo etc are located near the coastal regions because they are best locations for open ocean trade. It has been observed that risks are correlated like collapse of ATC would lead to fall in temperature in northern hemisphere thereby reducing the rainfall and hence agricultural productivity and water supply. Increasing weather events will raise the insurance premiums and the capital which insurance companies should possess to cover losses.

There is likely to be large inequalities in income between developed and developing countries due to large scale migration. There will be large scale population movement esp. from the coastal areas due to rising temperature, rising sea level and deteriorating resources. Developed Countries will have climate related conflicts like water wars over water resources, over water extraction from shared rivers and displacement of population due to dam building has led to growing political tensions.

## **VI. CRITICISM**

As Kumar(2013) points out, Indira Gandhi in 1974 Stockholm Conference “Poverty Pollutes”. According to her it is the poor who exploit the resources and make incessant use of free resources of nature. Ever since the phase of liberalisation and industrialisation of Indian economy, there have been lax environmental regulations in order to attract capital. The local bodies have been lured for money in case of setting up of SEZs. It is the poor who use the natural resources as a small fraction compared to rich who bribe the officials for incessant deforestation for their ulterior motive of earning profits. It is poor who consumes low quality food which leads to rising bill on health problems. It is these poor people who work in adverse conditions (due to poor labour laws) in order to fulfil the demands of rich (want diversified basket of products). Poor recycle the resources to prevent environmental degradation.

Kuznets curve of environment which states that as per capita incomes of poor countries rise pollution rises but as soon as they develop enough, they innovate environment friendly technology. But this is not completely true, because poor countries have low per capita income and low consumption therefore they don't create too much environmental damage while rich create diversified pollution intensive goods. It is the poor who recycle the goods consumed by rich. In fact rich countries dump their pollution intensive and hazardous waste in developing countries. Developing countries in order to compete for exports have started giving low wages to workers and started having lax environmental conditions.

Capitalist production is social waste as they sell defective products with the view to gain repeatedly from repairs and it can partially be attributed to poor training to workers. This production leads to double counting as the productive activities are counted and the damage that they do to the environment in terms of health is also counted again. It also leads to depletion of resources for which it will be appropriate to discount growth. Wastage is causing climate change and global warming.

They argue that solutions itself turn out to be non solutions. The inventors of new solutions themselves are not fully aware about the side effects of their solutions. For e.g. DDT was

developed as a pesticide but later it entered into food chain through soil and water pollution and affected health of people. In short the innovators have myopic vision they are not far sighted. If the fine balance between nature and man is disturbed then we are bound to face the dire consequences. The science has developed new medicine for longevity but poor can't afford it and with coming up of new diseases this medicine may no longer deal with new bacteria and microbes. It has been said that materials useful to us are away from us while material harmful to us are close to us. With coming up of modern technology, poor even change the way they used to use the traditional technology which leads to damage to the environment. With water getting privatised (who driven by profit motive) there was hue and cry about overexploitation of resources.

Throughout history it is the rich who have exploited the poor class. It is said that Kuznets curve would hold true and developing countries would also move along the curve but the conditions are different. Poor pollute only to fulfil the needs of rich and since they have no knowledge about the usage of modern technology. Poverty has been rising due to rising consumerism and increasing health problems which are constantly posed by environmental change for which they have to raise debt as their meagre income doesn't allow them to pay the medical bills.

### **CONCLUSION**

It is often claimed that bulk of water is used for irrigation but if we look at the present scenario we will find that agriculture in developing countries is still rain fed implying that major water use for irrigation is done by developed countries at the expense of developing countries. It is again the question of north south divide where north due to its industrialised policies have created too much of pollution in the atmosphere and it is because of them developing countries are suffering. In fact, Stern points out that one should have a common emission fee which may not be the case as developed countries should pay higher taxes compared to developing countries as their share in total emissions is much higher than developing countries.

In the Indian context, due to top down approach followed by India after incorporating World Bank and IMF's strategies India has moved away from clean technology to dirtier technology. Even though we had gained independence in 1947 but in the mind we are still copying west. This has not only led to fall in employment for those whose livelihood was based on that small scale sector but has also intensified a rich-poor divide in the society. As the new government which is coming to power is a puppet in the hands of big corporate players like Ambani who bend the laws of the country to get their work done otherwise it is impossible for a small firm to grow many folds within a short span of time. They have bribed every official to get their work done. They have moulded environmental laws as per their own needs. The trade liberalisation policy followed by India during 1990s had led to laxer environmental regulations to drive foreign companies to India because our ruling elite was of the view that it is only through industrialisation that country can grow and they dint pay heed to agricultural sector.

If we would have followed the bottoms up approach we could have developed much faster and cleaner, but the idea to imitate west has led to adverse consequences for the economy. There is also a large amount of corruption in Indian economy. Rajiv Gandhi during his times used to say that every rupee sanctioned for poverty removal only 15 paise would be reached to the poor. Now with rising corruption the poor who used to cut trees only for fuel and who had less than marginal contribution to degradation of environment is now being accused of environmental damage. In case of India, laws should be more stringent and binding. Business units who are found using carbon intensive technologies should be taxed and heavy fines should be imposed on them along with cancellation of their licences.

If government would have spent enough resources on ensuring that subsidies reach farmer and the NPK ratio is maintained without de-regularising the prices of potassium and phosphorous then the use of solely nitrogen based fertiliser could be curbed and the land would have been fertile enough to yield higher productivity. But instead the government was busy following the IMF's policy and wanted to keep fiscal deficit within the range of 3% through reducing the

expenditure. In last few years very small amount of funds have been sanctioned for agricultural sector growth and most of it has been spent on promoting industrialisation and relaxing environmental and financial norms for their growth and development. Our government has been forgetting that these MNCs and Indian corporations are profit driven. They will not be concerned about social welfare and environmental aspect. Coca cola has overdrawn water thereby raising the salinity and depleting water table in water scarce places. There was no storage of water and incessant drawing of water.

Government should step in esp. in agriculture, coastal areas and other sectors which are prone to climate risk and provide them insurance cover which no company would be ready to undertake as it involves higher risk and lower return due to climate variability.

Strict punishment should be given to those officials who are found violating rules or taking bribes so that the benefits reach where they are targeted and rich shouldn't enjoy the liberty of breaking and moulding the rules and regulations as per their convenience, thereby raising inequalities in society.

The responsibility of cleaner and greener earth lies on the shoulder of developed countries, which they will never fulfil unless they are affected adversely by climate change, and develop eco friendly technology keeping in view its side effects ( including dumping and recycling) and make it available to developing countries at cheaper prices. But all this would seem like a fairy tale because USA would keep pressuring developing countries to increase their abatement of emissions and this would give an outcome similar to prisoner's dilemma of game theory.

## REFERENCES

1. Stern, N. ( 2007) "The Economics of climate change: The Stern Review", Cambridge: CUP
2. Goulder, Lawrence, and William A. Pizer. (2006) "The Economics of climate change", NBER, Working Paper No. 11923
3. Kumar, Arun. (2013): "Indian Economy since Independence: Persisting Colonial Disruption", New Delhi: Vision Books
4. Mendelsohn, Robert, William D. Nordhaus and Daigee Shaw(1994) "Impact of global warming on Agriculture: A Ricardian Analysis", American Economic Review 84(4): 753-771
5. Kumar, K.K., B. Rajagopalan, M. Hoerling et al. (2006): "Unravelling the mystery of indian monsoon failure during the El Niño", Science 314: 115-119, doi: 10.1126/science.1131152
6. Barnett, T.P., J.C. Adam, and D.P. Lettenmaier (2005): "Potential impacts of a warming climate on water availability in snow-dominated regions", Nature 438: 303-309
7. Bosello, F., R. Roson, R.S.J. Tol et al. (2006): "Economy-wide estimates of the implications of climate change: human health", Ecological Economics 58: 579-591
8. Hotelling, H. (1931): "The economics of exhaustible resources", Journal of Political Economy 39(2): 137-175
9. Hallegatte, S., J-C- Hourcade and P. Dumas (2006): 'Why economic dynamics matter in assessing climate change damages: illustration on extreme events', Ecological Economics, in press
10. Keynes, J.M. (1921): "A Treatise on Probability", London: Macmillan
11. Pigou, A. C. (1912): "Wealth and Welfare", (4<sup>th</sup> ed), London: Macmillan
12. Schlenker, W., W.M. Hanemann and A. Fisher (2005): 'Will US agriculture really benefit from global warming? Accounting for irrigation in the hedonic approach', American Economic Review 95: 395 – 406
13. Tol, R.S.J., T.E.Downing, O.J. Kuik and J.B. Smith (2004): 'Distributional aspects of climate change impacts', Global Environmental Change 14: 259 – 272
14. Brown, C. and U. Lall, (2006): 'Water and economic development: the role of interannual variability and a framework for resilience', Working Paper, Columbia University, NY: International Research Institute for Climate Prediction.
15. Nordhaus, W. (2006): 'Geography and macroeconomics: New data and new findings', PNAS, 103(10): 3510-3517
16. Sen, A.K. (1999): 'The Possibility of Social Choice', American Economic Review 89(3): 349-378
17. Samuelson, P. (1954): 'The pure theory of public expenditure'.Review of Economics and Statistics 36(4): 387-389