

## **THE IMPACT OF CLIMATE CHANGE ON INDIAN AGRICULTURE WITH SPECIAL REFERENCE TO SOCIALLY DISADVANTAGED PEOPLE**

**Shilpa Magalad**

Assistant Professor

Government Law College Holenarasipura

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"Mother Earth – our only home – is under pressure...Without a sustainable environmental base, we will have little hope of attaining our objectives for reducing poverty and hunger and improving health and human well-being."

-Ban Ki-Moon, Secretary-General, United Nations, 22 April 2010.

### **INTRODUCTION:-**

"It is no longer a question of whether the earth's climate will change but rather when, where and by how much" Robert T. Watson, Chairman of the United Nations Inter-Governmental Panel on Climate Change.

As per UNDP's Human Development Report (HDR), 2007/2008, "Climate Change is the defining human development issue of our generation". This problem is not one which a single nation or community is facing in isolation. The problem needs to be viewed in the context of Growth and development in the developing countries and how the presently poor in Different parts of the world will be able to break the shackles of deprivation and have adequate access to health, nutrition, education and other basic services needed for their well-being.

India has about 18% of world's population and 15% of livestock population to be supported from only 2% of geographical area and 1.5% of forest and pasture lands. The arid regions of India cover an area of 317,090 km<sup>2</sup> and are exclusively depend on rain-fed crops, even modest alteration in the intensity, frequency and timing of rainfall should cause consternation to large section of farming community. Karnataka ranks second, next only to Rajasthan in India, in terms of total geographical area prone to drought. Among its 30 districts, 18 are drought prone.

Climate change is one of the greatest environmental issues of our time.

Climate change has been linked to the dramatic increase in extreme weather events witnessed by the developing world in recent years: disasters such as floods and droughts have already killed and affected millions, and these are predicted to escalate in frequency and intensity. Other effects of climate change include food insecurity, ill health, loss of forests and biodiversity, social and political instability and economic decline, all of which will hit the poorest hardest. Climate change, therefore, is one of the greatest threats facing the poor in the 21st century.

Agriculture represents a core part of the Indian economy and provides food and livelihood activities to much of the Indian population. While the magnitude of impact varies greatly by region. Climate change is expected to impact on agricultural productivity and shifting crop patterns. The policy implications are wide-reaching, as changes in agriculture could affect food security, trade policy, livelihood activities and water conservation issues, impacting large portions of the population.

### **Impacts of climate change on Indian Agriculture Literature:-**

**Sinha and Swaminathan (1991)** – A 2°C increase in mean air temperature could reduce rice yield by about 0.75 t/ha in high-yield areas (and about 0.06 t/ha in low-yield coastal regions).

A 0.5°C increase in winter temperature could shorten wheat crop duration by about 7 days and reduce yield by about 0.45 t/ha, which could lead to roughly 10% reduction in wheat production in high-yield northern states of India.

**Rao and Sinha (1994)** – showed that wheat yields could decrease between 28 to 68% without considering the CO<sub>2</sub> fertilization effects; and would range between +4 to -34% after considering CO<sub>2</sub> fertilization effects.

**Aggarwal and Sinha (1993)** – using WTGROWS model showed that a 2°C temperature rise would decrease wheat yields in most places.

**Saseendran et al. (2000)** reported that rice yield is highly sensitive to temperature changes; simulation results indicated that for every 1°C increase in temperature, rice yield declines by approximately 6%. Climate Change Scenario for India:-

National Action Plan on Climate Change (NAPCC), 2008 has documented that “India is faced with the challenge of sustaining its rapid economic growth while dealing with the global threat of climate change. This threat emanates from accumulated greenhouse gas emissions in the atmosphere, anthropogenically generated through long-term and intensive industrial growth and high consumption lifestyles in developed countries.”

Climate change may alter the distribution and quality of India's natural resources and adversely affect the livelihood of its people. With an economy closely tied to its natural resource base and climate-sensitive sectors such as agriculture, water and forestry, India may face a major threat because of the projected changes in climate. India's development path is based on its unique resource endowments, the overriding priority of economic and social development and poverty eradication, and its adherence to its civilizational legacy that places a high value on the environment and the maintenance of ecological balance.

The Food and Agriculture Organization's director-general has issued the following message on this year's World Food Day theme – World food security: the challenges of climate change and bio-energy.

There is indeed a need to address the growing food demand due to increasing populations, economic progress in emerging countries and competition in the bioenergy sector when supply is affected by climate change and declining stocks. This year's World Food Day theme provides an opportunity to promote the conclusions of the High-Level Conference so as to implement them as soon as possible.

Climate change affects everyone, but the poorest regions are already its first victims. Their situation is likely to worsen in the next decades. The worst hit will be hundreds of millions of people who are already vulnerable and food-insecure – small-scale crop and animal producers, fishermen and foresters. Climate change will affect availability of land, water and biodiversity. Changes in temperature and rainfall, as well as more frequent extreme weather patterns, are expected to result in agriculture production shortfalls with negative impact on access to food.

Therefore, climate change is likely to increase migration towards richer countries while rising sea levels may force many communities in low-lying coastal areas and river deltas to move to higher ground. These risks need to be taken into account, and the analysis of food security needs to be placed in a completely new context.

During the last three years, due to soaring food and energy prices, the number of hungry people has increased by another 75 million. This crisis is due to decreasing investment in agriculture in the poorest countries during the last 30 years. The share of agriculture in public development aid declined from 17% in 1980 to 3% in 2006. Financial institutions drastically reduced their funds for agriculture.

We need to reverse this trend to come back to the previous level of investment. We also need to create food-enabling frameworks for a substantial increase of direct foreign investment in agriculture in low-income, food-deficient countries. Equitable partnerships between countries which have land, water and a labor supply and countries which have financial resources, management facilities and markets would constitute a solid base for sustainable agriculture.

### **Global Warming:-**

The term 'global warming' is one aspect of the broader term 'climate change'. Global warming is the observed increase in the average temperature of the air near earth's surface and oceans in recent decades and its projected continuation. Global warming is primarily a consequence of building up of greenhouse gases in the atmosphere. Global mean temperature has increased by 0.74°C between 1906 and 2005. Global sea level has risen at the average rate of 1.8mm/yr during 1961-2003; the rate has been faster during 1993-2003 (@3.1 mm/yr). The Centre for Science and Environment quoted scientists, which highlights the complex ways in which global warming related events impact agriculture.

- As the climate warms due to greenhouse gases, sea water evaporates faster and increases air moisture that condenses and falls as intense rains
- Lack of uniformity in temperature changes in India affects microclimates and makes weather predictions more and more difficult.
- Increased intense rainfall with less of moderate rainfall could decrease groundwater recharge and soil moisture, affecting agriculture
- Changes in soil increase in pest population and weeds are all inevitable with the increasing temperatures.

### **The effects of climate change on agriculture:-**

1. The overall predictability of weather and climate would decrease, making planning of farm operations more difficult.
2. Changes in Rainfall Patterns Affect Crop Production: Climate change alters rainfall distribution, causing droughts, floods, and irregular monsoons, which directly affect crop yields and agricultural stability.
3. Climate variability might increase, putting additional stress on fragile farming systems.
4. Climate extremes – which are almost impossible to plan for – might become more frequent.
5. Spread of Pests and Crop Diseases: Warmer temperatures and humidity create favorable conditions for insects, pests, and plant diseases, leading to crop losses
6. The sea-level would rise, threatening valuable valuable coastal agricultural land, particularly in low-lying small islands like Seychelles.
7. Biological diversity such as mangroves and tropical forests could be reduced in some of the world's most fragile environments.

8. Climatic and agro-ecological zones could shift forcing farmers to adapt. Such changes could also threaten natural vegetation and fauna.
9. The current imbalance of good production between cool and temperate regions and tropical and subtropical regions could worsen.
10. Distribution and quantities of fish and foods could change dramatically, wreaking havoc in established national fishery activities.

In this way, Climate change over the long-term, in particular global warming, could affect agriculture in a number of ways – the majority of which would threaten food security for the world's most vulnerable people.

### **Indian perspective as a developing country:-**

India, as a developing country has reasons to be concerned about the adverse impact of climate change on its economy. A large part of its population depends on climate sensitive sectors for livelihoods which makes it highly vulnerable to climate change. Climate change can have serious impact on its crops, forests, coastal regions, etc. which can in turn affect the achievement of its important national development goals. As India has a sizeable service sector (53% of GDP excluding construction and 61% of GDP including construction in 2006-07 & 2007-08 (April-Dec.) and services exports is 35% of total exports in 2007-08 (April-Dec.) and 37% in 2006-07), its economic growth may not be associated with proportionate GHG emissions, though its emissions are bound to grow in short as well as medium term with the upsurge of the manufacturing sector and need for industrialization to meet the growing demands of its huge population.

India, with 17 per cent of the world's population, contributes only 4 per cent of the total global greenhouse gas emissions. Efforts to address climate change adaptation and mitigation needs should not take resources away from the core development needs and growth objectives of the developing countries. Climate Change mitigation and poverty reduction should be addressed simultaneously.

### **Interventions needed**

India has to take on globally the climate change issues it needs to drastically reform its internal agricultural policy preparing itself in a war footing on mitigation and adaptation. As part of the policy suggestion it was found that the following intervention would be needed immediately to equip Indian Agriculture to take on climate change:-

- 1) Zero Tolerance to conversion of agricultural land for non-agricultural use.
- 2) A resolve to make few regions in India chemical and synthetic fertilizer free by 2020.
- 3) An urgent initiative or a bill to conserve biomass in the farm and Waste Recycling for Agriculture.
- 4) Special Intervention from Indian Government to regulate the flood water for effective recharge using deep bore technologies at suitable depths.
- 5) Scaling up the organic agriculture and developing model centre of excellence and shift agriculture subsidies for intensive organic practices.
- 6) Revitalize the rural credit and crop insurance in the context of Climate change.
- 7) Launching of Sustainable Traditional Agricultural Revolution (STAR) using local resources for beating climate change.

### Impact of climate change on poverty:-

Climate change is believed to represent a serious challenge to poverty reduction efforts around the globe. Poverty is the sum total of a multiplicity of factors that include not just income and calorie intake but also access to land & credit, nutrition, health & longevity, literacy and & education, safe drinking water & other infrastructural facilities.

The incidence of chronic poverty in the duration sense is studied on the basis of analysis of panel data sets in the literature. Casual agricultural labourers are the largest group and cultivators the second largest among the chronically poor. The bulk of the chronically poor depend on wages.

While the poverty predictions are based on highly aggregative and simplified model that does not take into account adaptation, the illustrative results suggest that climate change will negatively affect poverty. As the Stern Review (Stern 2007) rightly notes, these poverty impacts are likely to be smaller if aggregate growth in these countries and regions proceeds faster than what is assumed by the IPCC A2 SRES scenario (which assumes, among other things, a high population by 2100 (15 billion) and a world GDP growing at 2 percent per year).

#### Predicted poverty rates with climate change

	Base year 2004/2005	No Growth 2040	Low Growth 2040	Medium Growth 2040	High Growth 2040
<b>Rural</b>	48.8	54.8	35.8	18.3	2.1
<b>Urban</b>	31.1	32.3	15.7	5.8	0.2
<b>All</b>	44.5	49.4	31	15.3	1.1

Notes: Annual growth rates in mean consumption derived from several NSS rounds are drawn from Datt & Ravallion (2011). Low growth refers to 1958- 1991 (0.58 rural and 0.79 urban). Medium growth rates to 1991-2006 (1.17 rural and 1.49 urban). High Growth simply doubles the growth rates under the medium growth rate scenario (i.e. 2.34 rural & 2.98 urban).

Source: Jacoby, Rabassa, and Skoufias (2011)

The estimated impacts of climate change on agricultural yields are generally a poor predictor of the poverty impacts of climate change at the national level. The evidence from the studies that have been carried out so far and reviewed here suggest that the decline in agricultural productivity resulting from climate change translates in much smaller increases in poverty at the national level. This is primarily due to two factors: (i) heterogeneity in how climate change impacts on different geographical areas within countries as well as across the national income distribution; and (ii) heterogeneity in the ability of households to adapt, i.e. moving across space and across sector of employment. It is important to keep in mind that the heterogeneity of impacts of climate change across space is not synonymous to heterogeneity in the ability of households to adapt (ex-ante or ex-post) to the changes in climate.

The eleventh five year plan emphasizes that economic growth is an essential prerequisite to reduce poverty. The poor the most vulnerable to climate change. The former prime minister, late smt. Indira Gandhi had stated, "Poverty is the worst polluter". Therefore development and poverty eradication will be the best form of adaptation to climate change.

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### **IMPACTS ON AGRICULTURE AND FOOD PRODUCTION:-**

The discussion so far has relied on the evidence emerging from the relationship between climate (temperature and precipitation) and growth or the level of GDP. While informative, these studies do not shed any light on the channels through which climate change can impact household welfare. For example, climate change may have a negative effect on agricultural productivity and also affect poor people's livelihood through its effects on health, access to water and natural resources, and infrastructure.

Considering the complexities involved in modeling some of these channels, the literature has largely focused on the impacts on agricultural output. This section reviews the quantitative estimates of climate change impacts on poverty through its effects on agricultural productivity.

Over the last few years a large literature has attempted to quantify the impacts of climate change on agricultural productivity at the regional as well as at the country level. The general consensus emerging from this literature is that climate change will negatively affect agricultural productivity and yields, and that the impacts will vary across countries as well as within countries. To the extent that yield changes are good predictors of the changes in the welfare level of rural households, and ultimately of the changes in the poverty rates at least in the rural areas, these findings suggest that climate change would have significant effects on poverty rates.

Yet, it is quite plausible that the impacts of climate change on agricultural yields may actually be a rather poor predictor of the poverty impacts of climate change. There is a variety of mediating factors that can mitigate the impacts on the level of household welfare, as well as the distribution of these impacts across different households. The list of such factors includes (among others): the extent of autonomous adaptation by households, such as the ability to migrate or switch employment between agricultural and nonagricultural occupations, the extent of policy induced adaptation through prices and explicit government programs, such as providing access to credit and insurance.

Also, the distribution of productive endowments (irrigated and non-irrigated land, skilled and unskilled labor), and the dual role of rural households as consumers and producers of food -and whether they are net consumers or producers- will determine how the impacts are distributed among the population. Economic growth, often absent in the discussion of future impacts of a warming world, will have a tremendous ameliorating effect through the decrease of the food expenditure share on total expenditure, and the reduction of the relative weight of agriculture in national GDP (Nordhaus 1993).

Food production in India is sensitive to climate changes such as variability in monsoon rainfall and temperature changes within a season. Studies by Indian Agricultural Research Institute (IARI) and others indicate greater expected loss in the Rabi crop. Every 1 °C rise in temperature reduces wheat production by 4-5 Million Tonnes. Small changes in temperature and rainfall have significant effects on the quality of fruits, vegetables, tea, coffee, aromatic and medicinal plants, and basmati rice. Pathogens and insect populations are strongly dependent upon temperature and humidity, and changes in these parameters may change their population dynamics. Other impacts on agricultural and related sectors include lower yields from dairy cattle and decline in fish breeding, migration, and harvests. Global reports indicate a loss of 10-40% in crop production by 2100.

The three scenarios of climate change on agricultural productivity (low, medium, or high productivity) to evaluate the resulting changes by 2030 in: (i) global commodity prices, (ii) national economic welfare and (iii) the incidence on the poverty headcount rate (defined as the portion of a nation's population living on less than \$1 a day). The poverty consequences of a decline in agricultural

productivity are evidenced through two channels: changes in earnings and changes in the real cost of living at the poverty line.

### Agricultural production 2010-2011

Crops	2nd advance estimates 2010-2011	Target 2010-2011	Percentage of 2010-2011	2009-2010 Final Estimates	Percentage change in 2010-11 compared to 2009-10
Rice	94.01	102.00	92.17	89.09	5.52
Wheat	81.47	82.00	99.35	80.08	0.83
Coarse Cereals	40.08	44.00	91.09	33.55	19.46
Pulses	16.51	16.50	94.01	14.66	12.62
Total Foodgrains	232.07	244.50	94.92	218.11	6.40

#### National Mission for Sustainable Agriculture – Economic Survey 2010-2011:-

While agricultural productivity is adversely affected by climate change, agricultural activity itself contributes to global warming. The adoption of ‘ecological agriculture’, which integrates natural regenerative processes, minimizes non-renewable inputs, and fosters biological diversity, has tremendous scope for reducing emissions and enhancing soil carbon sequestration. At the same time, many ecological agricultural practices also constitute effective strategies for adapting to climate change, which is a priority for developing countries. This calls for more investment and policy support to be devoted to this productive and sustainable form of farming. Recognizing the challenge of climate change to Indian agriculture, the National Mission for Sustainable Agriculture (NMSA), which is one of the eight Missions under the National Action Plan on Climate Change (NAPCC) has been conceptualized.

It seeks to address issues regarding ‘sustainable agriculture’ in the context of risks associated with climate change by devising appropriate adaptation and mitigation strategies for ensuring food security, enhancing livelihood opportunities, and contributing to economic stability at national level. While promotion of dry-land agriculture would receive prime importance by way of developing suitable drought and pest resistant crop varieties and ensuring adequacy of institutional support, the Mission would also expand its coverage to rain fed areas for integrating farming systems with livestock and fisheries, so that agriculture continues to grow in a sustainable manner.

#### Steps taken by the Government of India:-

India has a very comprehensive framework of legal and institutional mechanisms in the region to respond to the tremendous challenges to the environment it is facing, owing to population growth, poverty and illiteracy augmented by urbanization and industrial development. India is one of the leading developing countries in so far as having incorporated into its Constitution the specific provisions for environmental protection.

- Article **48A** of the Constitution of India provides that ‘the State shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country’.

- Article **51A (g)** makes it obligatory for every citizen of India, ‘to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures.’

Despite the fact that India’s contributions to greenhouse gas emissions are very small, the Government of India has taken many measures to improve the situation in this regard. India has initiated several climate-friendly measures, particularly in the area of renewable energy. It has one of the most active renewable energy programmes besides having a dedicated Ministry for non-conventional energy sources. India had adopted the National Environment Policy 2006, and has also taken many other measures and policy initiatives.

### **National Environment Policy:-**

The principal objectives of the National Environment Policy are the following:-

- Conservation of Critical Environmental Resources
- Intra-generational Equity: Livelihood Security for the Poor
- Inter-generational Equity
- Integration of Environmental Concerns in Economic and social Development
- Efficiency in Environmental Resource Use
- Environmental Governance
- Enhancement of Resources for Environmental Conservation

### **Recent steps:-**

A Council has also been set up under the Chairmanship of the Prime Minister of India on 6 June 2007 constituting eminent persons to evolve a coordinated response to issues relating to climate change at the National level and provide oversight for formulation of action plans in the area of assessment. Prime Minister on June 30th, 2008 released India's **National Action Plan on Climate Change**. The National Action Plan (see GOI, 2008) has been prepared under the guidance and direction of Prime Minister's Council on Climate Change. The National Action Plan reflects the importance the Government attaches to mobilizing our national energies to meet the challenge of climate change. The National Action Plan focuses attention on 8 priority National Missions. These are:-

1. Solar Energy
2. Enhanced Energy Efficiency
3. Sustainable Habitat
4. Conserving Water
5. Sustaining the Himalayan Ecosystem
6. A "Green India"
7. Sustainable agriculture
8. Strategic Knowledge Platform for Climate Change

### **Measures for mitigating climate change:-**

These are as follows:

- (i) Improving energy efficiency & conservation as well setting up a Bureau of Energy Efficiency
- (ii) Power sector reforms
- (iii) Afforestation and conservation of forest
- (iv) Environmental quality management and improving energy efficiency

### **Adaptation:-**

India's expenditure on adaptation as a percentage of total expenditure has suddenly increased from 4.16% in 2004-05 to 8.23% in 2005-06 and 10.62% in 2006-07 and as a percentage of GDP, it has suddenly increased from 0.88% in 2004-05 to 1.61% in 2005-06 and 2.17% in 2006-07. Major components of adaptation include:-

- I. Crop improvement & research
- ii. Drought proofing & flood control
- iii. Health improvement and prevention of disease
- v. Disaster management
- vi. Forest conservation
- vii. Poverty alleviation and livelihood preservation

### **Suggested course of action for adaptation to climate change:-**

These include the following:-

1. Intensify poverty alleviation, especially in regions prone to high climate variability and extreme weather events
2. Intensify research into high yielding heat and drought resistant crop varieties and promote irrigation (local, regional, and national)
3. Promote afforestation for hydrological benefits
4. Intensify programs for known climate variability in all key sectors, including coastal management/cyclone protection
5. Embody climate impacts concerns in all design codes for infrastructure projects.

### **CONCLUSION:-**

The HDR Report 2007/2008 of UNDP has also warned that "Climate change will undermine International efforts to combat poverty..... Climate change is hampering efforts to deliver the MDG promise. ....Looking to the future, the danger is that it may stall and then reverse progress built up over generations not just in cutting extreme poverty but also in health, nutrition, education and other areas". This danger needs to be guarded against with full commitment and zeal. Civil Society has been coming together regionally and nationally to place these traditions squarely in the centre of the response to Climate Change.

As Karnataka moves towards achieving economic and human development, it is important that no group is left behind in the State's road to progress. Ensuring social justice is a crucial factor to ensure inclusive growth. Therefore, the State will enable backward and vulnerable groups to achieve human

development and economic standards on par with the rest of the population, while ensuring their safety and security.<sup>1</sup> Added to this is the problem of reduced share of agriculture in total growth. This is a major problem since agriculture is the livelihood of most workers of the State, and has seen sluggish growth. The rapidly declining share of agriculture in the economy and its poor growth prospects indicate its inability to absorb the growing workforce and provide productive opportunities or higher incomes. This means that the already high disparity between workers in agriculture and other sectors may increase further.

#### REFERENCES:-

1. Mishra & Puri,(2010), Indian Economy, Himalaya Publishing House, New Delhi.
2. Government of India, Economic Survey, 2010-2011
3. India Chronic Poverty Report, Indian Institute of Public Administration, New Delhi, 2011.
4. Poverty impacts of climatic change, The World Bank report, April 2011.
5. Climate Change and India- Some Major Issues and Policy Implications, Department of Economic Affairs, GOI, March 2009.
6. Rosenzweig, C., Iglesias, A., Yang, X.B., Epstein, P.R., & Chivian, E. (2001). Climate change and extreme weather events: Implications for food production. Science.
7. Eleventh Five Year Plan 2007-12, Volume III, Planning Commission, GOI.
8. National Action Plan on Climate Change, GOI.
9. Impacts of Climate Change on Agriculture, Pierre Crosson, June 1997.
10. <http://unfccc.int/2860.php>
11. <http://moef.nic.in/cc/index.htm>
12. <http://www.unep.org/climatechange/>
13. <http://www.indiaclimateportal.org/how-climate-change-affects-india>
14. <http://www.scidev.net/en/features/india-climate-change-facts-and-figures.html>
15. <http://www.indiaclimateportal.org/fast-facts>
16. <http://www.pewclimate.org/facts-figures>
17. [http://planningcommission.gov.in/eg\\_poverty.htm](http://planningcommission.gov.in/eg_poverty.htm)
18. [http://mospi.nic.in/Mospi\\_New/site/home.aspx](http://mospi.nic.in/Mospi_New/site/home.aspx)
19. <http://mhupa.gov.in/>

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<sup>1</sup> Karnataka – A Vision for Development , DECEMBER 2008,available at <http://www.jnanaayoga.in/document/Other%20Resources/State/KVD15th%20Jan%20English.pdf> ,visited on 22-11-2011.