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## CLIMATE CHANGE AND ITS IMPACTS ON AN INDIAN AGRICULTURE

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### A. INTRODUCTION:

The present research paper attempts to review global warming as one of the severe problems of the world that is responsible for climate change. It releases the pollutants harmful to the life on the earth. It affects the environment of the earth. It also affects agriculture. India is an agricultural country. Mostly the fiscal position of the country is dependent on the agricultural production. The agriculture depends on the nature, particularly on the rainy and other seasons. Nowadays the cycle of seasons is changing due to the changing global climate. The global warming is increasing so is changing the conventional pattern of seasons. Untimely rain, wet and dry droughts, cloudbursts, floods are responsible elements for a grand loss received to the kharip and rabi crops in India. The farmers can't repay the loan, debts borrowed from their relatives, friends and banks so they are committing suicides. From 30<sup>th</sup> November to 11<sup>th</sup> December 2015, the UNO's Climate Change Summit is organized in Paris. The Paris Climate Summit, the UN's meteorological agency injected the urgency of the negotiations by announcing that global temperatures were to set to rise 1°C above the pre-industrial era in 2100, which was on course to be the hottest year on record by a wide margin. The summit will meet in Paris to discuss on the limit of global greenhouse gas emissions to level that restricts worldwide temperature rise to 2°C by the end of the century. 2100 will almost be the hottest year around the world since 1880. Average temperatures this year likely to reach global warming milestone of 1°C above pre-industrial level. (*The Times of India-Times Global - dated 27/11/2015*) Though the report-aggregate effect of national climate action plans-noted that the promises made by 146 countries as part of their efforts to fight climate change can dramatically slow global emissions and bring down per capita emissions in next 15 years. Intended Nationally Determined Contribution (INDC) reported that, 'The INDCs have the capability of limiting the forecast temperature rise to around 2.7°C by 2100, by no means enough but a lot lower than the estimated 4.5, or more degrees of warming projected,' said *Christiana Figueres, an executive secretary of the United Nations Framework Convention on Climate Change*. Global average temperature may rise by 2.7°C by 2100 from pre-industrialisation (1880) level (target was to keep it at 2°C). Countries- mainly those having high per capita emission like US, China, Russia and Japan- need to scale up emission cut target.

*Per capita emission in 2030 (in ton):* a) Global: 6.7 b) India: 3.1 c) Russia: 13.4 d) United Nations: 11.9 e) China: 11.9 f) Japan: 11.4 (source: *WRI CAIT 2 version, '14*) (*Sunday Times of India, Nashik dated 1st Nov. 2015*). India also prepared its INDC (post 2020 climate action plan) It is comprehensive and ambitious. Union Minister of Environment, Forest and Climate Change, Prakash Javadekar said that India has pledged to reduce its greenhouse emission intensity by upto 35% by 2030 from 2005 levels, a 75% jump over its present voluntary commitment. He said that India would achieve 40% installed capacity for electric power from non-fossil fuel resources by 2030, a jump of 33%. (*The Times of India - dated 3<sup>rd</sup> October 2015*) He was also interviewed by *TOI* in which he informed that we have already taken a number of measures to increase our carbon sink through a massive afforestation drive and will spend over 2 lakh crore to increase forest cover in coming years. (*The Times of India, Nashik dated 9<sup>th</sup> October, 2015*) The Climate Change Summit COP21 (Conference of the Paris -21) inaugurated on 30<sup>th</sup> Nov. 2015, in Paris. Prime Minister of India Narendra Modi warned the developed countries, which powered their way to prosperity on fossil fuels, that it would be 'morally wrong' if they shift the burden of reducing emissions on developing countries like India. He reiterated his plans to launch an alliance of

121 solar-nations in the tropics aimed at bringing affordable solar power to villages that are off the grid. The summit highlighted the joint responsibility of all nations to keep global warming below 2°C over pre-industrial temperatures. French President Francois Hollande and India's Prime Minister Modi launched an International Solar Alliance in the summit. More than 150 representatives of different countries participated in the summit. (*The Times of India, 1/12/2015*)

#### B) AIMS AND OBJECTIVE:

1. To define global warming
2. To find out causes of global warming
3. To study changing pattern of climate
4. To study how Indian agriculture is affected by global warming and changing climate
5. To suggest preventive measures

#### C) METHODOLOGY:

Used secondary data from the literature, newspapers and various websites, and analyzed the data.

#### D) DISCUSSION:

**Global Warming and its Causes:** 'Global warming is the increase in the average global temperature because of the intensified greenhouse effect'. The global warming is also caused by CO<sub>2</sub> emission by transportation, vehicles, industry, deforestation, combustion of fossil fuels for electricity generation, heating, and the manufacture of cement.

**A Greenhouse:** A greenhouse is a structure covered with glass or plastic used to grow plants, especially in winter. Greenhouses work by trapping heat from the sun. The transparent panels of the greenhouse let in light but keep heat from escaping. This provides enough warmth to the plants to live in the winter. The atmosphere allows most of the sun light to reach the earth's surface and heat it. A part of this energy is radiated back into the atmosphere by the earth's surface. Much of this re-radiated energy is absorbed by molecules of carbon dioxide and water vapour in the lower atmosphere and then reflected back to the earth's surface as heat. This is quite like the greenhouses for plants, which transmit sunlight but hold in heat. Apart from carbon dioxide, some other gases that trap heat in the atmosphere are nitrous oxide, chlorofluorocarbons (CFCs). Together these are called greenhouse gases. The proportion of these gases in the atmosphere is increasing. So more heat is trapped by the atmosphere. The earth has warmed about 1 F (less than 1 c) in last 100 years. Although this trend appears to be small change, the increase would make the earth warmer than it has been in the last 125,000 years, possibly changing climate patterns, affecting crop production, disrupting wildlife distribution, melting glaciers and raising the sea level. These changes would affect the whole world.

**Global Warming and Change in Climates:** The earth's climate is mostly influenced by the first 6 miles or so of the atmosphere which contains most of the matter making up the atmosphere. This is really a very thin layer if you think about it. In fact, if you were to view the earth from space, the principal part of the atmosphere would only be about as thick as the skin on an onion! Realizing this makes it more plausible to suppose that human beings can change the climate. A look at the amount of greenhouse gases we are spewing into the atmosphere makes it even more plausible. The rise in atmospheric carbon dioxide is largely caused by modern industry's widespread combustions of fossil fuels (coal, oil and natural gas), especially in the last 100 years. CFCs are chemicals that were used in refrigerators, air conditioners and in the manufacture of polystyrene products till the year 2005. Human beings have increased the CO<sub>2</sub> concentration in the atmosphere by about thirty percent, which is an extremely significant increase. It is believed that human beings are responsible for this because the increase is almost perfectly correlated with increases in fossil fuel combustion. Combustion of fossil fuels, for electricity generation, transportation, and heating, and also the manufacture of cement, all result in the total worldwide emission of about 22 billion tons of carbon dioxide to the atmosphere each year. This enormous input of CO<sub>2</sub> is causing the atmospheric levels of CO<sub>2</sub> to rise dramatically. The projected increase in CO<sub>2</sub> is very startling and disturbing.

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**History of Global Warming:** Recent years have consistently been the warmest in hundreds and possibly thousands of years. The warming trend has started in about 1900. It might seem a bit surprising that warming started as early as 1900. How is this possible? The reason is that the increase in carbon dioxide actually began in 1800, following the deforestation of much of Northeastern American and other forested parts of the world. The sharp upswing in emissions during the industrial revolution further added to this, leading to a significantly increased carbon dioxide level even by 1900.

**The IPCC and the Study of Global Warming:** Most of the scientific community, represented especially by the Intergovernmental Panel on Climate Change (IPCC — [www.ipcc.ch](http://www.ipcc.ch)), now believes that the global warming effect is real, and many corporations, even including Ford Motor Company, also acknowledge its likelihood.

In 1998, the IPCC was established by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), in recognition of the threat that global warming presents to the world. The IPCC is open to all members of the UNEP and WMO and consists of several thousand of the most authoritative scientists in the world on climate change. The role of the IPCC is to assess the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change. It does not carry out new research nor does it monitor climate related data. It bases its assessment mainly on published and peer reviewed scientific technical literature. The IPCC has completed two assessment reports, developed methodology guidelines for national greenhouse gas inventories, special reports and technical papers. Results of the first assessment (1990—1994): confirmed scientific basis for global warming but concluded that “nothing to be said for certain yet”. The second assessment (1995), concluded that “...the balance suggests a discernable human influence on global climate”, and concluded that, as predicted by climate models, global temperature will likely rise by about 1-3.5 Celsius by the year 2100. The next report, in 2000, suggested, that the climate might warm by as much as 10 degrees Fahrenheit over the next 100 years, which would bring us back to a climate not seen since the age of the dinosaurs. The most recent report, in 2001, concluded that “There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities”. The scientific body predicts a global mean surface air temperature change for the period 2016-2035 compared to 1986-2005 could be in the range 0.4 C-1.0 C. The change, however, is likely to be near the lower range. Scientific evidence, the report claims, shows global combined and ocean temperature data indicates an increase of about 0.8 C over 1901-2010 and about 0.5 C over the period 1979-2010.

#### IMPACTS OF GLOBAL WARMING:

1. **Rising sea water level-** Due to the global warming there is climate change and ice melting so marshlands, low-lying cities, and islands are being covered or flooded with fresh seawater.
2. **Changes in rainfall patterns and its effects on agriculture** - Droughts and fires in some areas, flooding in other areas affect the agriculture of India and other countries. The recent example of global warming is a heavy rainfall in Chennai.
3. **Melting of the ice caps** - Causes loss of habitat near the poles. Polar bears are now thought to be greatly endangered by the shortening of their feeding season due to declining ice packs.
4. **Melting glaciers** - The melting of old glaciers is already observed. Disastrous cloudburst in Uttarakhand, Jammu and Kashmir took place last year.
5. **Spread of diseases** - Migration of diseases such as malaria to new, now warmer, regions take place.

#### CLIMATE CHANGE AND ITS IMPACTS ON AN INDIAN AGRICULTURE:

For India, the area-averaged annual warming by 2020 is projected to be between 1.0 and 1.4°C and between 2.2 to 2.9°C by 2050. Relatively, the increase in temperature would be less in kharip (monsoon season) than in rabi (winter season). The kharip rainfall is expected to increase in most places whereas rabi rainfall may decrease in some areas. The rabi rainfall will, however, have larger uncertainty. The following table projected change in temperature and rainfall due to global warming in different crop seasons in 2020, 2050 and 2080s in south Asia.

Year	Season	Increase in temperature, °C		Change in rainfall, %	
		Lowest	Highest	Lowest	Highest
2020	Rabi	1.08	1.54	-1.95	4.36
	Kharip	0.87	1.12	1.81	5.10
2050	Rabi	2.54	3.18	-9.22	3.82
	Kharip	1.81	2.37	7.18	10.52
2080	Rabi	4.14	6.31	-24.83	4.50
	Kharip	2.91	4.62	10.10	15.18

[http://iari.res.in/?option=com\\_content&view=article&id=198&Itemid=545](http://iari.res.in/?option=com_content&view=article&id=198&Itemid=545)

The needed adaptation measures including changes needed for mitigation to improve agriculture sector in India. It considers the likely changes that climate change will bring in temperature, precipitation and extreme rainfall, drought, flooding, storms, sea-level rise and environmental health risks and the overall impact on agriculture. The agricultural sector is the major source of employment in . Climate change has adverse impacts on agriculture, hydropower, forest management and biodiversity. Anticipated impacts on agriculture from climate change and its various aspects have been studied. Due to the change in climate untimely rainfall, or wet and dry droughts the farmers of India can't manage or plan the crop cultivation. They are in utter disaster , frustration as are under the heavy debt so commit suicide. In India 62% people depend on farming and out of them 60% farmers depend on the rainy water for the agricultural productivity. Due to the untimely rainfall , from Feb. to April 2015 , hundred lakh tons rabi crops spoiled worth Rs.twenty thousand crores .( *Center for Science and Environment –CSE report –Maharashtra Times –dated 29/11/2015*)

A 10-15% increase in monsoon precipitation in many regions, a simultaneous precipitation decline of 5-25% in drought-prone central India and a sharp decline in winter rainfall in northern India are also projected. This implies changes in output of winter wheat and mustard crops in northwestern India.. A decrease in number of rainy days (5-15 days on an average) is expected over much of India, along with an increase in heavy rainfall days in the monsoon season (Indian Institute of Tropical Meteorology, Ministry of Earth Sciences, Government of India). These changes are expected to increase the vulnerability of Indian agriculture. This is particularly important in India, where agriculture is highly sensitive to monsoon variability as 65% of the cropped area is rain-fed.Changes in temperature and precipitation could have a significant impact on more than 350 million people who are dependent on rain-fed agriculture.

Practices and technologies can play a role in climate mitigation and adaptation. This adaptation and mitigation potential is nowhere more pronounced than in developing countries It is estimated that India needs 320 MT of food grains by the year 2025. For a country like India, sustainable agricultural development is essential not only to meet the food demands, but also for poverty reduction through economic growth by creating employment opportunities in non-agricultural rural sectors.

It is possible that climate change may force the pace of rural-urban migration (rurbanisation) over the next few decades. The role of Science & Technology cannot be ignored. Right kind of technologies and policies are required to strengthen the capacity of communities to cope effectively with both climatic variability and changes. Adaptive actions may be taken to overcome adverse effects of climate change on agriculture

‘Small and marginal farmers practising agriculture on rain-fed farms will bear the brunt of climate change’, says *Surinder Sud*.

The vulnerability of Indian agriculture to climate change is well acknowledged. But what is not fully appreciated is the impact this will have on rain-fed (non-irrigated) agriculture, practiced mostly by small and marginal farmers who will suffer the most. The crops that may be hit include pulses and oilseeds, among others. These are already in short supply and are consequently high priced. Nearly 80 million hectares, out of the country's net sown area of around 143 million hectares, lack irrigation facilities and, hence, rely wholly on rain water for crop growth. Over 85 per cent of the pulses and coarse cereals, more than 75 per cent of the oilseeds and nearly 65 per cent of cotton are produced from such lands. The crop yields are quiet low. The available records indicated that the predominantly rain fed tracts experience three to four droughts every 10 years. Of these, two to three droughts are generally of moderate intensity and one is severe Most of the rain-fed lands, moreover, are in arid and semi-arid zones where annual rainfall is meagre and prolonged dry spells are quite usual even during the monsoon season. This makes crop cultivation highly risk prone. If

the quantum of rainfall in these areas drops further or its pattern undergoes any distinct, albeit unforeseeable, change in the coming years, which seems quite likely in view of climate change, crop productivity may dwindle further, adding to the woes of rain-fed farmers. According to A K Singh, deputy director-general (natural resource management) of the Indian Council of Agricultural Research (ICAR), medium-term climate change predictions have projected the likely reduction in crop yields due to climate change at between 4.5 and 9 per cent by 2039. Though the rainfall records available with the India Meteorological Department (IMD) do not indicate any perceptible trend of change in overall annual monsoon rainfall in the country, noticeable changes have been observed within certain distinct regions.

SurinderSud

(<http://www.rediff.com/money/.../guest-impact-of-climate-change-on-indian-agriculture/20100406.ht>)

#### E) SUGGESTIONS:

1. We need new to use technologies, such as hydrogen technology, as quickly as possible. The most promising sector for near term is reductions in fossil fuel electricity. Wind power, solar energy, nuclear energy these unconventional sources should be used in spite of fossil fuel energy. So clean climate will be created and the farmers will not be affected by the drought, cloudburst, untimely rainfall, and changing cycle of seasons. So they would not receive loss and commit suicides.
2. The carbon dioxide levels are rising dramatically. There is no debate about this. If we continue to use fossil fuels in the way we presently do, then the amount of carbon we will release will soon exceed the amount of carbon in the living biosphere. So we should reduce the use of fossil fuels.
3. A major increase in renewable energy use should be achieved to help offset global warming. While there are some US government programs aimed in this direction, there is simply not enough money being spent yet to achieve this goal in a timely manner. A primary goal of many new programs is not to increase renewable, but rather, is to find ways to capture the extra CO<sub>2</sub> from electricity generation plants and "sequester" it in the ground, the ocean, or by having plants and soil organisms absorb more of it from the air.
4. There should be an improvement in forecasting & early warning systems. It would help the farmers for crop management and prevent the loss.
5. We should be public awareness and efforts should be made to reduce emission of carbon per capita.
6. There must be the creation of community-based forest management, afforestation projects and improvement in irrigation. So farmers would get irrigated water for rabi crops.

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