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CLIMATE CHANGE AND ITS IMPLICATION CROP AND FOOD SECURITY

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Abstract: *Improving living standards for mankind has been the single minded goal of all nations and world bodies. After defining development in numerous way for over decades, there seems to be a consensus on 'Human Development'. While a large population on the earth is still to get the 'bare minimum' for development humanity is at the crossroads where it is faced with the first of it kind challenge-the challenge of 'climate change'. The dilemma is that whatever we can do our development there has t be a repercussion on nature. An even bigger dilemma is in achieving a global consensus on how to cheek or restrict and finally reverse the process of climate change. Climate change is disturming the natural and ecosystems and expected to have substantial adverse effect in India, mainly on agriculture (on which 58% of the population still depends for livelihood), water storage in Himalayan glacious which are the source of major reveres and groundwater recharge, sea-level rise and threats to a long coastline and habitations. Climate change will also cause increased frequently of extreme event such as floods and droughts. These is turn impact India's food security problems and water security. The cropping patter in India has undergone significant change over time. As the cultivated area remains more or less constant. The increased demand for food, because of increase in population and urbanization, puts agricultural land under stress, resulting in crop intensification & crop substitution of food crops with commercial crops. India attained self sufficiency in food crops with security still evades the country. Food security still evades the country, food security making food available at affordable price at all items, without interruptions. Through India's GDP growth has been impressive and the agricultural production has also increased over the past few decades, hunger and starvation still persist among the poorer sections of the population.*
Keywords: *Climate change, Implication crop, Food, Security, Emission*

Introduction: Improving living standards for mankind has been the single minded goal of all nations and world bodies. After defining development in numerous ways for over two decades, there seems to be a consensus on 'Human Development'. While a large population on the earth is still to get the 'bare minimum' for development humanity is at the crossroads where it is faced with the first of its kind challenge--the challenge of 'climate change'. The dilemma is that whatever we can do for our development, there has to be a repercussion on nature. An even bigger dilemma is in achieving a global consensus on how to check or restrict and finally reverse the process of climate change.

We are consider the year 2012, arguably, a high water mark in the field of environment and sustainable development initiatives, The global community met at the UN Conference on Sustainable Development that took place in Rio in June 2012, also marking the 20th anniversary of the first Earth Summit held in 1992. The conference reviewed the progress made, identified implementation gaps, and assessed new and emerging challenges, which resulted in a political outcome called the 'The Future We Want'. In India the Twelfth Five Year Plan was launched with a focus to sustainable growth. This along with sustainable development policies and programmes, which are being followed signaled to citizens at home and the world at large that India is committed to sustainable development with equal emphasis on its dimensions--Social, economic and environmental.

A survey of the global comparative opinion shows that people in India and indeed all countries, have a marked and rising concern about sustainable development and climate

change (cited by the Economic Survey 2014-15). However, the challenge also formidable, especially in the context of finding the matching resources of the required magnitude given the economic conditions. Climate science has rightly taken up important position in the public debate. Even as the science of climate change grapples with uncertainties, the word is witnessing more extreme event. With rising extreme event and rising citizen demand, the world has little option but to listen to the voice of evolving science and respond adequately strategies and policies rooted in the principles of multilateralism with equitable and fair burden sharing [1].

Since 2010 onwards, the world has witnessed increasing numbers of natural disasters and extreme weather conditions--frequently getting news headlines across the world. Policy-makers have been facing enormous pressure on availability of clean air, water and energy together with the problems of poverty and hunger, especially in the developing world, Though, the concerns of climate and environment have been there in India Policies, we see it increasing in the past half a decade.

The year 2015 witnessed two landmark international events--the historic climate change agreement under the UNFCCC in Paris in December 2015 and the adoption of SDGs (Sustainable Development Goals) in September 2015. The Paris agreement aims at keeping the rise in global temperatures well below 2^0C, which will set the world towards a low corbon, resilient and sustainable future, while the sustainable Development Goals, which replace the MDGs (Millennium Development Goals), set the development agenda for the next fifteen years. On the domestic front too some important climate-related initiatives were taken, including the launching of the historic International Solar Alliance (An Initiative taken by India) and the submission of the ambitious INDC (Intended Nationalty Determined Contribution).

As per the WMO (World Meteorological Organization) 2015 was the warmest year with temperature 1^0C above the pre-industrial era. This was owing to EI Nino and warming caused by greenhouse gases (GHGs). Anthropogenic emissions have been increasing at an unprecedented rate since the industrial revolution. According to an IEA (International Energy Agency) report 2015, concentration of CO_2 in 2014 was 40% higher than in the mid-1800s. The energy sector is the largest contributor to GHG emissions and within this CO_2 emissions from combustion of fuels have the largest share. The global emissions profile shows [2] that emissions have been distributed very unequally among deferent countries.

If historical CO_2 emissions from 1970 to 2014 are considered, India with 39.0 Gt is way behind the top three emitters- the USA (232 Gt), EU (190.2 Gt) and China (176.2Gt). USA's emissions, for example, were around six times India's. Even if historical levels are discounted and only present levels considered, both in terms of absolute and per capita emissions, India is way behind the three major CO_2 emitters. Per Capita emissions for USA, EU, China and India are 17 ton/capita, 7.5 ton/capita, 7 ton/capita and 2 ton/ capita, respectively. In terms of sectoral CO_2 emissions from fuel combustion, electricity and heat production was the largest contributor for china, India, the EU and the USA, more so for China and India followed by the manufacturing industry for India and China and transport sector for US and the EU. These compositional patterns reflect the different priorities of these countries.

Agriculture remains the most important sector of the Indian Economy, whether it be the pre-independence or the post-independence periods. This fact is emphatically proved by the large number of people who depend on it for their livelihood. Before starting any discussion on Indian agriculture, we must look of special features.

From the monetary point of view the share of the agriculture sector in the economy remains at 17.4% of GDP [3]. In the fiscal 1950-51 agriculture accounted for 55.4% of the GDP.

The share of agriculture has been falling in the country's gross income, while industrial and services sectors' shares have been on a rise constantly. But from the livelihood point of view still 48.9% of the people of India depend on the agriculture sector [4]. This makes it a more important sector than the industry and the service (for Nepal and Tanzania the dependency for livelihood on agriculture is still higher at 93% and 81%, respectively). It means that 48.9% of population lives with only 17.4% of the total income of the Indian economy--this fact clearly substantiates the reason why the people who depend on agriculture are poor. In the developed economies such as the USA, France, Norway, The UK and Japan, agriculture contributes only 2% of their GDP with only 2% of the people dependent on this sector for their livelihood.

2015-16, foodgrains production is estimated to be 253.16 million tonnes(AE) [5] higher by 1.14 million tonnes over the production of 252.02 million tonnes during 2014-15. The acreage under several crops declined substantially in 2014-15 as compared as 2013-14.

Productivity of major crops is lower in case of India as compared to the world's best practice. Trough it has been improving with a show pace, the productivity of rice, wheat and pulses improved from 2202 kg, 2802 kg and 625 kg per hectare of 2007-08 to 2390 kg, 2872 kg (falling from 3026 kg of 2011-13) and 744 kg per hectare in 2014-15 [6]. A total of 66.1% of the cropped area in the economy still depend on the uncertainties of monsoon for their irrigational requirements [7]. There are certain special terms used to understand the cropping seasons of India. The agriculture crop year in India is from July to June. The Indian cropping season is classified into two main season- (1) *Kharif* and (2) *Rabi* based on the monsoon. The *kharif* cropping season is from July to October during the South-West/summer monsoon and the *rabi* cropping is from October to March (North-East/Returning/Winter monsoon). The crop grown between March and June are summer crops, known as Jayads.

The *kharif* crops include rice, maize, sorghum, pearl miller/bajra, finger miller/ragi (cereals), arhar (pulses), soyabean, groundnut (oilseads), cotton, etc. The *rabi* crops include wheat, barley, oats (cereals), chickpea/ gram (pulses), linseed, mustard (oilseeds), etc.

Materials and Methods: The Govt. of India Used to estimate crops production using data from the Survey on agriculture out by the National Agriculture/Economic Survey (Govt. of India). The methodology for estimation of crops production followed by Agriculture Ministry Govt. of India has been based on the recommendations of the Expert Group headed. As per this methodology, crops production for the period 1950 to 2014 are as given below:

Table : Crop Production Estimate 1950-51 to 2014-15

Crop	Year 1950-51 Avg.	1st plan 1951-58 Avg.	2nd plan 1958-61 Avg.	3rd plan 1961-68 Avg.	4th plan 1969-74 Avg.	5th plan 1975-79 Avg.	6th plan 1980-85 Avg.	7th plan 1985-90 Avg.	8th plan 1992-97 Avg.	9th plan 1997-2002 Avg.	10th plan 2002-07 Avg.	11th plan 2007-12 Avg.	12th plan 2012-13	12th plan 2013-14
														(Million Tonne)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rice	208	250	303	381	418	473	545	651	787	873	856	973	1052	1062
Wheat	64	79	97	111	254	298	412	283	629	713	702	844	955	935
Jwar	55	75	87	88	83	108	113	109	107	78	72	70	53	55
Bajra	26	34	34	39	60	50	60	52	67	71	82	82	87	88
Maize	17	27	36	46	61	63	73	76	98	116	140	198	223	233
Others Cereals	61	66	65	63	64	71	60	54	49	45	36	40	37	40
Pulses	84	101	117	111	109	117	118	125	133	131	133	159	183	198
Total Fertilizer	508	632	740	810	1030	1181	1381	1550	1890	212	2020	2374	2571	2632
Oil Seeds	62	55	67	73	83	89	114	139	219	219	232	289	209	330
Cane	571	553	803	1092	1281	1533	1749	1964	2584	2924	2770	3258	3412	3459
Cotton	30	39	48	54	59	68	75	84	122	108	160	281	342	355
Pastsan	33	39	44	57	55	52	64	89	81	96	101	103	109	114

Results and Discussion: The set and combination of crops which farmers opt for in particular region, in their farm practices is cropping pattern of the region. Multiplicity of cropping system has been one of main features of Indian agriculture and it is attributed to rainfed agriculture and prevailing socio-economic situations of the forming community.

The cropping pattern in India has undergone significant changes over time. As the cultivated area remains more or less constant. The increased demand for food, because of increase in population and urbanization, puts agricultural land under stress, resulting in crop intensification & crop substitution of food crops with commercial crops [5].

Cropping system of a region are decided, by and large, by a number of soil and climatic parameters, which determine the overall agro-ecological setting for nourishment and appropriateness of a crop or set of crops for cultivation. Nevertheless, at farmers' level, potential productivity and monetary benefits act is guiding principles, while opting for a particular crop or cropping system. These decisions with respect to choice of crops and cropping system are farther narrowed down under influence of several other focus related to infrastructure facilities, socio-economic and technological factors, all operating interactively at the micro-level. These a factors are- (i) Geographical factors: Soil, landforms, precipitation, moisture, altitude, etc, (ii) Socio-cultural factors: Food habits, festivals, tradition etc, (iii) Infrastructure factors: Irrigation, transport, storage, trade and marketing, post-

harvest, fuel, handling & processing etc, (iv) Economic factors: Financial resource base, land ownership, size and type of land holding, household needs of food, fodder, fiber and finance, labour availability etc, (v) Technology factors: Improved varieties of seed and plants mechanization, plant protection, access to information etc.

India attained self-sufficiency in food by late 1980s, though food security still evades the country, Food security making food available at affordable price at all items, to all, without interruptions. Through India's GDP growth has been impressive and the agricultural production has also increased over the past few decades, hunger and starvation still persist among the poorer sections of the population. Lack of food security hampers the nutritional profile of the vulnerable section of the population. Chlorine and protein intake of a large number of people in India, specially in rural area, are lower than normal [8], As per state of food insecurity in the World, 2015 (FAO), India has the second higher number of undernourished people at 194.6 million which is around 15.2% of the world's total undernourished population.

Two important things need attention regarding India food security- (1) Around 27% of India population is BPL and a greater portion (one conservation estimate puts in at 75%) of their household income is spent on food. (2) There is a strong correlation between stability in agriculture Production impacts food supplies and can result in spikes in food prices, which adversely affect the lower income groups of the population.

Therefore, along with provision of food subsidy, stability in agricultural commodity prices is essential for making the poorer sections food secure. It means, in the direction of assuring food security, India needs to tackle mainly two hurdles- (1) Enhancing of food production. If food (i.e., food grains) is to be supplied to all today India will face deficit of around 30 million tonnes of food grains. This shows the food insecurity dimension of India. (2) Strengthening supply chain, Managing the issues like storage, transportation, proper retailing and integrating the segmented agri-markets into a national agri-market.

Due to high level of undernourishment and volatility to agricultural prices. India has one of the largest number of food schemes in the World to insure food security. There is entitlement feeding programmes like Integrated Child Development Scheme (ICDS- covers all children under 6, pregnant & lactating mothers). Mid Day Meal Scheme. Food subsidy programmes like the targeted Public Distribution System. Annapurana and the Employment Programmes Like Mahatma Gandhi National Rural Employment Guarantee Scheme. (100 days of employment at minimum wages to ensure food security)

Till the vulnerable population is not enabled with the market-linked purchasing capacity, these programme will be relevant in case ensuring food security in the country. There is a need to run these schemes with utmost focus of beneficiaries. Climate change is disturbing the natural and ecosystems and is expected to have substantial adverse effects in India, mainly on agriculture (on which 58% of the population still depends for livelihood), water storage in Himalayan glaciers which are the source of major reveres and groundwater recharge, sea-level rise, and threats to a long coastline and habitations. Climate change will also cause increased frequency of extreme event such as floods and droughts. These is turn will impact India's food security problems and water security. As per the Second National Communication submitted by India to the UNSFCC, it is projected that the annual mean surface air temperature rise by the end of the century range from 3.5^0C to 4.3^0C, where as the sea level along the Indian coast has been rising at the rate of about 1.3 mm/year an average. The climate change projections are likely to impact human health, agriculture, water resources, natural ecosystems and biodiversity.

Concerned of the threats imposed by climate change and pressures on natural resources, sustainability and environment are increasingly taken centre stage in the Indian policy domain. India has been part of 94 multilateral environmental agreements. India has also voluntarily agreed to reduce its emission intensity of its GDP by 20-15 per cent over 2005 levels by 2020, and emissions from the agriculture sector would not form part of the assessment of its emissions intensity. Indian economy is already moving along a lower carbon & sustainable path in terms of declining carbon intensity of its GDP which is expected to fall further through lower carbon strategies. It is estimated that India's per capita emission in 2031 will still be lower than the global/capita emission in 2005 (in 2031, India's per capita GHG emissions will be under 4 tonnes of carbon

dioxide equivalent (CO_2 eg.) which is lower than the global per capita emissions of 4.22 tonnes of CO_2 in 2005).

Together with the national efforts in different sectors, India also recognizes that rural areas are equally prone to stress and pressures from natural resource exploitation. In this context, scheme for rural development and livelihood programmes are very relevant. A vast majority of the works under the mahatma Gandhi National Rural Employment Guarantee Scheme are linked to land, soil and water. There are also programmes for non-timber forest produce-based livelihood, promotion of organic and low chemical agriculture, and increased soil health and fertility to sustain agriculture-based livelihood. These schemes help mobilize and develop capacities of community institutions to utilize natural resources in a sustainable manner and their potential can be further developed.

Along with effort incorporate sustainability in the rural development process, India is increasingly making effort to integrate the three pillars of sustainable development into the national policy space. In fact, environment protection is enshrined in our Constitution (Article 48A and 51A). Various policy measures are being implemented across the domains forestry, pollution control, water management, clean energy and marine and coastal environment. Some of these are policies like joint Forest Management, Green Rating for Integrated Habitat Assessment, Coastal Zone Regulation Zone, Eco Labeling and Energy Efficiency Labeling. Fuel Labeling organizational structure has been developed for environment protection.

Conclusion: Above discussion have demonstrated the effects on crops production and food security to changing climate. Climate change is disturbing the natural & ecosystems and is expected to have substantial adverse effects in India, mainly on agriculture (on which 58% of the population still depends for livelihood), water storage in Himalayan glacier which are the source of major reveres and groundwater recharge, sea-level rise, and threats to a long coastline and habitations. Climate change will also cause increased frequency of extreme event such as floods and droughts. These is turn will impact India's food security problems.

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