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A Commentary on Economic Impact of Climate Change on Indian Farmers

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Introduction

Climate change is a threatening reality and has forced countries across the world to come together on various platforms in order to fight it with a strong resolve. However, three years after the adoption of the Paris Agreement, global climate actions are not yet sufficient to limit global warming or rising temperature and overall climate fluctuations. Source of climate change and its impact is however, not distributed equally. The causes of climate change, mainly human activities have been unequally undertaken by the countries, but the impact of the climate change, is borne unequally by others. It is often said that the poor bears the cost of the rich when it comes to climate change. Europe and North America have gained at the cost of environment and while the impact is severe on non-western countries due to lack of their economic might and technological advancements. The same is also true in terms of rural and urban areas in a country. While it's the urban population that exploits the resources at a much faster pace, it is the rural population that pays the price. Economic effect of climate change is one of the many effects it has on people's life, including health, social being and lifestyle.

Farmers have faced the ill effect of climate change since quite some time in form of erratic and hug fluctuations when it comes to important climate components, like temperature and precipitation. It is much more important for India for two major reasons - India has a huge chunk of its population engaged in agriculture as its primary income activity, and second, Indian farmers are much more dependent on rains and other natural resources for growing crops than their western counterparts, in the absence of requisite capital, skill and technological advancement. Clearly, the economic impact that a farmer in India bears is much more than the urbanite in India or a farmer in the western economy.

Hence, it is critical to assess and understand the 'why' and 'how' of the economic impact of climate change on Indian farmers, so that there are better policies that could be drawn in for the most affected group of population, who probably have the least to do with the reasons for climate change.

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Climate change and its impact

Climate change has been touted as the one of the most critical problem that the communities are facing today. Climate change and its impact has a strong economic connotation with respect to individuals at micro level and communities and country on a macro level (Climate Change, 2019). Activities such as construction of dams, industrial units, destruction of forests, increase in land for agricultural usage and heavy urbanisation etc are some of the major reasons that have caused imbalance between the human settlement and environment (EnviStats, 2019), leading to climate change.

Climate change is caused by multiple reasons, including but not limited to, growth of CO2 and other greenhouse gases in the atmosphere. Climate change not only impacts areas like agriculture, forestry, and aquatic to mountain ecosystems, it also has an economic impact on societies. Besides, factor like temperature, solar radiation and precipitation have potentials to influence crop production (Malla, 2009) and rotation.

More reasons attributed to climate change have been classified by (Smith, Schellnhuber, & Mirza, 2001) in their important work on vulnerability of climate. Among various other relationships mentioned by the author on the subject, the relationship between global mean temperature increase and the probability of extreme weather events is important.

Also, the relationship between greenhouse concentrations and the probability of large-scale singular events has had significance in the climate change study (Smith, Schellnhuber, & Mirza, 2001).

Climate change and its impact in India

Climate change in India stresses the ecological structure of the country which is already facing pressure from rapid urbanisation and industrialisation (Climate Change Scenarios for India, 2019). India's climate sees wide variation where the range swings between extremes of heat to extremes of cold, from extreme aridity and negligible rainfall to excessive humidity and torrential rainfall. The rainfall in India shows great variation across the year. This is strictly seasonal and distributed geographically.

Figure 1: Average Temperature by Cropping Season - Kharif and Rabi (Degree Celsius) Source - Economic Survey 2017-18 Volume 1

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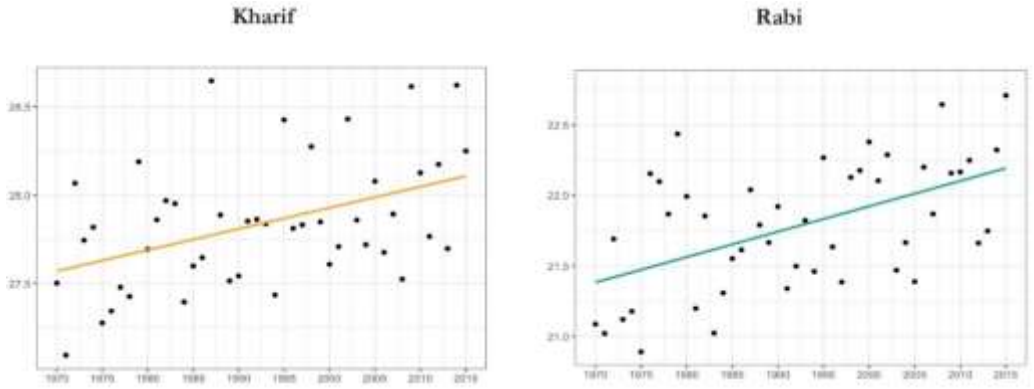
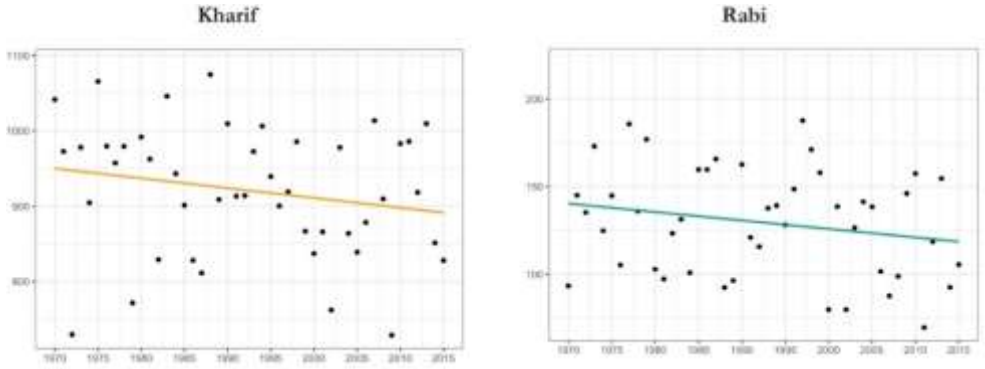


Temperature variations are also notable in the Indian sub-continent, which can be attributed to the large geographical landscape with multitude of differences when it comes to geography across the country (Economic Survey, 2017-18). The below scatter plots show the variation over a period of 45 years in temperature and precipitation in India in Kharif and Rabi cropping seasons.

Figure 2: Average Precipitation by Cropping Season - Kharif and Rabi (Millimetres) Source - Economic Survey 2017-18 Volume 1



Clearly, from the scatter plots above, it's clear that the impact of temperature and rainfall is non-linear, and felt almost only when temperature increases and rainfall shortfalls are extreme (Economic Survey, 2017-18). The report further states that these shocks have highly divergent effects between unirrigated and irrigated areas (and consequently between crops that are dependent on rainfall), which explains the different impact of these variations on different geographies and rural areas.

Some countries are more vulnerable to the effects of climate change than others. This is due to various factors like the density of economic activity, share of population

reliant on economic activities that are based on natural resource and rainfall. India is one such country which makes it one of the more vulnerable countries in the world (Climate Change, 2019). Climate change is making the world warmer and disrupting rainfall patterns. No country is immune to these forces, but India is particularly vulnerable (Padmanabhan, Alexander, & Srivas, 2019)

Climate change affects economic activities in India in many ways. Its impact on water resources and availability is a major reason that makes the country like India, due to its dependence on rain for its agricultural and livelihood need, as well as to quench thirst of an ever-growing population, much more susceptible to dangers of climate change (Climate Change, 2019). About 2,400 people lost their lives in India in 2018-19 to events directly or indirectly related to extreme weather events such as floods and cyclones. The India Meteorological Department (IMD) says these events are increasing in both frequency and intensity Extreme events may be the most tangible and immediate impact of climate change, but another more long-term and equally dangerous effect is rising temperatures (Padmanabhan, Alexander, & Srivas, 2019).

Within India also there are some regions which are more vulnerable to climate change than others. It depends on several factors such as access to infrastructure (electricity, roads and water connections) and dependence on agriculture. Clearly those regions which are heavily dependent on agriculture and have weak or dilapidated infrastructure are more at risk.

This has also been emphasised by the World Bank (Padmanabhan, Alexander, & Srivas, 2019). While climate change has inadvertently increased the temperature in the urban cities, in coastal cities, climate change-induced rising sea levels also pose an additional threat through more frequent flooding and even submerging (Kumar C. P., 2012). India ranks 11th in this year's Climate Change Performance Index, or CCPI. CCPI is an instrument designed to enhance transparency in international climate politics. Its aim is to put political and social pressure on countries. It is released by – Germanwatch, NewClimate Institute & Climate Action Network, a climate change watchdog based out of Germany.

As per the report, while India improved its performance in the Renewable Energy category, joining the group of medium performers, its continued affinity towards coal could be an issue in its climate change resolve. This pose a risk of offsetting positive developments in the renewable energy sector (Germanwatch, 2019).

In terms of global greenhouse gas emissions, India's share remains significantly lower than those of both the US and China. In many ways, India is paying for the excesses of the developed world. There are several domestic drivers to the contribution of climate change in India. The country relies on coal for electricity (two third of India's emission come from energy production) which acts as a major contributor to the emissions leading to climate change. This causes serious air pollution while also aiding into climate change which is detrimental for the environment and rural economy

(Padmanabhan, Alexander, & Srivas, 2019). Finally, while climate and its change is a global phenomenon, it does not impact the whole globe in the same way, ironically enough, it's the world's wealthiest countries that contribute the most to climate change, the world's poorest and most vulnerable bear the brunt of its impact.

Economic impact of climate change on Indian farmers

Rural economy, and farmers particularly bear the brunt of climate change more than anyone else. The monsoon and suitable temperatures, which are factors of climate and hence are susceptible to climate change, are critical inputs for farmers. A disruption in normalcy of these factors invariably hurts cop yields (quantity and quality), and consequently, farmer income (Padmanabhan, Alexander, & Srivas, 2019).

Extreme temperatures and droughts, which are a closely linked outcome to climate change, if not directly, then indirectly, shrink farmer incomes by up to 4-14% for key crops (Economic Survey, 2017-18). As mentioned earlier farmers in those region which are more vulnerable to the effects of climate change due to higher dependency on rains and have poor infrastructure around them, are especially more vulnerable to the effects of climate change

Often the inaction by countries and organisations against the activities that lead to climate change and climate change itself is due to the opining that some scientists carry about the cost of climate change to the global economy being lesser than the cost it requires to control the climate change, essentially the activities that cause climate change (Quiggin & Horowitz, Costs of Adjustment to Climate Change, 2001). This view have been propagated by many more authors (Mendelsohn, Nordhaus, & Shaw, 1994) and (Cline, 1992). However (Quiggin & Horowitz, 1999) showed in their research that the main costs of climate change will be costs of climate change is for adjustment. And this loss will be enhanced if the process of climate change is variable and stochastic.

The Indian Agriculture Ministry in one of its submission to the parliament of Indian stated that the weather events that are typical of outcome of climate change are costing the country $9-10 billion annually. To add to this figure, climate change is projected to impact agricultural productivity, which in turn will also lead to financial losses to the farmers and the country overall. These vagaries which are caused by climate change are also expected to increase starting 2020 and would continue to affect the country and agriculture sector up to the end of the century (Economic Survey, 2017-18). To add, the figures which have been quoted from the mid-year report of the Economic Survey, are expected to rise if the extent of climate change is aggravated owing to increased activities that lead to the same.

Natural calamities which are some way or other are affected by the extreme change in climate have too resulted in huge economic losses. The 2014 floods in Kashmir cost more than $ 15 billion and Cyclone Hudhud the same year cost $ 11 billion. How much of this loss can be attributed to the intensity that was accentuated due to the climate change, cannot be said, but it is clear that some part of this economic devastation can

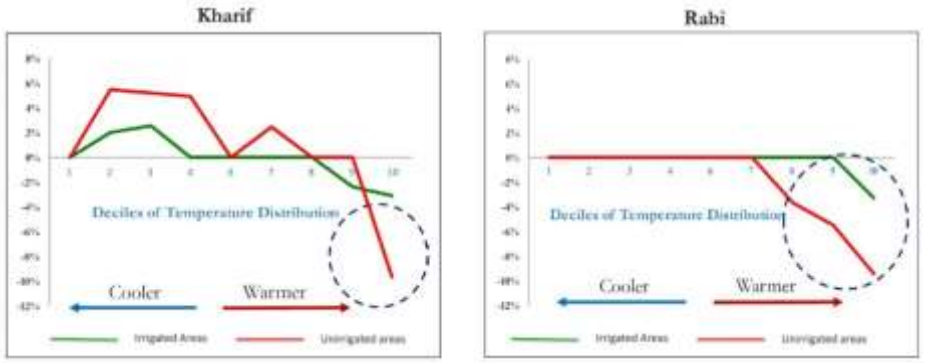
be attributed to the acute climate change owing to extreme human exploitation (Mohan, 2017).

Unfortunately, in an under-insured country like India most of the assets and properties as well as crops and produce, is not insured. This means the financial burden of the loss of climate change is often borne by the poorest, all alone.

As per (Economic Survey, 2017-18) the impact of temperature and rainfall is felt only in the extreme; but it impacts significantly more in unirrigated areas (and hence rain fed crops) compared to irrigated areas which are again farmed by the most vulnerable of the lot. The GoI projections based upon climate change predict that it could reduce annual agricultural incomes in the range of 15 percent to 18 percent on average, and up to 20 percent to 25 percent for unirrigated areas.

This can be easily corroborated from the charts given below which captures the impact of unpredictable variation in temperature and precipitation on the crop yield for Kharif and Rabi cropping seasons. This is a strong measure of the economic impact caused by the vagaries of the climate change. The x-axis depicts deciles of temperature and rainfall, with the 5th decile being the middle category (normal temperature and rainfall) against which all comparisons are made.

Figure 3: Effects of Temperature on Yields



Source - Economic Survey 2017-18 Volume 1

Figure 4: Effects of Rainfall on Yields

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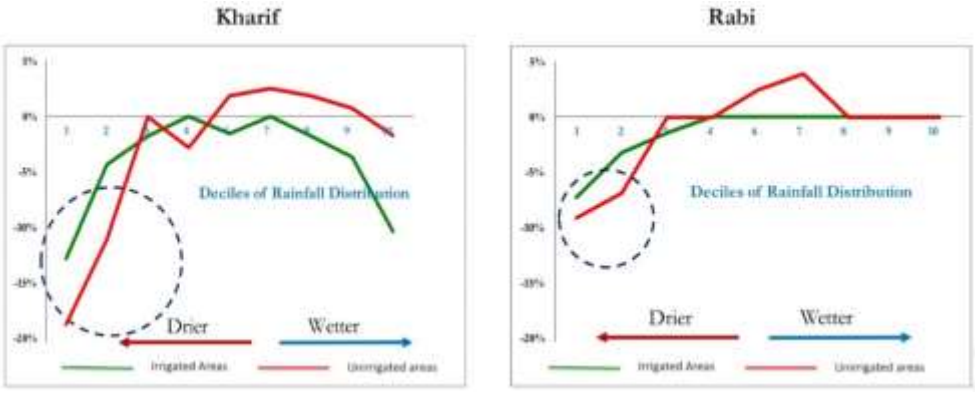

Source - Economic Survey 2017-18 Volume 1

The charts explain that the productivity or crop yield falls with the extreme variation in temperature as well as rainfall. However, this productivity or crop yield must be quantified to ascertain the 'Rs loss' on revenue, that a farmer bears due to the extreme variation in temperature and rainfall that is the symptom and outcome of climate change. The below table depicts the 'Rs loss' as a percentage of revenue on Kharif and Rabi crop under extreme temperature and rainfall situation.

Table 1: Impact of Weather Shocks on Farm Revenue

Crop Season	Irrigation Status	Temperature Variation	Rainfall variation
Kharif	Irrigated	7.0%	7.0%
Kharif	Unirrigated	5.1%	14.3%
Kharif	*Overall*	*4.3%*	*13.7%*
Rabi	Irrigated	3.2%	4.0%
Rabi	Unirrigated	5.9%	6.6%
Rabi	*Overall*	*4.1%*	*5.5%*

Source - Economic Survey 2017-18 Volume 1

Cleary, there is an 'lost' income implication of the tune 3% to 14% for the farmers, associated with the limited cases with given boundaries mentioned in the table. It can

also be established that Kharif crops generally are more vulnerable to the climate shocks than Rabi crops.

Unirrigated crop is always at a higher risk for its dependency upon the rains in order to grow. These findings are in line with another research conducted by (Dell, Jones, & Olken, 2012) who not only found the direct relation between extreme temperature and farm productivity but also pointed out an impact on the growth of the productivity year on year. (Fisher, Hanemann, Roberts, & Schlenker, 2012) established a clear association between the agricultural output and random fluctuations in weather in their research, negatively linking weather fluctuations with the agriculture output.

These insights could be helpful while making policy decisions in order to shield farmers from the vagaries of the climate change so that they don't lose their investment on farming. Though the research from (Fisher, Hanemann, Roberts, & Schlenker, 2012) is from the US, the farmer income and productivity are much worse in India. The changing climate and its outcome is expected to have a worse effect on the low income countries like India. The proportion of damage faced by countries like Indian economically is much higher than its western counterpart, even when they have not been a major source of the overall problem (IMF Publication, 2017).

On the similar lines, was the study done using the InfoCrop-WHEAT model by (Kumar, et al., 2014). The study projected that climate change will reduce the wheat yield in India in the range of 6% to 23% by 2050 and 15 to 25% by 2080. It went on to state that the negative impacts of climate change are going to be less severe in low-emission scenarios than in high-emission scenarios and south-central regions of India may be more affected again highlighting the higher vulnerability faced by the Indian subcontinent with respect to the climate change and its outcome in terms of temperature and rainfall fluctuations. Climate change is quite likely going to hurt the agricultural sector as lower yields is a sign of poor productivity leading to lower incomes and higher food prices (Wiebelt, Al-Riffai, Breisinger, & Robertson, 2015).

Analysis of the impact of climate change on the farming income is especially important giving the vulnerable economic situation farmers are in. Unlike other sectors the net farm income often declines year on year also hurting the investment rate in farming at the start of the year (Chand, Saxena, & Rana, 2015). A comparison of the income of a farmer with the poverty line for rural India shows that the average income of a farmer household dependent on agriculture is only 58% above the poverty line based on the Tendulkar methodology (Planning Commission, 2013).

The average farm income per farm household is estimated to be Rs 77,230, while the poverty line for a family of five members in rural areas is Rs 48,960 (Chand, Saxena, & Rana, 2015). It is well established that most farmers have to keep a secondary job in order to not fall below the poverty line when the daily sustenance become a challenge. Hence, climate change and its impact on farm income becomes a key area for research

in order to establish its magnitude and the required policy intervention in agriculture and non-agriculture areas.

Discussion and Conclusion

Climate change is a looming danger in front of everyone, with a multitude of dangers, direct as well indirect. Economic impact of climate change is a crucial phenomenon, especially since the people who are going to be affected the most due to climate change are also the ones who are the most vulnerable. Living in rural areas in the poorest belts, climate change is most dangerous for these people, than anyone else. Climate and environment dictate their way of life, socio-culture set-up, and economic sustenance.

Climate change has a strong impact on economic activities and outcome, especially for the people who are dependent upon farming as a primary or only source of income. Indian is an agrarian economy in context with the number of people employed in this sector. Poor agriculture practices, lack of investment for modern equipment and technological backwardness, along with smaller land ownership have already ensured that the sector has been unproductive for majority of farmers.

Climate change adds to the agony of the already reeling sector and stressed farmers. Indian farmers are dependent upon rains for their crops. Lack of irrigation infrastructure has ensured that this has been the case for time immemorial. Climate change causes various unpredictable changes in the weather, the most important being fluctuation in temperature and rainfall. This leads to erratic temperature cycle and rainfall which is completely unpredictable. These fluctuations affect the yield and brings down the productivity further.

For a large set of farmers this brings farms distress that adds to their existing troubles. Most small farmers in India do farming with the money received through credit. Crops in India are generally not insured with figures ranging from two-third to four-fifth produce not insured. In an event of untimely rain or non-conducive temperature, the farmer faces loss of crop, but that does not relive him from the loan which he had taken to do farming. This puts him in a debt cycle which is almost impossible for marginal farmers to get out of. It ultimately leads to them selling off their land and become daily wage labour. Since a huge population of farmers in India is small and marginal, a bad monsoon and an erratic temperature can be detrimental to his financial position. The effects that climate change has over a farmer who has lost his crop or whose yield has fallen, are far reaching in terms of social and financial extent.

With climate change leading to extreme swing in temperature and untimely rains, the instances as mentioned above increase many fold for farmers, causing more farmers to fall into debt trap. These debt cycles with no realistic way to get out of it, have also been the reason of the extremely unfortunate incidences of farmer suicides. Almost all farmer suicides are linked to financial distress of the farmer, which is often due a failed

crop. Climate change as a phenomenon single headedly has potential to increase such unfortunate incidents owing to erratic climate behaviour which leads to failed crops and economic distress among farmers. Conclusively, climate change affects the most vulnerable section of the society which can hardly invest into remedies to stop the change. It is up to the governments, and private sector along with the citizens to adopt ways and approaches to tackle the menace of climate change that would help the vulnerable sections of the society and have them lead a better life with dignity and certainty.

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