Climate Change's Impact On Asia's Agriculture

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ABSTRACT: Asian agriculture is responsible for two thirds of global agricultural GDP. There have been numerous studies exploring the impact of climate change on crops in specific locations in Asia but no study has yet analyzed crops across the entire continent. This study relies on a Ricardian study of China that estimated climate coefficients for Chinese crops. These coefficients are then used to interpolate potential climate damages across the continent. With carbon fertilization, the model predicts small aggregate effects with a 1.5°C warming but damages of about US$84 billion with 3°C warming. India is predicted to be especially vulnerable. South Asia is home to more than a fifth of the world's population and is recognised for being the world's most disaster-prone area. South Asia is one of the most sensitive regions to the effects of climate change due to high rates of population increase and natural resource degradation, as well as persistently high rates of poverty and food insecurity.

KEYWORDS: Agriculture, Asia, Climate Change, Impact, Ricardian.

1. INTRODUCTION

Agriculture is one of the most susceptible industries to the impending climate change. Despite technical improvements, such as the Green Revolution, in the second part of the twentieth century, In most places, weather and climate are still major determinants of agricultural production. of the globe Temperature and rainfall patterns are expected to alter, as well as their timing. Water availability, pests, illness, and extreme weather occurrences are all factors to consider. expected to have a significant impact on agricultural output potential[1]**.** The literature on climate change economics shows that, while world crop output may be increased, In the medium future (before 2030), it will be influenced little by global warming, but it will eventually turn negative. in the long run . Furthermore, climate change has a negative influence on the environment. It is doubtful that agricultural production will be divided equitably among areas. a narrow range of options The agricultural consequences of globalisation are projected to be more severe in poorer nations. higher agricultural role in climate change, reflecting their disadvantaged geographic location Their economies are strained, and they have limited capacity to adjust to climate change. Climate change, on the other hand, will typically boost agricultural output in high latitude locations. Cline (2007) estimated that if global warming continues unchecked, worldwide agricultural production will fall by 15.9% in the 2080s, with poor nations seeing a disproportionately higher loss of 19.7%. Agriculture is important in Southeast Asia, producing more than 10% of gross domestic product (GDP) in most economies and employing more than one-third of the population. the region's working population. As in other emerging regions throughout the world, In Southeast Asia, approximately three-quarters of the poor live in rural regions, with a vast majority of them living in poverty. Agriculture is their primary source of income for many of them. As a result, agricultural growth is crucial. implications for poverty alleviation in Southeast Asia Furthermore, because Southeast Asia's agriculture sector is more exposed to international commerce, any climate change-related shocks in world agricultural markets would be quickly communicated to the area via trade channels[2]. In this study, a dynamic computable general econometric model was employed.

Asia is the world's most populous continent, with 63 percent of the world's population. Asian farmers, on the other hand, now account for 67 percent of world agricultural production thanks to the green revolution[3]. The area is self-sufficient in terms of food. Will Asian agriculture, however, be harmed by future global warming? This article investigates Asian agriculture's temperature sensitivity and predicts what will happen if temperatures continue to increase. 1) Agronomists carried out controlled tests in greenhouses at various temperatures. 2) Key grains including maize, wheat, soybeans, and rice are modelled in agronomic crop simulations. 3) Cross-sectional yield studies of particular grains have been carried out in various climatic zones. 4) Land values and agricultural net income were used to build cross-sectional economic models across climatic zones[4][5]. All of these studies show that crops are sensitive to temperature fluctuations. The consistency of these data implies a high degree of certainty that crops are susceptible to climate change. The main question in this study is not if climate change would harm Asian crops, but how much will it influence them. Despite the fact that several research have been conducted throughout Asia, the outcomes are mixed. Many studies, for example, are looking at how climate change may effect crops and farmers in China, India, and other Asian countries. Yet, a full examination of Asian agriculture as a whole has yet to be completed.

The goal of this study is to bridge the gap until a more complete investigation can be undertaken. To gain a feel of the extent of possible consequences, the sensitivity function between agricultural net revenue and climate from China is extended to surrounding Asian nations. The study's 29 Asian nations are listed in detail in the Appendix[6]. The Middle East, as well as numerous Asian islands, are not included. The specific extent of climate change's influence will be determined by the scale of the climatic change under consideration. Climate change models using the RCP 6.0 emission scenario anticipate a wide range of warming between 1.4 and 3.1°C by 2100. As a result, we investigate both a moderate 1.5°C warming and a more extreme 3°C warming over the 1960-1990 climatic normals. Because this climate change won't happen until 2100, we'll look at agriculture in 2100 and compare results to the existing environment (1960-1990) to these warmer possibilities.

South Asia, which consists of eight nations (Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka), is the world's most densely populated geographical region, with almost one fifth of the world's population . South Asia is renowned for being the world's most disaster-prone area. Although the agricultural sector in South Asia continues to develop, its relative importance is diminishing, both in terms of GDP contribution) and labour force share. Farm households are expanding their sources of income beyond agriculture as urbanisation grows. Agriculture's relative decrease is unavoidable in nations that suffer from climate change[7]. The region has experienced extensive economic expansion. Nonetheless, agriculture continues to employ a large percentage of the economically active people in South Asia, and agricultural employment is especially essential for the poor. A majority of the world's impoverished live in South Asia. In 2009, 1.02 billion people were undernourished worldwide, according to the FAO. In South Asia, it is estimated that 456 million people are malnourished.

1.1 Climate Change And Agriculture:

Agriculture is influenced by the weather in a number of ways. Temperature, radiation, rainfall, soil moisture, and carbon dioxide (CO_2) concentration are all key factors that influence agricultural production, yet their interactions aren't always straightforward. Current research indicates that certain climatic factors have thresholds over which agricultural yields fall. Modeling studies mentioned in previous IPCC reports, for example, show that moderate to medium increases in mean temperature (1–3°C), as well as related CO_2 rises and rainfall changes, are likely to enhance temperate agricultural yields. Moderate temperature rises (1–2°C) in low-latitude locations, on the other hand, are expected to have a detrimental influence on main crop yields. Warming of more than 3 degrees Celsius would have detrimental consequences in every location. The influence of climate change on soil moisture is determined by the combination of rising temperatures and changing rainfall patterns. Evaporation and precipitation are predicted to increase as temperatures rise. The net effect on water availability would be determined by which force is stronger. According to the IPCC assessments, water availability will rise at high latitudes and in certain wet tropical areas as a result of climate change by the middle of the twenty-first century, while decreasing at mid-latitudes and in the dry tropics. Some areas that are already prone to drought may see even more severe dry spells[8].

Increases in CO_2 concentration in the atmosphere can benefit crop yields by increasing photosynthesis and lowering water loss through plant respiration. For so-called C_3 crops1 including rice, wheat, soybeans, fine grains, legumes, and most trees, which have a lower rate of photosynthetic efficiency, this carbon fertilisation impact is substantial. These impacts are significantly less for C_4 crops including maize, millet, sorghum, sugarcane, and many grasses. Increases in CO_2 concentration in the atmosphere can benefit crop yields by increasing photosynthesis and lowering water loss through plant respiration. For so-called C_3 crops1 including rice, wheat, soybeans, fine grains, legumes, and most trees, which have a lower rate of photosynthetic efficiency, this carbon fertilisation impact is substantial. These impacts are significantly less for C_4 crops including maize, millet, sorghum, sugarcane, and many grasses.

1.2 Climate Change Impacts in South Asia

Climate changes in South Asia are expected to be diverse and heterogeneous, with some parts suffering more intense precipitation and higher flood hazards, while others see sparser rainfall and extended droughts, according to projections. The effects will differ depending on the sector, region, and population. In tropical regions of South Asia, where these crops are already cultivated close to their temperature tolerance threshold, rising temperatures will have a detrimental influence on yields of rice and wheat. While direct effects from rising temperatures are expected to be seen, indirect effects from water availability, altering soil moisture status, and insect and disease incidence are also likely to be felt. Small-holder rainfed farmers, who make up

the bulk of farmers in this region and have limited financial and technical capability to adjust to climate unpredictability and change, are expected to bear the brunt of the effects[2].

According to the World Bank, rising temperatures would cause a fall in living conditions in more than half of South Asia, affecting agricultural productivity and potentially sparking mass migration. 375 million people might be harmed in the next 30 years, even if emissions are decreased. Due to melting polar ice caps, sea levels are predicted to rise by one to three metres by 2100. A one-meter rise would put 23 million people at risk in China's coastal districts, while a three-meter rise would put 52 million people at risk. China's coastal regions may be submerged for up to 71,000 square kilometres.

1.3 Impacts Of Natural Disasters:

Natural calamities strike South Asia at an alarmingly high rate. Between 1990 and 2008, natural disasters impacted over 750 million people, or half of the region's population, killing almost 60,000 people and causing billions of dollars in damage. Damages totaling $45 billion. In many regions of South Asia, the frequency of more extreme rainfall events has increased, resulting in severe floods, landslides, debris and mud flows, but the number of wet days and total annual precipitation has dropped. Droughts are becoming more frequent and intense in many regions of South Asia, owing in part to rising temperatures, notably during the summer and typically drier months, and during ENSO occurrences. Droughts and intense rainfall events are becoming more common, which might lead to a drop in tea output, especially in areas below 600 metres. The tea business is a key source of foreign money and a substantial source of income for Sri Lankan labourers, thus the consequences are expected to be severe. During the years 1962–1988, Bangladesh lost an average of 0.5 million tonnes of rice per year due to floods, accounting for approximately 30% of the country's average annual food grain imports. Drought frequency and severity have risen as a result of global warming, according to mounting data. A worldwide research found that dry and semi-arid regions are more susceptible to sudden changes in rainfall, and that this sensitivity is presumably connected to significant positive feedbacks between plant and climate interactions. Droughts may have socio-economic consequences as a result of interactions between natural and human variables, such as changes in land use and land cover, as well as water demand and consumption. Drought can be exacerbated by excessive water withdrawals. Changes in the frequency of severe events will have an influence on land degradation processes including floods and mass movements, as well as water and wind erosion and soil salinization.

1.4 Impact Of Water Resources:

Because water resources and climate are closely connected, the threat of global climate change has significant consequences for water resources and regional development. Water recharge rates and soil moisture conditions are expected to be impacted by a rise in severe rainfall, with the possibility for significant rainfall episodes spread over a few days. Floods and droughts will be more likely as a result of a warmer environment with more climatic variability. Great rivers abound in South Asia, and they are the lifeblood of the region's economy. The Himalayan-Hindu Kush mountain range's ice mass is the source of Asia's nine major rivers, including the Ganges, Brahmaputra, and Indus. More over half of the world's population gets their water from these rivers. During the dry season, many people in Asia rely on glacier melt water. Accelerated glacier melt calls into doubt several of the Himalayan running rivers' perennial character. Great rivers abound in South Asia, and they are the lifeblood of the region's economy. The Himalayan-Hindu Kush mountain range's ice mass is the source of Asia's nine major rivers, including the Ganges, Brahmaputra, and Indus. More over half of the world's population gets their water from these rivers. During the dry season, many people in Asia rely on glacier melt water. Accelerated glacier melt calls into doubt several of the Himalayan running rivers' perennial character.

Climate change has an especially negative influence on freshwater in semi-arid and desert regions. Climate change may lengthen the dry season in semi-arid regions. season of no or extremely low flows, which disproportionately impacts water consumers who are unable to rely on the supply.

On deep groundwater wells or reservoirs Groundwater and precipitation are the primary sources of freshwater for the Maldives' population. Both of these water sources are vulnerable to climate change and rising sea levels. With the islands of the Pacific, Because the Maldives are low-lying, rising sea levels are expected to drive seawater into the islands. into the lens of freshwater Rainfall recharges the groundwater table[7][9]. Although an improved climate regime is expected to increase rainfall, the geographical and temporal distribution of rainfall patterns remains unknown.

For every 1°C increase in temperature, agricultural irrigation demand in Asia's arid and semi-arid regions is expected to rise by at least 10%. Efforts to compensate for declining surface water availability due to increasing precipitation variability will be hampered by the fact that groundwater recharge will drop significantly in some already water-stressed areas, where vulnerability is often exacerbated by rapid population and water demand growth.

2. LITERATURE REVIEW

R. Mendelsohn [10] proposed that agriculture in asia accounts for two-thirds of worldwide agricultural output. Numerous studies have looked at the influence of climate change on crops in specific parts of Asia, but none has looked at crops throughout the whole continent. The climatic coefficients for Chinese crops were calculated in a Ricardian study of China. These equations are then used across the continent to interpolate future climatic harm. The model forecasts minor collective impacts with carbon fertilisation with a 1.5°C warming but damages of around US$84 billion with a 3°C warming. India is expected to be particularly at risk.

M. V. K. Sivakumar and R. Stefanski [3] proposed that South Asia is home to more than a fifth of the world's population and is recognized for being the world's most disaster-prone area. The high prevalence of with continued high rates of population increase and natural resource deterioration South Asia is one of the most susceptible regions due to poverty and food insecurity. climate change's consequences Climate patterns in the past and present, in general, South Asia's variability is marked by rising air temperatures. Moreover, the severity and frequency of severe occurrences are on the rise. Throughout the last century in South Asia South temperature forecasts for the twenty-first century show a considerable acceleration of warming over the twentieth century. According to recent modelling studies, warming would be considerable across the Himalayan Highlands, including the Tibetan Plateau, as well as dry parts of Asia. Extreme weather occurrences, such as heat waves and blizzards, are becoming more common.

3. DISCUSSION

Climate change is one of the most important issues of the twenty-first century. As a multidisciplinary problem, global warming and its impacts on climate change are being explored in depth. As a result of the increased greenhouse effect, significant changes in climatic variables such as absolute humidity, precipitation, and net terrestrial and global solar radiation are predicted. On a global and regional scale, atmospheric temperature is perhaps the most commonly used indicator of climate change. During the late 1800s, global temperatures increased by 0.3–0.6 degrees Celsius, and by 0.2–0.3 degrees Celsius in the previous 40 years Climate change cannot be avoided. Improved photosynthesis, reduced photorespiration, and lower stomatal conductance may all contribute to increased crop growth and yield. A rise in temperature, on the other hand, may reduce rice and wheat grain yields since crop growth occurs over a shorter period of time. When CO2 levels rise, the protein content of legume grains may decrease. Because of enhanced mineralization and phosphatase enzyme activity in the rhizosphere, higher CO2 concentrations may improve soil N and P availability. C3 plants will certainly compete considerably more fiercely against C4 crops than they do now, and vice versa. Increased heat and humidity can lead to an increase in the number of people who get sick.

Southeast Asia is a major agricultural producer and consumer, with numerous agricultural goods playing a significant role in the global economy. The aggregate production losses from climate change-related agricultural productivity reductions would be minimal for most Southeast Asian nations, given the expected fall in agriculture's percentage of GDP. Southeast Asia's reliance on agricultural imports, on the other hand, is likely to increase in the future decades.

4. CONCLUSION

Climate change is becoming a more serious worldwide issue, with severe consequences already being seen in some parts of the globe. The long-term economic impacts of climate change are assessed in this article using a global CGE model. The findings imply that the world economy will be moderately impacted by agricultural damages induced by climate change. The effects, on the other hand, are not uniformly spread throughout the globe. Climate change would cause disproportionately huge losses in developing countries. Climate change may be accompanied by major changes in global agricultural output and commerce, as well as the distribution of wealth. Southeast Asia is a major agricultural producer and consumer, with numerous agricultural goods playing a significant role in the global economy. The aggregate production losses from

climate change-related agricultural productivity reductions would be minimal for most Southeast Asian nations, given the expected fall in agriculture's percentage of GDP. Southeast Asia's reliance on agricultural imports, on the other hand, is likely to increase in the future decades. Southeast Asian economies would incur higher welfare losses if terms of trade deteriorated as a result of their increased exposure to global agricultural markets. This impact is particularly noticeable in Malaysia and Singapore. Because of its enormous population, high number of impoverished people experiencing food insecurity, and inadequate soil and management methods on marginal lands in semi-arid regions, South Asia is one of the world's most vulnerable regions to climate change. resulting in increased rates of land degradation and climate change projections Agriculture, forests, and fisheries are all changing. The rural poor's coping capacity, particularly in marginal regions, is low, and there is a need to include excellent climate change adaptation strategies into regional sustainable development planning. This process might be aided by a better knowledge of climate change consequences, susceptibility, and adaptation methods to cope with climate change.

Agriculture's technical development is one important source of unpredictability. The most crucial line of defence for global food security has been, and will continue to be, agricultural productivity increases. However, during the last two decades, the Green Revolution's productivity gains have begun to show indications of exhaustion. If growing demand for agricultural goods, driven by population and economic development, keeps pace with technical advancement in the future, the effects of climate change on agriculture might be significant. This is particularly true in Southeast Asia, where crop production growth has been negative since 1980. Reversing the downward trend in agricultural production would be a key component of a Southeast Asian plan to deal with the potential threats posed by climate change.

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