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Impact of Climate Change on Agriculture Productivity

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Abstract: ***An Environment is everything that is around us, which includes both living and nonliving things such as soil, water, animals and plants, which adapt themselves to their surroundings. It is nature's gift that helps in nourishing life on Earth. Agriculture is strongly influenced by weather and cli-mate. Agriculture production is dependent on climatic and weather conditions but now-days increasing in temperature, precipitation, Climate change is a global threat to the food and nutritional security of the world. As greenhouse-gas emissions in the atmosphere are increasing, the temperature is also rising due to the greenhouse effect. The average global temperature is increasing continuously and is predicted to rise by 2 ◦C until 2100, which would cause substantial economic losses at the global level. CO2 concentration directly affects crop production. The CO2 concentration is rising at a rate of 1.8 to 2.2 ppm per year average but CO2 concentration rising rate might be varies as per country to country in North Africa zone. Decline in rainfall of 1.10 percent and 7.0 percent in 2050, of 11.0 percent and 7.6 percent in year 2100 and 3-4 degrees Celsius temperatures are increased by the end of the 21st century should be observed in North Africa. Increasing in 10C in temperature reduces wheat production by 4 to 5 percent. The dependence of some regional agriculture on remote rainfall, snowmelt and glaciers adds to the complexity. Indirect impacts via sea-level rise, storms and diseases have not been quantified. Per-haps most seriously, there is high uncertainty in the extent to which the direct effects of CO2 rise on plant physiology will interact with climate change in affecting productivity. At present, the aggregate impacts of climate change on global-scale agricultural productivity cannot be reliably quantified. In this research paper, we are analyzing the impact of climate change, global warming, CO2 in Agriculture area.***

Keywords*:* Climate change; climate-smart agriculture; food security; climate impacts, economics, greenhouse.

1. Introduction

Agriculture is strongly influenced by weather and cli-mate. While farmers are often flexible in dealing with weather and year-to-year variability, there is nevertheless a high degree of adaptation to the local climate in the form of established infrastructure, local farming practice and individual experience. Climate change can therefore be expected to impact on agriculture, potentially threatening established aspects of farming systems but also providing opportunities for improvements. The impacts of climate change on global agricultural productivity through a wide range of processes. The aim is to provide a global-scale overview of all relevant impacts, rather than focusing on specific regions or processes, as the purpose of this review is to inform a wider assessment of the risks to global food security. Although there are a large number of studies which focus on the impact of a particular aspect of climate. Change in a specific location, there are relatively few studies which provide a global assessment. Moreover, these studies tend to focus more on the direct effect of changes in the mean climate state on crop growth and do not consider changes in extremes or in indirect effects of climate change such as sea-level rise or pests and diseases. A comprehensive, internally consistent assessment of all potential direct and indirect effects of climate change on agricultural productivity has not yet been carried out. As a step towards such a full-system assessment, we complement each stage of our review of the literature with presentation of project changes in relevant climate-related quantities from the Met Office Hadley Centre (MOHC) models. This allows a comparison of the different aspects of climate change relevant to agricultural productivity, so that the relative importance of the different potential causes of impacts can be assessed. This provides some context to decision making in an area of high uncertainty, and also informs future research directions.

As the scientific consensus grows that forceful climate change, in particular, increased precipitation and temperatures, is very likely to appear over the 21st century (Christensen and Hewitson 2007), economic research has attempted to measure the possible effects of climate change on society. Due to universal climate change, one of the biggest effects is expected to be on agriculture and many impacts also expected. Agriculture production is directly dependent on weather and climate change. Possible changes in rainfall rates, change in temperature and CO2 concentration are expected to significantly impact crop growth. Worldwide food production is considered to be little cautious with successful adaptation and adequate irrigation due to brunt of climate transformation. Global agricultural production should be promotes because of doubling of the CO2 fertilization effect. Agriculture will also be impacted due to climate changes imposed on water resources in Libya. There is now a great problem about deterioration in soil fertility, promote salinity, change in the water table, degradation of irrigation water quality and defiance many pesticides. In North Africa, North America, South America, Northern Asia as well as Central Asia has been found increase in rainfall. Tropics and Subtropics have been facing severe and long-lasting droughts since the 1970s whereas areas like Africa, and Central Asia have parched land. Changes in both crop yields and requirement for irrigation water under short term climate scenarios are estimated through simulation models and this tools is also used for estimating likely effects of climate on crop yields. Small-scale farmers face a series of challenges, to which climate change will be risk multiplier. They include poor natural resource management (especially of water and land), limited land tenure security, small farm sizes, low technological access, low market access and limited investment reported that changes in climate and atmosphere as inevitable for the coming decades, raise concerns regarding the adaptive ability and/or the likely responses of the agricultural sector. Information on the fiscals of climate transformation suggests that global crop production may be increase lightly by global warming in the short term (before 2030), it will later turn negative over the deeper term. Climatic change effects world-wide, which effects significant perturbations that can be expected to be natural systems that have possible effects on the fiscal policies of highland range through both direct and indirect.

2. Impacts of Climate Change on Agriculture

Agriculture in Libya is assumed to have a negligible effect on the overall increase in the number of greenhouse gases. This is attributable to the minimal use of fertilizers and low soil fertility levels in the country. Change in frequencies, types, and intensities of various livestock pests and crops; the availability and limit of irrigation water supplies; and the harshness of soil erosion changes because of climate change. Due to extreme and unsuitable weather conditions in Libya, there exist high chances of soil infertility leading to a decline in the quantity and quality of the crop. Change in climate will affect the groundwater recharge, soil moisture, and frequency of drought or flood, and groundwater level in different areas. Increased soil temperature may also lead to an increase in autotrophic CO2 losses from the soil caused by root respiration, root exudates, and fine-root turnover. In general, current information from various method including soil chemistry, soil physics, agro-meteorology, plant breeding, crop physiology, and agronomy, into a set of mathematical equations to achieve growth, development, and In areas where temperatures are already close to the physiological maxima for crops, such as seasonally arid and tropical regions, higher temperatures may be more immediately detrimental, increasing the heat stress on crops and water loss by evaporation. A 28C local warming in the mid-latitudes could increase wheat production by nearly 10 per cent whereas at low latitudes the same amount of warming may decrease yields by nearly the same amount (figure 1). Different crops show different sensitivities to warming. It is important to note the large uncertainties in crop yield changes for a given level of warming By fitting statistical relationships between growing season temperature, precipitation and global average yield for six major crops, warming since 1981 has resulted in annual combined losses of 40 million tons or US$5 billion (negative relationships between wheat, maize & barley with temperature).

Figure (1 &2) show two scenarios for changes in mean annual temperature at relative to present day. All areas of cropland are projected to experience some degree of warming, but the largest change in warming is projected in the high latitudes. However, small increases in temperature in low latitudes may have a greater impact than in high latitudes (figure 1), possibly because agriculture in parts of these regions is already marginal.

Water is vital to plant growth, so varying precipitation pattern have significant impact on agriculture. As over 80 per cent of total agriculture is rain-fed, projections of future precipitation changes often influence the magnitude and direction of climate impacts on crop production. The impact of global warming on regional precipitation is difficult to predict owing to strong dependencies on changes in atmospheric circulation, although there is increasing confidence in projections of a general increase in high-latitude precipitation, especially in winter, and an overall decrease in many parts of the tropics and sub-tropics which project different signs of precipitation change averaged over all croplands, even though there is agreement in the sign of change in some regions. One scenario which predicts an overall increase in precipitation, shows large increases in North Africa but also significant decreases in the tropics and sub-tropics. The other scenario also shows the decreases in the low latitudes but without significant increases.

This reflects the wide range of projections of pre-capitation change from different climate models. The differences in precipitation projections arise for a number of reasons. A key factor is the strong dependence on changes in atmospheric circulation which itself depends on the relative rates of warming in different regions, but there are often a number of factors influencing precipitation change projections in a given location.

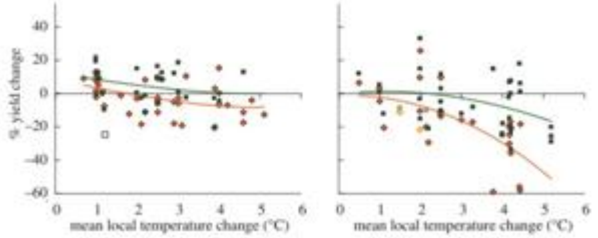

Figure 1: Sensitivity of cereal maize (mid- to high-latitude and low latitude)

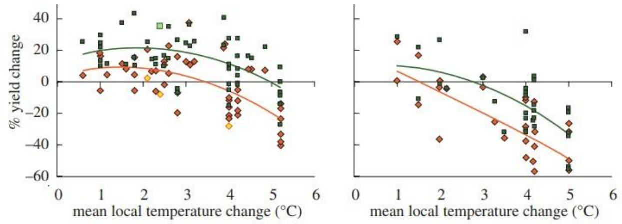

Figure 2: Sensitivity of cereal wheat (mid- to high-latitude and low latitude),

Scenarios of future change in meteorological, hydrological and plant physiological variables relevant to agricultural productivity, selected from an ensemble of 17 scenarios with variants of the HadCM3 climate model. Results are presented as means over global cropland areas for 30-year periods centered on 2020 and 2050, relative to 1970–2000 (except for extreme temperature which is relative to 2000). Two scenarios are presented for each variable, spanning the range of results for each variable to illustrate uncertainties in the projections. For further details see the electronic supplementary material.

Change in annual mean temperature (8C)		
Scenario T1	1.1	2.6
Scenario T2	0.6	1.6
Change in annual mean precipitation (mm d21)		
Scenario P1	0.04	0.05
Scenario P2	-0.04	-0.08
Change in 20-year extreme temperature (8C)		
Scenario ET1	1.0	2.7
Scenario ET2	0.4	1.5

Change in annual mean net primary productivity (kg C $m^{22}y^{21}$)		
Without CO2 fertilization	-0.02	-0.06
With CO2 fertilization	0.08	0.17

3. Simulations and Results

A baseline scenario from 1990–2050 was constructed under the assumption that there would be no climate change impacts on economic activities. The baseline scenario provided a reference growth trajectory for examining the effects of climate change-induced agricultural damages. In the baseline, GDP growth up to 2013 was exogenous, derived from the International Monetary Fund's (IMF) medium baseline projection. For each region, an economy-wide, labor-augmented productivity grew endogenously over the simulation period of 1990–2020 to match the pre-specified GDP growth path. After 2020, the productivity growth rate was held fixed at the level of 2020 up to 2040, and then declined by 1% per year afterwards. The supply of agricultural land was assumed to be fixed in high-income countries and to grow by 0.12% annually in Asia and 0.2% annually in Latin America, Africa and other regions. The baseline scenario projected a high rate of world economic growth over the next seven decades, with global GDP growing by an average of 3.1% per year over the period of 1990– 2020, and slowing down to 2.5% per year between 2050. The average annual growth of north africa over 2010-2050 was 1.2 percentage points higher than that of the world average, and its share in global GDP increased from less than 2% in 2000 to 4.1% in 2050. Growth was accompanied by rapid structural change in developing countries. The share of agricultural value added, in volume terms, would decline from nearly 10% in 2000 to 3.8% in 2050 in north Africa & world slightly change. Even though some Asian & African countries had trade surpluses in agricultural products in the base year, they would become net importers in the next decade because of the combined effects of economic growth, industrialization, and land constraints. However, Thailand, the Philippines and Central Asia were expected to maintain surpluses in agricultural trade over the projection period. In the counterfactual scenario with agricultural damages, it was assumed that productivity in four crop agricultural sectors (paddy rice, wheat, other grains, and other crops) would be lower than that in the baseline scenario because of the projected changes in climate. Crop productivity shocks, which were Cline's estimates without carbon fertilization effect as reported in the crop productivity shocks were assumed to be uniform across sectors. The impacts of climate change were assessed by a comparison of the counterfactual scenario with the baseline scenario.

Simulated impacts on global welfare, GDP, and agricultural production, which are reported as percentage deviation from the "no damage" baseline. The table indicates that global real GDP would decline by 1.4% by 2050 as a result of the predicted impacts of climate change on agricultural productivity. African country suffer the largest GDP loss of 6.2%, followed by Sub-Sahara Africa, other South Asian countries, and Central Asia. Although the estimated productivity losses from Cline's study were modest for the overall Central Asia region, high agricultural shares in some of the region's national economies account for the relatively large loss of GDP in Central Asia & Africa zone. North Africa would see a drop in real GDP of 2.8 %, similar to that of the world's average. Aggregate welfare effects, which were measured by the sum of equivalent variation of the households and real investment, generally followed the changes in real GDP. However, international price adjustment played a role in determining the distribution of global welfare losses. After incorporating agricultural damage, international prices of crop products were expected to increase by 16–22% relative to the price of manufacturing exports of high income countries, reflecting the inelastic demand structure of agricultural products (Figure 3). The resulting changes in terms of trade would benefit net agricultural exporting countries, but damage net agricultural importing countries.

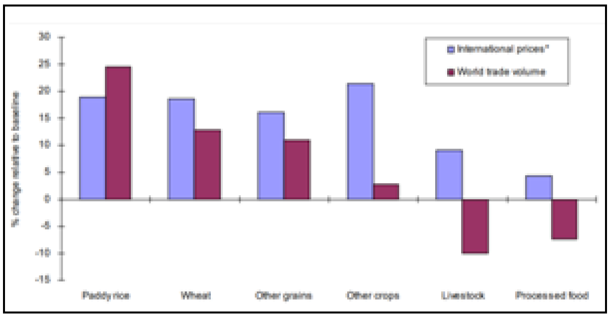

Figure 3: Climate Change on International Prices and World Trade of Agricultural Goods, 2050

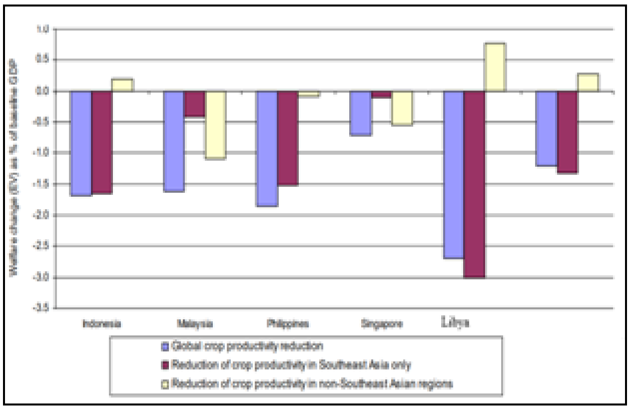

Figure 4: Decomposition of Welfare Impacts, 2050

The pattern of changes in production factor gains and losses is specific to each country. In general, following negative agricultural productivity shocks, the average return to agricultural factors of production would rise relative to non-agricultural production factors, because of the inelastic demand of agricultural products. This is evident from the smaller wage decline received by unskilled labor than skilled labor, and the rising rate of return to agricultural land in most Asian countries & African & declining rates of return to land, mainly due to their high use of intermediate crop inputs in their crop production.

As a result of the rising producer prices relative to other regions in the world, the crop exports would shrink significantly for all Southeast Asian countries & African. Experience export expansion in rice and other crop products due to its stronger comparative advantage in crop production and smaller reduction in agricultural productivity. Similarly, the imports of crop agricultural products would rise. As a consequence, the import dependence of African crops sector in 2050 would rise from 23.3% of baseline to 25.8% under the climate change scenario. North African grain self-sufficiency ratio in 2050 would decrease by 2.4 percentage points to 84.1%

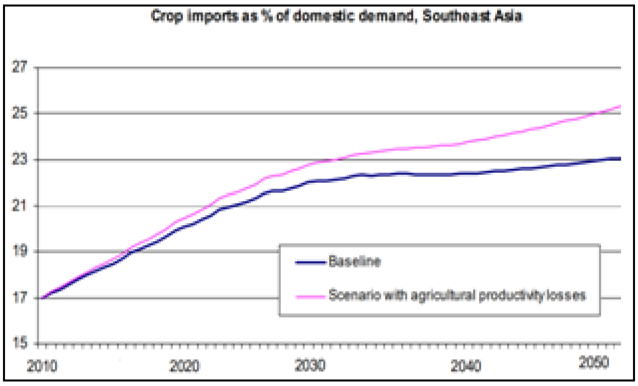

Figure 5: Import Dependence of Crop Agriculture, 2010-2050

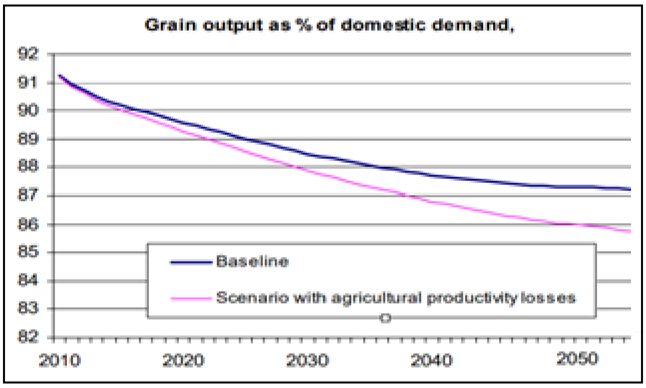

Figure 6: Grain Self-sufficiency Ratio, 2010–50

4. Conclusion

Climate change, the outcome of the “Global Warming” has now started showing its impacts worldwide. Climate is the primary determinant of agricultural productivity which directly impact on food production across the globe. Agriculture sector is the most sensitive sector to the climate changes because the climate of a region/country determines the nature and characteristics of vegetation and crops. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yield. Food production systems are extremely sensitive to climate changes like changes in temperature and precipitation, which may lead to outbreaks of pests and diseases thereby reducing harvest ultimately affecting the food security of the country. The net impact of food security will depend on the exposure to global environmental change and the capacity to cope with and recover from global environmental change. Coping with the impact of climate change on agriculture will require careful management of resources like soil, water and biodiversity. To cope with the impact of climate change on agriculture and food production, African country will need to act at the global, regional, national and local levels. Climate change is an increasingly significant global challenge and its negative impacts have been already felt in some regions of the world. This paper uses a global CGE model to assess the long term economic effects of climate change. The results suggest that the aggregate impacts of agricultural damages caused by climate change on the global economy are moderate. However, the impacts are not evenly distributed across the world. Developing countries would bear disproportionately large losses arising from climate change. Some significant adjustments in global agricultural production and trade, and consequently the distribution of income, may be accompanied by the changes of climate

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