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Studies of the Negative Effects of Climate Change on Crop Productivity and Global Food Security

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The earth 'climate change' has been well documented. Climate change is a long-term (decades to millions of years) distribution means of weather pattern changes caused by physical and biological factors. Physical factors that contribute to climate change include; volcanic eruptions, plate tectonics, and solar energy radiations. The biological factors that affect climate change mostly include human activities including CO_2 concentration increases due to fossil fuel combustion emissions and CO_2 released by cement manufacturing, and by aerosols (i.e., articulate matter in the atmosphere), ozone depletion, deforestation and also by animal agriculture [1].

Climate change has a non-linearity effect on the global food supplies system when the atmospheric CO_2 reaches a new level. Although one may assume that higher CO_2 may increase the earth vegetations due to the need for CO_2 in photosynthesis, increase in CO_2 has negative effects on plant growth mostly because increases in CO_2 increases the earth temperature causing greater soil moisture evaporations affecting the plant growth. However in certain cases, the increase in warmth along with rain falls has resulted in improved plant growth via the sequestration of airborne CO_2 in plants.

As far as the global climate change is concerned, increase in CO_2 is predicted to increase vegetation in Northern Latitudes; but to decrease the vegetation in Southern Latitudes, resulting in decline of amount of overall vegetation worldwide. Insects and pathogens can also increase under higher temperatures and the gradual increase in temperature can cause radical changes in vegetative stress, crop losses and desertification [2,3]. In extreme situations, plant and animal species can become extinct, as did due to the loss of rain forests during Carboniferous Rainforest Collapse (CRC) of event 300 million years ago [4].

Climate change is the fundamental threat to sustainable development, global food security and poverty eradication. All climate change experts agree on industrial governments needs on investing in agricultural adaptation to the climate change based on regions predicted to be affected such as South and Southeast Asia (e.g. Bangladesh, Philippines and Vietnam) and Africa (e.g. Malawi and Sudan) which are the major targets of the negative impacts of the climate change [5]. Furthermore, multilateral linked global strategies are needed to assure sustainable food supplies to feed the fast growing population of countries that are to become the further target of climate change [6].

While industrialized countries contribute to Greenhouse Gas emissions, most of these countries also provide opportunities via modern technologies to increase yield and productivity as an incentive mechanism to adapt to the climate change and to contribute to the environmental substantially and rural development in both industrialized and less-industrialized nations.

The United States National Academy of Sciences recently recommended [7] the needs for more studies to further understand and advance the science of climate change, and to assure sufficient and fast progress on adapting of the agriculture to predicted climate change via effectively de carbonizing of the economy by shifting from fossil fuels to renewable energy in order to cut planet-warming emissions to a net zero. Among many other measures, governments need to invest in changes in water resources via the science and tools of agricultural engineering, commit to reduce the temperature below the 2.4C and stabilize the target of 550ppmv CO_2 (i.e., part per million volume Co_2 equivalent) and reduce environmental pollutions within the next few decades [8].

Several models have been developed in order to be able to analyze and evaluate the global consequences to crop productivity and the risk of hunger. For example one model is based on cereal crops productions, prices and number of people at the risk of hunger due to climate change variables such as CO_2 effects and increase in temperature [9]. In all models/scenarios studied, the industrialized nations are less at risk of climate changes while they are mostly considered to cause the earth's climate change due to their industrializations. As an indirect measure of accepting that industrialized nations are to be taxed for polluting of the earth, and on socio-political humanitarian bases, industrialized nations have made commitments to set standards to their creation of CO_2 emissions, and to transferring crop improvement technologies to less developed nations. Transfer of technologies indeed fits well within the concept of climate change adaptation and the fact that food security cannot become sustainable without its' four factors of 'food availability via modern technologies, food access, food sustainability and food utilization'. It is the goal of the United Nations to reach the above goals prior to an extreme climate change that is expected to become an uncontrolled disaster.

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