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REVIEW ARTICLE

CLIMATE CHANGE-ITS IMPACT ON AGRICULTURE

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SUMMARY

Global warming has effects and consequences on all walks of life. The consequences of global warming can be seen in the atmospheric weather, local climate change, glacier retreat and disappearance, oceans, seal level rise, acidification, forest fires, ozone depletion, agriculture, water scarcity as well as the health of individuals. An increase of 2^{o}C in temperature could decrease the rice yield by about 0.75 t/ha and 0.5^{o}C increase in winter temperature reduce wheat yield 0.45 t/ha. Results showed that about 7.4, 8.7 and 9.8 per cent of total cumulative CO_2, SO_2 and NO_2 emission respectively could be avoided between 1997 and 2015 by using efficient appliances. Improved training and general education of populations dependent on agriculture. Agriculture research to develop new crop varieties. Identification of the present vulnerabilities of agricultural systems. Food programmes and other social security programmes to provide insurance against supply changes. Transportation, distribution and market integration to provide the infrastructure to supply food during crop short falls. It is imperative that the developed countries and the rapidly developing countries formulate strategies to curb greenhouse gas emissions. Countries on the fast tract of economic growth should also look at adopting new energy-saving technologies and planting of more trees. The emphasis should also be laid on increasing the use of renewable energy sources like solar and wind. It is high time for leading emitters of CO_2 to formulate national programmes to address climate change.

Key words: Climatic change, Agriculture, Environment, Variables

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1. Introduction

Climate change and agriculture are interrelated processes, both of which take place on a global scale. Global warming is projected to have a signficiant impacts on conditions affecting agriculture, including temperature, carbon dioxide, glacial run-off, precipitation and the interaction of these elements. These conditions determine the carrying capacity on the biosphere to produce enough food for the human population and domesticated animals. The overall effect of climate change on agriculture will depend on the balance of animals. The overall effect of climate change on agriculture will depend on the balance of these effects. Assessment of the effects of global climate changes on agriculture might help to properly anticipate and adapt farming to maximize agricultural production. As the same time, agriculture has been shown to produce significant effects on climate change, primarily through the production and release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide, but also by altering the earth's land cover, which can change its ability to absorb or reflect heat and light, thus contributing to radioactive forcing. Land use change such as deforestation and desertification, together with use of fossil fuels, are the major anthropogenic sources of carbon dioxide; agriculture itself is the major contributor to increasing methane and nitrous oxide concentrations in earth's atmosphere. Global warming is the observed and projected increase in the average temperature of

earth's atmosphere and oceans. The earth's average temperature has rise by 0.6°C in the last 140 years. Global warming is an increase in global average surface temperature due to natural or anthropogenic climate change (Wikipedia.org).

Effect on Agriculture

Sinha and Swaminathan (1991) observed that an increase of 2°C in temperature could decrease the rice yield by about 0.75 tons/ha in the high yield areas and 0.5°C increase in winter temperature would reduce wheat yield by 0.45tonns/ha. Rao and Shina (1994) reported that wheat yield could decrease between 28-68% without considering the carbon dioxide fertilization effects. Saseendran *et al*. (2000) reported that for everyone degree rise in temperature the decline in rice yield would be about 6%.

Soil process

The potential for soils to support agriculture and distribution of land use will be influenced by changes in soil water balance. Increase in soil water deficits i.e. dry soils become drier, therefore increased need for irrigation. Could improve soil workability in wetter regions and diminish poaching and erosion risk (Zarin, 2007).

Crops

Horticultural crops are more susceptible to changing conditions than arable crops. Field vegetables will be particularly affected by temperature changes. Water deficits will directly affect fruit and vegetable production (Zarin, 2007).

Effect on quality

For rice, the amylose content of the grain a major determinant of cooking quality is increased under elevated CO_2 (Conroy et al., 1994). Cooked rice grain from plants grown in high CO_2 environments would be firmer than that from today's plants. However, concentration of iron and zinc which are important for human nutrition would be lower. The protein content of the grain decreases under combined increase of temperature and CO_2 (Ziska *et al*., 1997).

Effect on growing period

An increase in temperature will speed up development. In case of an annual crops, the duration between sowing and harvest will shorten (e.g. the duration in order to harvest corn could shorten between one and four weeks). The shortening of such a cycle could have an adverse effect on productivity because senescence would occur sooner (Royal Society London, 2005).

Shortage in grain production

Crops such as sunflowers can be affected by severe drought conditions in Australia. Between 1996 and 2003, grain production has stabilized slightly over 1800 million of tons. In 2000-2003 grain stocks have been dropping, resulting in a global grain harvest that was short of consumption by 93 million tons in 2003 (Lobell *et al*., 2007).

Effect on pests and diseases

Global warming would cause an increase in rainfall in some areas, which would lead to an increase of atmospheric humidity and the duration of wet seasons. Combined with higher temperature, these could favor the development of fungal diseases. Similarly with highly temperatures and humidity, there could be an increased pressure from insects and disease vectors (Alexey *et al*., 2007).

Improving adaptive capability of Agriculture

Improving training and general education of population dependent on agriculture. Agriculture research to develop new crop varieties. Identification of the present vulnerabilities of agriculture systems. Food programmes and other social security programs to provide insurance against supply changes. Transportation, distribution and market integration to provide the infrastructure to supply food during crop short falls (Zarin, 2007).

Water scarcity

Sea level rise is projected to increase salt-water intrusion into groundwater in some regions, affecting drinking water and agriculture in coastal zones. Increased evaporation will reduce the effectiveness of reservoirs. Increased extreme weather means

more water falls on hardened ground unable to absorb it, leading to flash floods instead of a replenishment of soil moisture or groundwater. In some areas shrinking glaciers threaten the water supply (Hitz *et al.*, 2007).

Health

Climate change currently attributes to the burden of disease and premature deaths. The negative health impacts of climate change will outweigh the benefits, especially in developing countries. Negative health impact include increased malnutrition, increased deaths, disease and injury due to heat waves, floods, storm, fires and droughts and increased frequency of cardio-respiratory diseases. According to a 2009 study by UCL academics, climate change and global warming pose the biggest threat to human health in the 21st century (Lister, 2009).

Spread of disease

Global warming may extend the favorable zones for vectors conveying infectious disease such as dengue, fever, west Nile virus and malaria. The World Health Organization (WHO) says global warming could lead to a major increase in insect-borne diseases in Britain and Europe as North Europe becomes warmers. In the United States, Malaria has been endemic in as much as 36 states until the 1940s.

Extreme weather

Global warming may be responsible on past for some trends in natural disasters such as extreme weather. There will be increased intense tropical cyclone activity. There will be increased incidences of extreme high sea level (Stefan *et al*., 2007).

Local Climate Change

The first recorded south Atlantic hurricane "Catarina" which hits Brazil in March, 2004. In the northern hemisphere, the southern part of the Arctic region has experienced a temperature rise of 1 to 3°C over the last 50 years. Canada Alaska and Russia are experiencing initial melting of permafrost. This may disrupt ecosystems and by increasing bacterial activity in the soil lead to these areas becoming carbon sources instead of carbon sinks (Vladimir and Romanovsky, 2007).

Glacier retreat and disappearance

Excluding the ice caps and ice sheets of the Arctic and Antarctic, the total surface area of glaciers worldwide has decreased 50% since the end of the 19th century. Currently glacier retreat rates and mass balance losses have been increasing in the Andes, Alps, Pyrenels, Himalayas, Rocky mountains and North Cascades. The loss of glaciers not only directly cause landslides, flash floods and glacial lake overflow but also increases annual variation in water flows in rivers (Mauri and Pelto, 2007).

Oceans

The oceans serve as a sink for carbon dioxide, taking up much that would otherwise remain in the atmosphere but increase levels of CO_2 have led to ocean acidification. As the temperature of oceans increases, they become less able to absorb excess CO_2. Global warming is projected to have a number of effects which include rising sea level due to thermal expansion and melting of glaciers and ice sheets (Christian *et al*., 2003).

Sea level rise

With increasing average global temperature, the water in the oceans expands in volume and additional water enters than which has previously been locked up on land in glaciers, e.g. Greenland and Antarctic ice sheets. For most glaciers worldwide, an average volume loss of 60% until 2050 is predicted. The total ice melting rate over Greenland is 2.39±23 cubic km per year. Instead of a global 5 meter sea level rise. The United States, parts of Canada and the Indian Ocean would experience up to 6.5 meters of sea level rise (Christian *et al*., 2003).

Temperature rise

From 1961 to 2003, the global ocean temperature has risen by 0.10°C from the surface to a depth of 700 m. The temperature of the Antarctic southern ocean rose by 0.17°C (0.31°F) between the 1950s and the 1980s nearly twice the rate for the world's oceans as a whole. Having effects on ecosystems by melting sea ice, warming

reduces the ocean's ability to absorb CO_2 (Bindoff *et al*., 2007).

Acidification

Ocean acidification is an effect of rising concentration of CO_2 in the atmosphere. Oceans currently absorb about one tonne of CO_2 per person per year. It is estimated that the oceans have absorbed around half of all CO_2 generated by human activities (Sabine *et al*., 2004).

Solutions to Global Warming

When you buy your car, look for the one with the best fuel economy in it class. Each gallon of gas you use is responsible for 25 pounds of heat-trapping gases in the atmosphere. Better gas mileage not only reduces global warming, but will also save your thousands of dollars at the pump over the life of the vehicle.

Choose clean power

More than half the electricity in the United States comes from polluting coal-fired power plants. Power plants are the single largest source of heat trapping gas. None of us can live without electricity, but in some states, you can switch to electricity companies that provide 50-100 per cent renewable energy (Ponce, 2009).

Look for energy star

When it comes time to replace appliances, look for the energy star label on new appliances (refrigerators, freezers, furnaces, air conditioners and water heaters use the most energy. Household energy savings really can make a difference. If each household in the United States replaced its existing appliances with the most efficient models available, we would save #15 billion in energy costs and eliminate 175 million tonnes of heat-trapping gases (Ponce, 2009).

Unplug a freezer

One of the quickest ways to reduce your global warming impact is to unplug the extra refrigerator or freezer you rarely use. This can reduce the typical family's carbon dioxide emissions by nearly 10 per cent (Ponce, 2009).

Plant a tree

Get a group in your neighborhood together and contact your local arborist or urban forester about planting trees on private property and public land. In addition to storing carbon, trees planted in and around urban areas and residences can reduce energy bills and fossil fuel use (Ponce, 2009).

Let Policy Makers know you are concerned about global warming

Our elected officials and business leaders need to hear from concerned citizens. Sign up for the union of concerned scientists action network to ensure that policy makers get the timely accurate information they need to make informed decisions about global warming solutions (Ponce, 2009).

Global warming control strategies on international level

The World Meteorological Organisation (WMO) has the responsibility to coordinate the environmental issues related to the atmosphere including air quality, on a global basis. About 7.4, 8.7 and 9.8 per cent of total cumulative CO_2, SO_2 and NO_2 emission respectively could be avoided between 1997 and 2075 by using efficient appliances (Shrestha *et al*., 1998). Dioxin emissions can be reduced by flue gas treatment by bag filter and flyash treatment by sintering (fusion solidification), chlorination, thermaldehyde and other photolytic and chemical methods (Ahuja, 2008).

2. Conclusion and Future Strategies

It is imperative that the developed countries and the rapidly developing countries formulate strategies to curb green house gas emissions. Countries on the fast track of economic growth should also look at adopting new energy saving technologies. It is imperative to carry out a massive reforestation. The emphasis also is laid on increasing the use of renewable energy sources like solar and wind. Application of fertilizer should be reduced.

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