Ameliorating the effects of climate change with conservation farming

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Climate change is one of the most important global environmental challenges affecting all of us on our planet. Over 100 years ago, people, in the whole world, began burning more coal and oil for homes, factories and transportation. Burning these fossil fuels releases carbon dioxide and other green house gases (GHG: CO_2, CH_4, N_2O, HFC, PFC, and SF_6) which build up in the atmosphere and trap more of the sun's energy. This is called the 'greenhouse' effect and causes global warming, a condition which is resulting in temperatures rise all over the world. Published studies show that it will have a negative effect on our food supply due to more frequent adverse weather events as rainfall events have become more erratic with a greater frequency of storms leading to increasing crop failures. The security of our food supply concerns all of us. Soils are the fundamental foundation of our food security, global economy and environmental quality. There is general agreement that although soil is part of the climate change problem, it is also an integral part of the solution.

One scenario by the IPCC tells us during the past 100 years, the world's surface air temperature increased an average of 0.6°C (1.1°F). The average surface temperature of the earth is likely to increase by 2 to 11.5°F (1.1-6.4°C) by the end of the 21st century, relative to 1980-1990, with a best estimate of 3.2 to 7.2° F (1.8-4.0°C). The average rate of warming over each inhabited continent is very likely to be at least twice as large as that experienced during the 20th century (IPCC, 2007). We have seen in the last few decades, mountain glaciers in all areas of the world have decreased in size and so has the amount of permafrost in the Arctic. Carbon dioxide dissolving into the oceans is making sea water more acidic impacting seriously on marine life. Species may either move to a cooler habitat or die when the temperature rises. There are 7 indicators that would be expected to increase in a warming world, and 3 indicators would be expected to decrease (Fig.1). The Maximum temperature is showing increasing trends at Annual, Kharif and Rabi time scales, with a very sharp rise for years 2000 and beyond in North West India.

Agriculture as a greenhouse gas contributor: The main gases emitted are CO_2, CH_4, and N_2O. Agriculture accounts for approximately 13% of total global anthropogenic emissions and is responsible for about 47% and 58% of total anthropogenic emissions of methane (CH_4) and nitrous oxide (N_2O), respectively. Burning crop residues, clearing forests for fields, submerged condition in rice paddies, raising large herds of cattle and other ruminants and fertilizing with nitrogen, all release greenhouse gases to the atmosphere. Besides CH_4 from enteric fermentation (32%), N_2O emissions from soils due to fertilization constitute the largest sources (38%) from agriculture. Agricultural chemicals RMPs involve 0.86 kg C/kg N, 0.17 kg C/kg P_2O_5, 0.12 kg C/kg K_2O, 0.36 kg C/kg lime, 4.7 kg C/kg of herbicides, 5.2 kg C/kg of fungicides, 4.9 kg C/kg of insecticides, and 150 kg C/ha for pumping groundwater for irrigation. Increasing SOC concentration from a low of 0.1 to 0.2% to a critical level of 1.1% is a major challenge for tropical ecosystems.

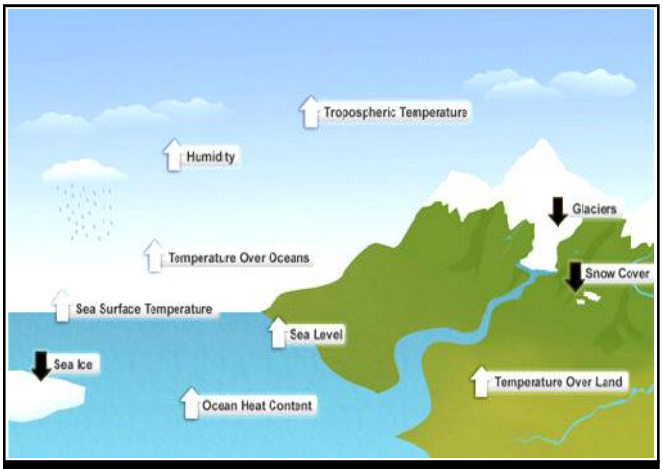

Fig. 1 : Ten indicators for a warming world, Past Decade Warmest on Record According to Scientists in 48 Countries, NOAA, July 28, 2010

Developing countries as a greenhouse gas contributor: Developing countries accounted for only 37% of cumulative CO_2 emissions from industrial sources and land-use change during the period 1900 to 1999 whereas industrialized countries accounted for 63%. However, in recent years, developing countries, largely China and India have contributed the biggest increase in emissions, while those from the developed countries are growing slowly. The International Energy Agency (IEA) projects that more than two-thirds of the world energy will come from developing

countries between 2003 and 2030. Fig. 2 gives a comparison of the projected annual CO_2 emissions from the Organization for economic co-operation and development (OECD) and non-OECD countries. The non-OECD emissions from 2005 to 2030 (2.5%) are five times higher than the projected increase of the OECD countries (0.5%). China surpassed the US as the biggest CO_2 emitter, and India will soon overtake Russia to become the third largest emitter. Developing countries are into high energy and emission path, and will contribute considerably to the climate deterioration in the near future.

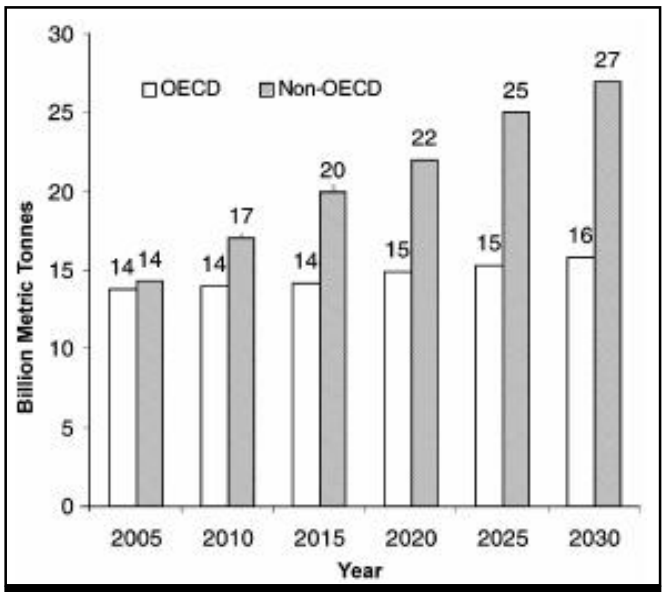

Fig. 2 : World energy related CO_2 emission by different countries (EIA)

Effect of global warming on soil fertility and soil-biological and chemical interactions: Higher air temperatures will also be felt in the soil, where warmer conditions are likely to speed the natural decomposition of organic matter and to increase the rates of other soil processes that affect fertility. Carbon content of soil is a major factor in its overall health.Soils is the largest carbon reservoirs of the terrestrial carbon cycle. Soils contain about three times more C than vegetation and twice as much as that present in the atmosphere. Soils contain much more C (1500 Pg of C to 1 m depth and 2500 Pg of C to 2 m; 1 Pg = 1 × 10 g) than is contained in vegetation (650 Pg of C) and twice as much C as the atmosphere (750 Pg of C). Carbon in the form of organic matter is a key element to healthy soil. It is estimated that each tonne of soil organic matter releases 3.667 tonnes of CO_2, which is lost into the atmosphere. The continual cycling of plant nutrients-carbon, nitrogen, phosphorus, potassium, and sulfur-in the soil-plant-atmosphere system is also likely to accelerate in warmer conditions, enhancing CO_2 and N_2O greenhouse gas emissions.

Conservation farming-Bracing for global warming: The essence of true soil conservation is carbon management. By properly managing the carbon in agricultural ecosystems, we can have less erosion, less pollution, healthy soil, natural fertility, higher productivity, increased biodiversity and sustainability. Comparison studies have shown that organic systems have less soil loss due to the better soil health The amount of carbon released from soils depends directly on the volume of soil disturbed during tillage operations.

Advantages:

- Greater stability in yields
- Higher ratios of outputs to inputs
- Better soil moisture retention
- Reduced demands for labor and much lower costs of farm power (fossil fuels) and greenhouse
- Less gas emissions, through reduced tillage
- Increased land value over time because of progressive improvements in soil, water and air quality
- Increased biodiversity both in the soil and the above-ground agricultural environment for nutrient cycling
- Less soil erosion
- Greater carbon sequestration and retention in soils resulting in reduced emissions of GHGs including CO_2 and CH_4
- Less water pollution from pesticides and applied fertilizer nutrients

As more and more people depend on fewer farmers it is essential that each farm not only contribute to the world's supply of food, feed, fiber and fuel but also play a critical role in improving environmental quality.

Received : *29.09.2012* ***Revised :*** *16.10.2013* ***Accepted :*** *17.11.2013*