From the Desk of General Secretary

Climate change is not a new phenomenon. Change has been a consistent feature of global climate. Such a change in climate is mostly due to emission of greenhouse gases (GHGs) *viz.* carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases (F-gases) including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6) into the atmosphere. These GHGs form a blanket around the earth, trapping the outgoing infrared radiations from the earth's surface and thus raising the temperature of the atmosphere. According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the sector of agriculture, forestry, and other land use (AFOLU) contributes about 24% of 2010 global GHG emissions. GHG emissions from this sector come mostly from agriculture (cultivation of crops and livestock) and deforestation. This estimate does not include the CO_2 that ecosystems remove from the atmosphere by sequestering carbon in biomass, dead organic matter, and soils, which offset approximately 20% of emissions from this sector. However, total annual emissions from agriculture in 2011 were at the highest level in history, and almost 9% higher than the decadal average (2001-10). In the current scenario, increase in mean temperature; changes in rainfall patterns; increased variability both in temperature and rain patterns; changes in water availability; frequency and intensity of extreme events; sea level rise and salinization; and perturbations in ecosystems, all are exerting profound impacts on agriculture, forestry and fisheries with dire consequences on food and forestry production, and food insecurity. The extent of these impacts depends not only on the intensity and timing (periodicity) of the changes but also on their combination. A change in minimum temperature is more crucial than a change in maximum temperature. For example, India stands to lose nearly 4-5 million tonnes of wheat production with every rise of 1°C temperature throughout the growing period. In case of rice, grain yield decline can occur to the extent of 10% for each 1°C increase in the growing season minimum temperature above 32°C.

Climatic vagaries are discernible with weather extremes (increased occurrence of storm, flood, drought, heat wave, tropical cyclone *etc.*), growing shortage of irrigation water, higher frequency of drought and flood, changing pest scenario, substantial increase in soil erosion *etc.* Agriculture, particularly in India with nearly 60% rainfed area, has been a highly risky venture, especially with vagaries of monsoon besides the interplay of other abiotic and biotic factors. Many minor pests like false smut disease, panicle mite of rice *etc.* are becoming major problem in many places. Changing weather patterns also increase crop vulnerability to insects, diseases, weeds and other invasive plants, thereby decreasing yields and increasing pesticide applications. Thus, climate change is set to compound the daunting complex challenges already being faced by agriculture. Therefore, concerted efforts are required for mitigation and adaptation to reduce the vulnerability of Indian agriculture to the adverse impacts of climate change and making it more resilient. Likewise, agriculture in other developing countries must undergo a significant transformation in order to meet the related challenges of achieving food security and responding to climate change. Farmers need to intelligently adapt to the changing climate in order to sustain agricultural production and farm income. Developing climate-smart agriculture is, thus, crucial to achieving future food security and climate change goals.

Climate-smart agriculture (CSA) is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. CSA aims to address three intertwined challenges: sustainably increasing agricultural productivity and incomes (economic); adapting and building resilience to climate change (adaptation); and reducing and/or removing GHG emissions (mitigation), where possible. CSA is not a single specific agricultural technology or practice that can be universally applied; rather it is an integrative approach that requires site-specific assessments to identify suitable agricultural production technologies and practices.

To cope with the complexities of climate change, there must have different climate-smart interventions for increasing resilience and sustainability of crop production, which may be nutrient-smart (*e.g.* application of organic manures; site-specific integrated nutrient management as per guidelines of 4R Nutrient Stewardship; use of appropriate chemical fertilizers and nitrification inhibitors like neem coated urea; and foliar nutrition in pulses), crop-smart (*e.g.* proper crop establishment method; diversification through climate-smart short duration crops and their stress-tolerant climate-ready varieties; seed priming; inter / multiple / relay cropping; and improved crop management practices), water-smart (*e.g.* rainwater harvesting and management; laser land leveling; System of Rice Intensification; mulching; alternate wetting and drying in rice; aerobic rice; and use of hydrogels), pest-smart (*e.g.* growing varieties with multiple resistance / tolerance; ICT-based pest surveillance; bio-intensive pest management; and adjusting sowing / planting time) and weather-smart (*e.g.* weather forecasting and advisory services through ICT; and crop insurance), besides other risk averting contingent options (*e.g.* System of Assured Rice Production; community nursery; rice straw management; and harnessing indigenous technical knowledge of farmers). An integrated farming system including different enterprises like crop husbandry, livestock *etc.* would also be an ideal approach to improve production efficiency, environmental sustainability and profitability of farming systems, especially for small and marginal farm-holders. Conservation of plant biodiversity is another important issue for sustainable growth and development. The scientific and technological experiences of the last half century, including remarkable progress in advancing agronomy, resource-conserving technologies and science-based conventional breeding, need to be combined with modern biological sciences - molecular genetics, informatics and genomic research, and improved land, water and agro-biodiversity management systems.

Mitigation and adaptation actions, if appropriately designed, can advance sustainable development and equity both within and across the countries and between the generations. In the coming decades, the development and effective diffusion of new agricultural practices and technologies will largely shape how and how well farmers mitigate and adapt to climate change. Even though climate change in India is a reality and impending negative consequences are predicted, a more certain assessment of impacts and vulnerabilities along with a comprehensive understanding of adaptation and mitigation options across the full range of warming scenarios, sectors and regions would go a long way in preparing the nation for climate change. Being a serious concern not only to the environmental scientists, agricultural scientists, planners and policy makers but also to the farmers and common people of the country, climate change should be addressed and solved carefully and systematically to save our agriculture and ensure food security of the millions for the future years to come.

(GOUTAM KUMAR BHOWMIK)