CMFRI

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Lecture Notes

Part 1

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CLIMATE CHANGE, MITIGATION AND ADAPTATION WITH REFERENCE TO AGRICULTURE OVER THE HUMID TROPICS

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Introduction

The Bali road map under UNFCCC highlighted the conclusions of IPCC on climate change across the World. It indicates that the global warming is real. The Polar ice is melting and sea level will increase. One-third of our plant and animal species are likely to vanish. There will be famine around the world, particularly in Africa and central Asia. The Reduction of Emissions from Deforestation and Degradation (REDD) in developing countries is on top priority as deforestation alone may cause 20 to 25% increase in greenhouse gas emissions in the atmosphere. The second major issue is on "Adaptation Fund" designed to help developing countries dealing with impact of climate change. Therefore, it is pertinent to follow the guidelines at the regional scale so as to mitigate the ill effects of climate change on war-footing.

Like the Indian climate scenario, where rainfall decline and temperature increase were noticed since the last 50 years, the State of Kerala also experienced decline in annual and monsoon rainfall and increase in temperature. The mean annual maximum temperature over Kerala has risen by 0.8°C, the minimum temperature by 0.2°C and the average by 0.5°C between 1961 and 2003. The maximum temperature increased up to 40°C in Palghat during February and March 2004 and the highest of 41°C was noticed on April 26, 1950. The year 1987 was the warmest year over Kerala. The 1990s were the warmest decade over the globe while 1981-90 was the driest decade over Kerala. The monsoon behaviour in 2007 over Kerala was totally different to that of previous years and heavy rains were noticed from June to September, which led to floods in low lying areas. Torrential rains also hit the surface transport roads very badly. The length of prolonged rainy season adversely affected prawn farming in several places across the State. In contrast, severe summer droughts were noticed in 1983 and 2004 during which the surface water resources became scarce, led to hydrological droughts and the State's economy was hit very badly. The wetlands or paddy lands in Kerala are the rich water source during summer and act as sink during the rainy season and such wetlands were declining very fast. The decrease in wetlands might be one of the reasons for frequent floods and droughts in recent years. The recent drought during summer 2004 over Kerala led to increase in maximum temperature of 1-3°C during February and March and thermo-sensitive crops like black pepper, cocoa and cardamom across the high ranges and several other perennial crops in the State suffered to a larger extent.

The groundwater is depleting at a faster rate than that the recharge mainly due to the rainfall decline, overuse of water for irrigation, more land is brought under irrigation for cultivation, more water needed for drinking and for other uses due to increase in population, deforestation, riverbed sand-mining, decline in wetland area and disappearance of lakes and ponds in recent times. Some of the above factors also led to drying up of open and surface wells. Silting also led to less water storage capacity in existing major reservoirs and surface wells. These factors lead to impending disaster in the form of severe water scarcity and saline water intrusion along the coastal areas. The saline water intrusion was not there when traditional freshwater lakes were built in wet lands. Destruction of freshwater lakes or conversion of wetlands aggravated the scarcity of fresh water, especially in rainfall deficit years during summer in places like Kuttanad.

Ozone depletion is taking place at a faster rate due to man-made interventions in the form of CFCs. The CFCs are used in a variety of industrial, commercial, and household applications. These substances are non-toxic, non-flammable and non-reactive. They are used as coolants in commercial and home refrigeration

units, aerosol propellants and electronic cleaning solvents. The diurnal variation of UV-B radiation recorded at Kerala Agricultural University, Vellanikkara revealed that the UV filtered radiation (>1MED) reaches the ground surface between 1030hrs and 1430hrs, which may be detrimental to biological activities. The ozone loss leads to more UV-B radiation. It has the potential to increase incidence of skin cancer, cataracts and damage to people's immune system. In addition, mosquito transmitted diseases are increasing year after year due to global warming. Little is known on the impact of ozone depletion and increasing UV-B radiation on ontogeny of tropical plants, and human and animal diseases. Because CFCs remain in the atmosphere for 100 years, continued accumulation of these chemicals pose ongoing threats, even after their use is discontinued.

All the above factors indicate that climate change or variability lead to more frequent weather related disasters in the form of floods, droughts, landslides and sea level rise in a tiny State like Kerala, which falls under the humid tropics. The climate projections across the high ranges of Kerala indicate that the southwest monsoon rainfall is likely to decline, and surface air temperature and its range are likely to increase. Under such circumstances, there is a threat to thermosensitive crops like black pepper, cardamom, tea and coffee. Therefore, there is a need to formulate climate change risk management strategies to minimise the ill effects of climate change. The projected sea level rise may lead to disappearance of low lying coastal areas in addition to the damage to ocean biodiversity due to global warming. Fish catch is reportedly dwindling in most parts of the State's coast due to marine pollution and climate change in addition to unscientific fishing practices.

The habitat of plantation crops is different as they are perennials traditionally grown in the humid tropics under the rainfed conditions. Within the tropics, crops like coffee, cardamom and tea prefer cool-temperate climate as they grow along the high ranges. Black pepper is an intercrop between warm and cool climates within the tropics due to its adaptability. The forests exert a domineering influence on soil, water resources and microclimate of the above crops. In the turn of twenty-first century, forests constituted only 24% when compared to 70% in the middle of nineteenth century in Kerala. The fast-dwindling forest cover and its consequence over climate are the concern across the high ranges of Western Ghats.

The production and productivity of small cardamom were increasing, but a sharp decline was noticed in cardamom area across the Western Ghats. This could be attributed to technological interventions in the last three decades. However, the inter-annual fluctuations in cardamom production were common due to weather aberrations. For example, the cardamom production was badly hit during 1983 due to unprecedented drought that occurred from November 1982 to May 1983 across the cardamom areas of the Western Ghats. Similar was the case during 2003-04 over Kerala. It is noticed that the cardamom production over Kerala in recent years was also badly hit due to dry spells that occurred during monsoon of 2002 and 2003. There existed a strong relationship between dry spells and cardamom production and the climate risk is more in the Karnataka region when compared to other regions across the Western Ghats. A decline of 39% in annual cocoa yield was noticed in 2004 when compared to that of 2003 due to rise in maximum temperature by 2 to 3°C from 14th January to 16th March, 2004 along with prolonged dry spell. Such trend was noticed whenever summer temperature increased up by 2 to 3°C when compared to that of normal maximum temperatures of 33.0 to 36.5°C. The adversity of weather aberrations on rhythm of normal growth of cocoa is reflected in yield after a lag period of 4-5 months. Cashew is also highly weather sensitive. Despite the advanced technologies in crop production and crop improvement, cashew productivity is declining over Kerala. Though the potent factor for low yield in recent years is weather aberrations, detailed studies need to be taken up. The monsoon variability along with pre-monsoon showers is likely to influence coffee production and its quality to a considerable extent. Similar is the case with black pepper too. A weather module suited to black pepper may not be suitable to coffee. Hence, mixed farming of coffee and black pepper may be a better option against climate risk instead of mono-cropping. In the case of coconut, decline in monthly nut yield was noticed in the following year from February 1984 to January 1985 due to severe drought of summer 1983. The effect of drought on monthly nut yield was noticed in the eighth month after

drought with a maximum (64.1%) reduction in nut yield in July 1984 (*i.e.*, 13 months after the drought) and the minimum (23.6%) in January 1985. Similar was the case during 1988-89. The recent drought during summer 2004 adversely affected coconut yield to some extent over Kerala. In the semiarid tropics like Tamil Nadu, heavy crop loss was reported due to continuous failure of rains in 2001 and 2002 and lack of irrigation due to poor water recharge in wells.

Drought management practices have to be followed under field conditions. Cultivation of drought tolerant crops and varieties, proper soil and water conservation practices like ploughing before the southwest monsoon and immediately before cessation of the northeast monsoon, opening basins of coconut before the southwest monsoon, covering the basins before the northeast monsoon, organic manuring, organic mulching and husk burial can conserve the available moisture in the soil and use water judiciously. Judicious use of water in day-to-day life and for agriculture purposes can reduce the impact of drought. Awareness on drought management practices is the need of the hour to sustain agricultural production in the State against the weather abnormalities.

Calamities like flood, drought, landslides, lightening, heat and cold waves are becoming common now-a-days. Both crops and farmers are to be safeguarded against these calamities. Often, the farmer who takes loan may not be able to repay it due to crop failure leading to hardship and suicides. Insuring farmers as well as crops become necessary against weather abnormalities. In this context, precise and accurate information on weather changes are necessary. Short, medium and long range forecasting will definitely help weather-tune-farming so as to minimize the adverse effects of weather abnormalities by taking suitable precautionary measures to lessen the harmful effects. The meteorological network has to be strengthened to disseminate agro advisory service based on integrated weather forecasting. Pro-active measures against weather aberration will go a long way in minimizing the crop losses against the climate disasters.

In the last century, industrial revolution, technology revolution and globalization were the three economic transformations that led to better world economy. Green economy and development are likely to be the major policy decision over the world to combat the climate change effects and generate employment opportunities during this century. Non-conventional and renewable energies can create more number of jobs even if 20 per cent of electricity is replaced by renewables. More people will be employed in Germany's enviro-technology industry than in the auto industry by the end of the next decade as per the Green Peace policies adapted. In India also, Maharashtra farmers took up to raise trees to meet Kyoto protocol provisions. They expect to sell their carbon abatement credits through the international commodities market. Internationally, the carbon finance market is expanding steadily as 107 million tonnes of carbon dioxide equivalents were exchanged in 2004 as against 78 million tonnes in 2003. The FoCs (Friends of Carbon - a Pune based NGO) is attracting farmers in Karnataka, Andhra Pradesh, Kerala, Tamil Nadu, Goa, Chhattisgarh and Madhya Pradesh to carbon commodity market. By sequestering such farm-based and matured forests in addition to deforestation reduction, a long-term storage of carbon in living and dead vegetation is possible. These steps will reduce the greenhouse gas emissions and it will be an eco-friendly transformation of global economy in terms of green economy and development in the 21st century. Fuel efficiency and low emission technologies, energy efficiency and saving technologies along with changes in lifestyles should be a part of green economics and development.

Suggested Readings

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