

Effect of Climate Change on Agriculture Including Livestock Sector

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Introduction

Climate change has been one of the most talked about subjects nowadays. Climate change has become a serious concern for India to ensure food and nutritional security for the growing population. Climate is changing and this change is now for real. It has come as a daunting challenge to agriculture and to the agriculturist. Therefore, a time has come to shift our focus from assessing impact on agriculture to the management-based solution to cope up with the food production sustainability. Many researchers are under way to evolve climate friendly, climate smart and climate neutral agricultural technology for the benefit of the society. The impact of climate change has been increasingly visible in terms of change in temperature, precipitation, retreating ice caps and glaciers, sea level rise, atmospheric circulation pattern and ecosystems. Climate change is not simply the increasing temperature, but indeed responsible for increasing frequency of extreme weather events like heat wave, cold wave, droughts, floods etc. In India, increased frequency of pronounced heat waves, cold waves, droughts and floods have already been realized in last few decades.

Effect of climate change on Indian Agriculture

The impact of climate change or variability on agriculture is both direct and indirect. The direct impact of climate change will be small in rainy season crops but the crops will become vulnerable due to increased incidence of weather extremes such as changes in rainy days, intensity of rainfall, duration and frequency of drought and floods, diurnal variation of temperature, pest/disease incidence etc. The production of pulses in general will be affected more by climate change than other crops. The climate impact on cereal will vary widely in rainy season as well as winter seasons. According to FAO, climate change is likely to trigger



a risk of hunger in India by affecting cereal production and India could lose as much as 125 million tones of its rainfed cereal production. Recent IPCC report and a few other global studies indicate a probability of 10-40% loss in crop production in India with increase in temperature by 2080-2100. Small change in temperature and rainfall could have significant effect on quality of cereals, fruits, aromatic and medicinal plants with resultant implications on their prices and trade. Pathogen and insect populations are strongly dependent upon temperature and humidity. Increase in these parameters will change their population dynamics resulting in yield loss.

Climate change will have profound effect on vector borne viral disease such as yellow mosaic virus in peas and beans, soybean etc. Reduction in rainfall and increase in temperature will reduce the production of blackpepper, turmeric and ginger. The climate change scenario may adversely affect the natural resources of agriculture that is the soil environment. The soil fertility, soil structure, soil and water erosion, siltation, depletion of soil organic carbon may be degraded due to change in rainfall pattern. Higher temperature may reduce the total duration of a crop cycle by inducing early flowering, thereby shortening the grain filling period. If duration of the crop decreases, yield per unit area will also decrease. Climate change had additional stress on ecological and socioeconomic systems even causing loss of human life. Climate change has an impact on drinking water and generation of hydro-electric power. Skewed rainfall distribution has now become more common with reduction in number of rainy days.

Impact of climate change on livestock production

Livestock is an integral part of agriculture sector in most of the developing countries in the world. It plays a major role in contributing lion share of agricultural GDP of the world economy. India has the largest livestock resources (536.76 million) in the world. The global demand for food of animal origin has been increasing day by day; hence it is assumed that livestock sector of India needs to be expanded further. Livestock are vulnerable to climate change. Climate change is a major challenge in sustainable livestock production. The inclement weather results in lower productive and reproductive performances of livestock. Extreme climatic condition and seasonal availability of fodder in quantity and quality affect the well-being of livestock and will lead to reduce productive and reproductive efficiency. Generally, the climate change is manifested by increasing global temperature. Climate

change affects livestock both directly and indirectly. Air temperature, humidity, wind speed and other climate factors directly influence animal performance including growth, production, health and reproduction. Higher temperatures along with altered precipitation are likely to result in the problem of heat stress in livestock in climate change sensitive regions leading to decreased production and increased susceptibility to diseases. Animal stress level due to temperature rise has been worked out using Temperature Humidity Index (THI) in India. All animals have a range of ambient environmental temperatures termed the thermos-neutral zone and temperature below or above this thermos-neutral range of the animal create stress conditions in animals. Climate change scenario constructed for India revealed that temperature rise of about or more than 4°C is likely to increase uncomfortable days (THI>80) from existing 40 days (10.9%) to 104 days (28.5%). This change in THI has a negative impact on the livestock production both directly and indirectly. There are number of ways that climate changes affect the livestock productivity parameters as follows:

Impact of heat stress on milk production:

One of the direct impacts of climate change on livestock is on the milk yield. Increase in number of stressful days (THI more than 80) and their frequency will impact yield and production of cattle and buffaloes. Milk yield can be reduced by 3 per cent to 20 per cent or more due to heat stress in dairy animal's. A thermal environment is a major factor that can negatively affect milk production in dairy cows, especially in animals of high genetic merit. The estimated annual loss due to heat stress among cattle and buffaloes at the all-India level is estimated to be over Rs 2,700 crore. The negative impact of direct temperature rise on total milk production of cattle and buffaloes for India has been estimated to be about 1.6 million tonnes in 2020 and more than 15 million tonnes in 2050.

Impact on reproduction:

Heat stress due to high ambient temperature accompanied with excess humidity during summer months causes infertility in most of the farm species and have adverse effect on reproductive performance of farm animals. During hot dry (March- June) and hot humid (July- September) seasons, the THI values exceed 80 in most parts of India. The pattern of estrus varies among cattle and buffaloes. Most of the buffaloes exhibit sexual activity during cooler parts of the year (October- Feb), when the THI generally remains < 72. A study in Florida reported an estimate of 76 to 82 per cent of undetected estrous events in summer

months compared to 44 to 65 per cent from October to May. Heat stress has a negative impact on quality of ova and the elevated uterine temperature of the heat stressed animal impairs the embryonic development, resulting in poor embryo implantation and increased embryo mortality. The conception rate can go as low as 0 per cent in extreme cases.

Impact on feed and fodder availability

The entire feed requirement of livestock is met from crop residues and by-products; grasses, weeds and tree leaves; and grazing on common lands and harvested fields. Climate change affects livestock production by altering the quantity and quality of feed available for animals. Climate change is expected to change the species composition (and hence biodiversity and genetic resources) of grasslands as well as affect the digestibility and nutritional quality of forage. Droughts and extreme rainfall variability can trigger periods of severe feed scarcity, especially in dry land areas, with devastating effects on livestock populations. Reductions in the quantity and quality of feed (leading to less feed intake and higher mortality) could make the impacts of climate change on livestock systems severe in certain places.

Impact on livestock health:

Warming and changes in rainfall distribution may lead to changes in spatial or temporal distributions of diseases such as anthrax, black quarter, haemorrhagic septicaemia and vector-borne diseases that thrive in the presence of moisture. Research studies from India have found that meteorological parameters like temperature, humidity and rainfall explain 52 and 84 per cent variations in the seasonality of Foot and Mouth disease in cattle in hyper-endemic areas. Similarly higher incidence of clinical mastitis in dairy animals and aggravated infestation of cattle ticks like *Boophilus microplus*, *Haemaphysalis bispinosa* and *Hyalomma anatolicum* during hot and humid weather has been reported.