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CLIMATE CHANGE AND IMPORTANCE OF CROP BIODIVERSITY CONSERVATION

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Abstract

Climate change is a global phenomenon that is felt now at local level also. We all have been experiencing changes in the seasons. The winter is getting shorter, summer long and monsoon highly unpredictable. Our agriculture production has gone down and the cost of cultivation has increased. The improved crop varieties that we grow are not capable of withstanding the burden of climate change at all the places. Earlier the crop varieties were suitable for particular place. These varieties were developed through selection over a long period of time, to suit the climatic and edaphic condition of an area. Many of such traditionally developed varieties have disappeared during the last few decades as there were no takers for them. Under the present scenario it is highly advisable to protect such varieties from getting extinct. Also there is need to document, test and preserve such valuable crop biodiversity from getting extinct. These varieties are useful not only for food security but also for livelihood of many who are dependent on agriculture.

***Keywords**: Biodiversity, climate change, food security, livelihood, traditional varieties.*

Introduction:

Our climate has been changing ever since the origin of planate. History tells us that there were drastic changes in the climatic conditions occurred when Homo sapience was not evolved. Earth's climate has changed naturally over the past 650,000 years, moving in and out of ice ages and warm periods. Changes in climate occur because of alterations in Earth's energy balance, which result from some kind of external factor or "forcing"—an environmental factor that influences the climate. The ice ages and shifting climate were caused by a combination of changes in solar output, Earth's orbit, ocean circulation, albedo (the reflectivity of the Earth's surface) and makeup of the atmosphere (the amounts of carbon dioxide and other greenhouse gases such as water vapour, methane, nitrous oxide and ozone that are present). Scientists have tracked these natural changes in climate by examining ice cores drilled from Antarctica and Greenland and got evidence about conditions as far back as 8,00,000 years. They established that there is direct correlation between CO2 levels and rising temperature. Today, CO2 level is 40 percent higher than it was before the industrial

revolution began in 18th century (From 280 ppm to 400 ppm in 2015 and 410 ppm in 2017). Also there is much more methane gas than ever before (Methane is 84 times more potent than CO2). Other gases that is responsible for increasing global temperature includes Chlorofluorocarbon (CFC), an organic compound that contains carbon, fluorine and chlorine. Because of the combined effects of Green House Gases (GHG) the global temperatures have raised an average of 1.4˚ F since 1880. Under the influence of rosining global temperature sea ice in the Arctic has thinned and decreased in the last few decades; the Greenland and Antarctic ice sheets are decreasing in mass. The North and South Poles are warming faster than anywhere else on Earth. Glaciers are retreating on mountains all over the world. Spring snow cover in the Northern Hemisphere has decreased over the last 50 years.

India has also witnessed the impact of global warming resulting in changes in climatic conditions. Recent floods in Rajasthan and parts of Gujarat (normally receiving scanty rainfall) are the best example to illustrate climate change. Increase in the summer days and increase in the normal temperature is the phenomenon felt all over the country including Maharashtra. Extreme heat wave affecting Andhra Pradesh and Telangana in 2015 killed more than 1735 and 585 people respectively. Cyclones like Okhi in 2017 and Aila in 2009 hit Indian states. Fluctuations in rainy days and beginning and end of rainy season are very common in Maharashtra and neighbouring Gujarat. We all are experiencing the impact of climate change in our day to day life. The farming community is affected most because of lesser production and increased cost of production. The increased cost of production is due to costly seeds, increased cost of irrigation, more pesticides and insecticides required and many more. Small and marginal farmers dependent on rains for their agricultural activities are worst affected, not only in Maharashtra but also in all the states of the country.

These small and marginal farmers are facing dual load of problems that are generated by human activities. As we have seen climate change is more serious because of human interference in nature. Similarly the “Green Revolution” began in 1970 resulted initially in increased crop production. As a side effect of green revolution our land has become less productive, underground water resources have dried up, the land and water has been contaminated with pesticides and the insects and pests have become resistant to such chemicals. All these side effects have culminated into increased cost of production and increased risk of getting benefit out of agriculture. Many a times failure of crops results in extreme steps like farmer’s suicide.

Crop biodiversity:

Crop diversity is a concept involving growing several different kinds of crops in one place. It not only safeguards biodiversity and thus ensures more sustainable, resilient agriculture but it also helps reduce food insecurity and poverty. It is essential to strengthening food systems and adapting to climate change. The biodiversity in cropped plants have been used ever since man started systematic cropping of edible plants for food and other uses. These plants were selected from wild to suit particular area having its own climatic and edaphic conditions. Over a period of time various communities worldwide developed thousands of such landraces of edible plants that later on became the cropped varieties. Thus there existed more than one lakh varieties of paddy and maize worldwide. The same was true for vegetables, pulses and fruit trees. For brinjal, cajanus, mung, urid, chillies, mangos, sapota, guava etc. Large number of varieties existed in India and all other countries growing it. However, with the advent of new technologies in agriculture and other sciences the stock of such traditionally grown varieties has shrunk. Thus for rice (paddy) in India the present list of widely cultivated varieties includes not more than 100 improved varieties. Similarly for maize 80% of the varieties have disappeared in Mexico where it was first cultivated.

These varieties have enormous genetic variations for production, resistance to pests and insects, requirement of water and endurance to a number of natural stresses, duration of crop, requirements of inputs, assisting other livelihood means etc.

Climate change and improved varieties:

After the beginning of green revolution in India, more and more farmers started cultivating improved high yielding varieties of various food, vegetables and legume crops. These crop varieties required more external inputs in the form of irrigation, fertilizers, pesticides and insecticides for better performance. Initially all such varieties performed well in various parts of country giving higher yields than the earlier varieties resulting in the spread of such varieties in areas that were not suitable or the farmers of the area not able to provide all the inputs in time. Where ever these improved varieties have been instrumental in increasing food production it was observed that as a side effect the soils and water is contaminated with pesticides and fertilizers. At many places the soils have become acidic and have reduced productivity due to the excessive use of fertilizers, especially urea, and water. The water table in many areas have come up due to excessive use of water for irrigation, mostly in areas taking water intensive crops like sugarcane and paddy. Moreover, it has been

observed that these varieties cannot tolerate water stress and are prone to attack of variety of insects and microbes.

Changes in the climatic conditions especially more temperature and unpredictable monsoon accompanied by hailstorms have negatively affected farmers of India including those of Gujarat and Maharashtra. Frequent hailstorms in summer affects irrigated crops including fruits and vegetables. Sometimes rain in December or during harvesting season affects the produce. In Gujarat during December 2017 under the influence of cyclone Okhi improved varieties of paddy crop in Southern parts of the state were badly affected (Fig.1).

Fig.1 Paddy field in the Dang district completely devastated due to unseasonal rain during Dec. 2017.

Similar examples can be noted from Marathwada and North Maharashtra wherein either due to unseasonal rains followed by long dry spell and hailstorms have made financial conditions of the farmers more vulnerable. Pest incidence may increase due to increase in rainfall. According to research by the Mahatma Phule Krishi Vidyapeeth, the increasing trend in post monsoon season in Maharashtra may increase incidence of black mould in sorghum and of Heliothis in cotton and red gram. According to agricultural scientists, the heat wave that India witnessed in 2013 had reduced four million tonnes of wheat production. Rise in one degree temperature during the flowering stage in that year caused a huge loss to the farmers in Marathwada. The Energy and Resource Institute (TERI) had prepared a report (2014) of assessment of climate change vulnerability and provided sustainable alternatives for mitigating impacts of climate change on agriculture. Thaware et.al.(2010) have listed most

common varieties of paddy grown in Western Maharashtra including - Nasik, Nagar, Pune, Satara, Sangli, Kolhapur regions as Amb-157, Kolamba, Chibbur K-42, Waksal-207 Zinia-31, ACK 5, Indrayani, Pawana Kundalika, VDN 12327, RDN-185-2 Phule Radha, Bhogawati, Jalgaon 5 , Sahyadri, Sahyadri – 2, Sahyadri – 3, Sahyadri-4, Ratnagiri 24, Ratnagiri -73, Ratnagiri-1. They have also listed traditional varieties of paddy grown in the state. The list includes Botwel, Mhadi, Walai, Bela, Patni, Bhadas, Kalarata, Bhurarata, Kolamb, Kolpi, Jiresal, Kala girga, Ghansal, Kothimbari Sal (Bodga), Champakali, Krishna Sal, Tambada jog, Ambemohar, Kasbai, Thilsa, White Luchai, Chinoor, Halga, Zinia. These varieties have specific features like nutritional, medicinal, pest, diseases, etc. These traditional cultivars are cultivated in specific geographical area of the state, the transplanting and dibbling are the popular methods for cultivation, the use of fertilizers is very low. The area under traditional varieties is meager but specific features like fine, scent and nutritional value. These cultivars are cultivated for the local market, home consumptions and religious occasions. In this area more than 500 different landraces of paddy is cultivated traditionally. Today cultivation of landraces is restricted to the backward areas having undulating terrain and inhabited by tribal.

Rahibai Popere (Fig. 2) from Akole taluka of Ahmednagar district is collecting and maintaining traditional varieties of a number of crops including paddy. Her collection has got fame all over the world. Apart from this, teachers from your own college have collected wild edible plants eaten by tribal from nearby Akole (Khyade, 2009).

Fig.2 Rahibai at her farm

Such wild edible plants and traditional varieties of crop form an important collection of biodiversity of your area. We have also started collection and documentation of traditional

varieties of paddy grown in the Dang district of Gujarat. We are in the process of evaluating these varieties for their production potential and stress endurance. Till today we have collected more than 60 such varieties (Somani, 2018).

Importance of conserving crop biodiversity:

Agricultural biodiversity provides a number of benefits within production systems. These include benefits associated with production and productivity, agro-ecosystem function, and human well-being, as summarized in Table 1. Thus agricultural biodiversity contributes directly to production and productivity, ecosystem function and human well-being (FAO, 2008).

Table 1: Biodiversity benefits to agriculture through ecosystem services

Provisioning	Regulating	Supporting	Cultural
Food and nutrients Fuel Animal feed Medicines Fibres and cloth Materials for industry Genetic material for improved varieties and yields Pest resistance	Pest regulation Erosion control Climate regulation Natural hazard regulation (droughts, floods and fire) Pollination	Soil formation Soil protection Nutrient cycling Water cycling	Sacred groves as food and water sources Agricultural lifestyle varieties Genetic material reservoirs Pollinator sanctuaries

Source: FAO, 2008

Climate change will affect the ecosystem services provided by agricultural biodiversity. This impact will be different for the different components of agricultural biodiversity. There will be mismatches in response times to climate change between interacting species (plant and pest). Certain genotypes will be favoured against others and communities within agro-ecosystems will reshuffle. This means potentially that there will be trophic decoupling of food webs and disruption of mutualism and evolutionary processes, leading to loss of functional biodiversity and to localized impacts in the delivery of ecosystem services such as lack of pollination, loss of soil biodiversity and capacity for nutrient cycling, or loss of natural biological control leading to potential new pest outbreaks.

With climate change, the value of genetic resources for food and agriculture will increase in the near future. Many of these resources will become more threatened, as global climate change will erode genetic diversity and destabilize food ecosystems significantly.

The sustainable use of genetic resources for food and agriculture will be the foundation for many of the adaptation strategies required in food and agriculture. In order to

adapt to climate change, plants and animals important for food security will need to adjust to abiotic changes such as heat, drought, floods and salinity. As climate change brings new pest and diseases, new resistances will be required for animal breeds, fish breeds and crop and forest varieties. Genetic diversity which is currently underutilized may become more attractive to farmers as a result of climate change. Moreover, the genetic diversity is under threat of getting lost as many people do not know the value of these resources. Therefore, there is an urgent need to identify, document, characterize, evaluate, multiply and popularize these resources to avert food insecurity and loss of livelihood of millions of fellow countrymen.

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