INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD ISSN: 2455-0620 Volume - 7, Issue - 3, Mar – 2021
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value: 86.87 Impact Factor: 6.719
Received Date: 18/03/2021 Acceptance Date: 30/03/2021 Publication Date: 31/03/2021

Agricultural Productivity in Eastern Plateau and Hills Zone : Role Of Environmental Factor

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Abstract: *Agriculture plays a vital role in the Indian economy. Eastern plateau and hills zone which includes states like Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha and west Bengal suffers from low productivity. Climatic factor is one of the major factors responsible for this low productivity. Suitable adaptation strategies are needed to tackle the impact of climate change in agricultural sector. Thus agriculture requires a change in the way of use of land, water, soil nutrients and genetic resources management by climate smart agriculture technique.*

Key Words: *Climate Change, Soil Erosion, Diversified farming, Climate smart agriculture (CSA).*

1. INTRODUCTION:

Agriculture plays an important role in growth, improving food security, providing employment and poverty reduction. The eastern Plateau and hills zone in India constitutes of an area of low agricultural productivity where large numbers of households suffer from severe poverty. The incidence of poverty is very high in this area. The natural resource base which is found in this region can be characterized as being poorly suited to agriculture due to climatic, water resource and soil conditions. Apart from this, many decades of environmentally damaging agricultural practices coupled with highly erosive monsoon rains, deforestation which in turn have accelerated soil erosion have left many parts of the plateau severely degraded (Banik , Edmonds & Fuwa, 2014[1]). In addition to land and labour as the critical factors of agricultural production, other crucial input variables are farm inputs and the components of the farmers' economic and biophysical environment. The farm inputs are seeds, fertilizers, pesticides, tractors, and irrigation. The biophysical environment includes the climatic factors like soil type, slope, soil depth, rainfall, temperature, etc. The economic factors pertain to the availability of farm credit, input subsidies, expenditure on R&D by government, infrastructure access, etc. In the eastern region the productivity can be increased by increasing grossed crop area and through judicious increase in fertilizer consumption. Improvement in infrastructure can also increase productivity to a great extent (Sharma, 2007[2]) However, instability in agricultural production in this zone is on the rise due to several factors such as erratic rainfall pattern, low irrigation coverage, and increase in frequency and severity of natural disasters, among others.(Singh,2009[3]).

2. FACTORS AFFECTING AGRICULTURAL PRODUCTIVITY:

a) IRRIGATION

Lack of irrigation facility and dependence of agriculture mainly on rainfall is the main factor behind the low agricultural productivity in the State. Jharkhand has a net irrigated area of 16.4 lakh hectares which constitutes 9.3% of the net sown area against the national average of 40%. Again the larger proportion of irrigated area is served by the ponds and wells which provide an unreliable source of irrigation as they themselves depend on rainfall. In the years of deficit rainfall or in the case of delayed rainfall or drought conditions, the ponds remain dry and water level of well goes down. A study by B.D Dhawan[4] revealed that yields on irrigated land was twice as high as on the unirrigated land. The reason is that irrigation is accompanied by inputs like HYV seeds, fertilizer and pesticides which have a great potential of giving higher yields. The return from these inputs is risky when used in rain-fed conditions. The HYV seeds and fertilizer can give higher yield when they are combined with controlled doses of water at critical stages of plants growth which is not possible when farming is done under rain-fed conditions, as rainfall is often uncertain, untimely and deficient. Very often the rain fails at critical time when it is most needed to start the farming operations (Singh, 2009[5]).

b) HYV SEEDS

The rain-fed region of Eastern India was responsible for increase in the use of HYV seeds. Increased HYV adoption in Eastern India was accompanied by increased use of chemical fertilizers. The observed pattern of HYV adoption (in Purulia) implies that the rapid increase in the HYV adoption rate was not due to the release of newer (and presumably more suitable for the conditions of the area) rice varieties, but rather due to the more recent adoption by farmers of the existing/well-established varieties. Given the high incidence of poverty and low productivity in

agricultural production in the area, this is certainly encouraging. In Purulia, panel survey results show yields increased between 1998 and 2006. The average yield per acre of traditional rice varieties increased from 1,004 kg in 1998 to 1,363 kg in 2006 (a 36 per cent increase). The average yield per acre of HYV increased from 1,351 kg in 1998 to 1,652 kg in 2006 (a 22 per cent increase)From sustainability point of view, however, the spread of high-input agriculture typically associated with HYV cultivation in the degraded and ecologically fragile environment is a potential source of concern (Banik, Edmonds & Fuwa, 2014)[6]. It may be mentioned that in Jharkhand only 44.4% of the paddy crop area is grown under HYV seeds as against the national average of 88.6%.(Dhawan[7])

c) PESTICIDES

Other crucial input in agricultural sector since the beginning of green revolution in India has been that of chemical fertilizers. Among different agricultural inputs, the amount of all inputs fell except pesticides. The higher per acre use of pesticide was due to an increase in insect infestation in the drought year. Apparently, the farmers were very anxious to save the small amount of crops that were left after being affected by rainfall deficiency. So they put all their efforts into preserving their future yield by applying more plant protection chemicals to combat pest infestation during the drought year. The higher incidence of pest attack in the drought year resulted from the decreased level of resistance of plants due to moisture stress. The paddy plants were weakened by moisture stress, making them highly vulnerable to different kinds of pests. In other words, 84.4 percent of total decrease in paddy yield was due to drought risk factors such as rainfall failure, rainfall variability, high temperature, and drought-induced pest attack (Swain,2014)[8].

The fertiliser consumption per hectare in the state(66.3 kgs) is roughly more than one half the National average(113.3 Kgs). The fertilizer consumption is much lower as compared to some States like Andhra Pradesh(204 Kgs/ha), Punjab(210 Kgs/ha), Haryana (167 Kgs/ha) and Bihar (140 kgs/ha). There is a great imbalance in the use of different types of fertilizer. NPK are used in the proportion of 23.7:10.4: 1 against the national average proportion of 6:2.4:1 and the suggested proportion of 4:2:1.Since farmers of the State use mainly traditional inputs like own farm produced seeds, manure and primitive implements like wooden sickle, plough, spade, hoe and less of modern and purchased inputs like hybrid seeds, fertilizers and machinery like pumpsets tractors, threshers etc. they get low yield per hectare.(Singh,2009)[9]

d) LACK OF INSTITUTIONAL CREDIT

Majority of the farmers (83%) of the State are small and marginal farmers who have their zero or negative saving and they cannot purchase the modern farm inputs unless they have access to the credit from institutional sources, commercial banks and co-operative credit agencies. However, the institutional credit to the farmers of the State is very much lacking. The credit-deposit ratio (CDR) in Jharkhand was 40.8% in Dec'2008 against the national average of 70%.It was 32.5 % in the rural area and 31.5% in the semi-urban areas.(Singh,2009)[10]

e) CLIMATE CHANGE

Due to global warming Climate change, has now started showing its impacts in all sectors. Among all of these, agriculture sector is most susceptible to Climate change because it is the primary factor of agricultural productivity. Thus it has a direct impact on food production across the globe. The increase in the mean seasonal temperature would lead to the reduction in the duration of many crops and hence reduce the final yield. Food production systems are extremely sensitive to climate changes like changes in temperature and precipitation, which may lead to occurrences of pests and diseases. This leads to a fall in production and ultimately affecting the food security of the country. The net impact of food security will depend on the exposure to global environmental change and the capacity to cope with this changing climate.

3. IMPACT OF CLIMATE CHANGE ON AGRICULTURE IN EASTERN PLATEAU AND HILLS ZONE :

Rising temperature and atmospheric CO2 concentration are two major climatic factors that have a huge influence on crop production (O'Leary, et al., 2011)[11]. Other than these increase in variability in temperature and precipitation parameters have also an effect on agricultural production (Hatfield, 2011)[12]. The ways in which the Greenhouse Effect may be important for agriculture are - Firstly, CO2-induced changes of climate may change levels of temperature, rainfall and sunshine that can affect plant productivity. And apart from this rises in sea level may lead to loss of farmland by inundation and increasing salinity of groundwater in coastal area (Mahato,2014)[13]. The impact of climate change on agriculture can be due to following reasons:

- increase in temperature
- increase in precipitation

- soil erosion
- increase in intensity of cyclone

3.1 Impact of increase in Temperature

Recent studies done at the Indian Agricultural Research Institute indicate the possibility of a loss of between 4 and 5 million tons in wheat production in the future with every rise of 1°C temperature throughout the growing period. Rice production is believed to decrease by almost a tonne/hectare if the temperature rises by 2° Celsius. Inspite of all the efforts by the state, the rice production has remained more or less at the same level. A significant rise in temperature might be the reason for this stagnant rice production in Jharkhand. From the year 1961 onwards the maximum temperature has been found in a increasing trend. The increase in temperature, particularly the maximum temperature has been found to have considerable adverse effect on crop performances, more on the rabi season crops (Wadood and Kumari P 2009)[14]. The mean daily maximum temperature in Odisha is gradually rising,as also the mean daily minimum temperature. According to data from the weather department, in the last 50 years the state's average temperature has gone up by 1° Celsius (Mahapatra,2006)[15]. Rice producers suffer a loss of 40 percent during severe droughts.

3.2 Impact of Increase in precipitation

Agriculture mainly depends on nature and so it's going to heavily impacted by climate change. Climate change has been affecting the region from the last couple of years. In Odisha, rainfall has become more erratic and less compatible to crop schedules. High intensity rainfall, often increases the problem of soil erosion. Uncertainty of monsoon onset and its withdrawal also puts a great problem before farmers (Wadood,2009)[16]. Disasters have spread to new areas. The annual rainfall showed an increasing trend over a period of 48 years from 1961 to 2008 for Ranchi Region (Wadood,2009)[17].

Studies show that forest cover in the state has declined to 4.72 million ha from around 6.8 million ha in 1960-61. Of the existing cover, only 2.73 million ha of forests have a density higher than 40%. Barren hills lead to heavy runoff of rainwater resulting in flash floods in the local area and more floods in Odisha's low coastal areas. Massive deforestation in west Odisha is not only destroying the livelihoods of the local people but also silting up riverbeds, causing floods in downstream coastal Odisha.

3.3 Impact of Soil Erosion

Light textured soils of this region having shallow depths are very prone to erosion in case of high intensity rainfall under the undulating terrain conditions. Soil of Jharkhand is very shallow and lands are undulating with varying slopes, intensify the extents of soil erosion. It is apprehended that such increase in number of erosive events may worsen the situation by leaving the top fertile soil barren and unproductive (Wadood, 2009)[18]. Barren hills lead to heavy runoff of rainwater resulting in flash floods in the local area and more floods in Odisha's low coastal areas. According to state agriculture department statistics, about 4.33 million ha of Odisha's 7.2 million ha of agricultural land suffer severe erosion and declining fertility (Mahapatra, 2006)[19].

3.4 Impact of increase in intensity of Cyclone

A possible increase in cyclone intensity of 10-20% against an increase in sea surface temperature of 2-4°C is very likely to happen. The 1999 super cyclone affected places like Bhubaneswar and Nayagarh, which were earlier not considered as cyclone-prone areas. (Mahapatra,2006)[20]. Besides, Odisha also experienced another two major cyclones i.e. Phailin (2013) and Hudhud (2014) when lots of precaution was taken by Government of Odisha to minimize the human loss. The major loss was property and crop loss. Phailin and hudhud damaged around 130 and 248 thousand hectares of crop land respectively. And the estimated financial loss from these two cyclones were $343.and $3.55 million of crops in these years (Dalei,2016)[21].

4. CONCLUSION:

Growth of crops mainly depend on various climatic factors like humidity, temperature rainfall etc. Thus if there is a change in these climatic factors it will have a direct impact on quantity of food production. Apart from these the major catastrophic events such as floods and droughts lead to huge crop loss and makes a large area of land unfit for cultivation. This leads to a fall in production of agricultural goods. And this shortfall in production will increase it's prices. This same pattern is clearly visible at global level also. This situation at global level is leading to food insecurity. (Mahato, 2014)[22].

5. WAY FORWARD:

The way of adapting to the impact of climate change on agriculture will require more careful management of resources like soil, water and biodiversity. To cope with the impact of climate change on agriculture and food production, India will need to act at the global, regional, national and local levels (Mahato, 2014)[23].

Impact of climate change on agriculture and livelihood included Soil fertility status, early flowering and fruiting, changes of fruit/crop ripening, status of crop production, new insect pest and diseases incidence and changing of cropping pattern. Policy measures to combat the negative impact of climate change include developing drought resistant crops, conducting awareness program and promoting farm level adaptation measures such as the use of irrigation technologies and adjusting planting dates. Such type of policy is utmost important for developing countries like India(Choudhary, et al.,2012)[24]. Diversified farming is the best option to combat climate related hazards. Availability of climate information is prerequisite for mitigating the adverse effect of climate variability and capitalizing on beneficial effect, especially in the region where the agriculture and livelihood totally depend upon natural resources.

Suitable adaptation strategies are a must to tackle impact of climate change in agricultural sector. Insurance to crop failure and suitable compensation are many times best public practice to adapt impact of climate change. Besides, water harvesting during rainy season and irrigation facilities during drought like situations can help farmers to grow their crops. Many times sowing season is very badly affected by extreme weather events and during post-showing season. In this situation government intervention at micro level is required to boost the moral and financial position of farmers. Prediction of climatic condition and providing information to farmers can help them in taking decision of when and what kind of farm activities to undertake to avoid the impact of climate change.

Further some part of the solution may lie in climate-smart agriculture (CSA). CSA is an approach to help the people who manage agricultural systems to respond effectively to climate change that will meet the triple objectives of sustainably increasing productivity and incomes while adapting to climate change and reducing greenhouse gas emissions wherever possible. The need of the hour is that agriculture requires a most important change in the way of use of land, water, soil nutrients and genetic resources management by climate smart agriculture technique.

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