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REVIEW ON SLASH OF CLIMATE CHANGE IN INDIAN AGRICULTURE WITH SPECIAL REFERENCE OF SOUTH INDIAN FIELDS

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ABSTRACT

Effects of environmental change on agricultural systems have been extensively researched, there is still limited understanding of what agricultural practices evolves over time in response to both climatic and non-climatic drivers and how actors mobilize their resources, institutions and practices in South India. Most actors, however, have considered private risks in the short run. Although there has been some progress in streamlining climate change into strategic planning in different countries of South Asia, policy, research and extension systems lack adequate attention to wider resilience of the system. The present paper evolves south Indian states climate conditions study in related to global expectations of improving production of exports in agro- based products by undertaking effects of emissions.

KEY WORDS: *Climate change, South India, Socio-economic drivers, Adaptation and Agriculture.*

INTRODUCTION : Current approaches to understanding agricultural adaptation are mainly dominated by technical models which focus on impacts of climatic parameters on biological potential of crops. These models rarely consider farmers innovativeness and agriculture actors at different levels. What farmers do is affected by what happens at market, policy, and research and at a whole set of social networks. Environmental change influences to adjust of natural and socio-economic systems. In the current years, literature has accumulated on the potentially large-scale impacts of climate change on India. India has developed as a standout amongst the most powerless nations on the planet, with a high-reliance on atmosphere touchy divisions, for example, horticulture, water resources, regular biological communities and ranger service, wellbeing, sanitation, infrastructure and energy. This required an immediate response by the government, especially in light of recent global negotiations. In this unique situation, an effort is made to present findings thus far on the potential vulnerability to the effects of climate change in India's key sectors. This paves the way for an argument to ensure current and future policy development in India incorporate climate change adaptation.

Climate change projections for India India's economy is tied to crucial sectors such as agriculture, water resources, natural ecosystems and forestry, health, sanitation, infrastructure and energy. The key findings are indicated in table below and highlight the impacts of climate change with regard to the climate variables like temperature variability, precipitation variability, rising sea-levels, extreme events (drought and flooding) and risk to environmental health.

The objectives of the investigations are as, a) To check the climate changing conditions in south India. b) To estimate the effect of temperature and water conditions in south Indian agriculture. c) To emphasise the global conditions effects agro based productivity in south India. d) To check the worthy conditions of implementing strategically steps to control polluted effects by using pesticides. e) Statistical analysis on improvement of socio-economic conditions and adaptability with similar conditions in the world.

CLIMATE CONDITIONS VERIFIED:

Monsoon- Monsoons are the lifeline of Indian agriculture so it is not surprising that the changes occurring in monsoon patterns are damaging crop yields. The timely arrival of the monsoon is of crucial importance to food production in the country and changing patterns in the monsoon are a threat to agriculture, food security, and the overall economy. The onset of the summer monsoon in India is getting delayed and disturbed. This affects crop cycles and cultivation in rained areas. Monsoon delays and failures inevitably lead to a reduction in agricultural output, thereby deepening food insecurity. Pre-monsoon rainfall disruption can be just as big problem however.

Soil- While it is natural to expect precipitation patterns to be impacted by climate change, soil processes are also heavily affected. This is because changes in temperature and precipitation influence water run-off and erosion, affecting soil, organic carbon and nitrogen content and salinity in the soil. This in turn has a major impact on the biodiversity of soil micro-organisms. These parameters are very relevant to soil fertility. Higher air temperatures will increase soil temperature and with it, increase the speed of organic matter decomposition and other soil processes that affect fertility.

Biodiversity - The fourth IPCC Report (2007) states that by the end of this century climate change will be the main cause of biodiversity loss. If there is an increase of the average global temperature by 1.5-2.5 °C, then approximately twenty to thirty percent of known plants and animal species will be threatened by extinction. Climate change will increase the pressure on land degradation and habitat loss, as well as genetic erosion which is already intensifying because of the growing uniformity in agricultural systems across the world.

According to the Food and Agricultural Organisation (FAO), three-quarters of the global crop diversity is already lost. This is particularly problematic as the loss of genetic diversity, both in natural ecosystems and domesticated crops, is exacerbating the impact of climatic change. Changes in the climate pattern also favour the diffusion of invasive alien species which are considered to be second only to habitat destruction as threats to global biodiversity and ecosystems. Invasive alien species are able to conquer new territories when changed eco-climatic zones become favourable for their breeding. Future biodiversity scenarios show a steady rise in the number of invasive alien species in many regions. Since these species constitute a large majority of the weeds in agriculture, they pose a growing threat to food production.

Temperature- Changes in ecological conditions are probably going to bring about the northward expansion of specific sicknesses and bugs, more ages of pathogens per season, and a superior ability to survive the winter, along these lines expanding their predominance and range. Additionally exacerbating the issue is that as agriculturists change trims and trimming examples to adjust to the evolving atmosphere, their harvests will be presented to new sorts of illnesses and vermin. In any case, it is likewise conceivable that physiological changes in the host (like more acidic sap) bring about higher sickness resistance. Then again, protection can be rapidly overwhelmed by faster pathogen life cycles when temperatures are high. As the effect of climatic change will probably fluctuate in various agro-climatic zones, the conduct of the rice bug populace will additionally differ making it hard to estimate its development.

PLANT-BASED CONTAMINANTS:

Another perspective is that the event of plant-based poisonous contaminants can be impacted by changes in atmosphere. For instance, aflatoxin a metabolite of the parasitic species *Aspergillus* is an unsafe

contaminant that taints nourishment grains and is destructive for human and creature wellbeing. Climatic changes including expanded pervasiveness of dry spell and unseasonal downpours, changes in relative stickiness, and move in temperature will influence the number of inhabitants in aflatoxin-delivering parasites.

Intensifying this issue is the way that adjustments in atmosphere may permit the expanded populace of contagious pathogens to have expanded chances to assault nourishment grain crops. For instance, dry conditions amid grain filling and development improve the likelihood of broke grains, which can get all the more effortlessly contaminated by this parasitic pathogen. Overwhelming downpours amid or after the gather can prompt not completely dried products previously capacity, causing expansion of the parasite amid the capacity time frame.

IMPACT AND VULNERABILITY OF INDIAN AGRICULTURE TO CLIMATE CHANGE:

Indian agriculture today is faced with the challenge of having to adapt to the projected vagaries of climate change. It must develop mechanisms to reduce its vulnerability. The Indian Council of Agricultural Research (ICAR) has already begun research to assess the likely impact of climate change on various crops, fisheries, and livestock. A sector wise analysis is given below.

Cereal crops- The Asia-Pacific region is likely to face the worst impacts on cereal crop yields. Loss in yields of wheat, rice and maize are estimated in the vicinity of 50%, 17%, and 6% respectively by 2050. This yield loss will threaten the food security of at least 1.6 billion people in South Asia. The projected rise in temperature of 0.5°C to 1.2°C will be the major cause of grain yield reduction in most areas of South Asia.

Wheat- India is considered to be the second largest producer of wheat and the national productivity of wheat is about 2708 kg/ha. The Northern Indian states such as Uttar Pradesh, Punjab, Haryana, Uttaranchal and Himachal Pradesh are some of the major wheat producing states. Here the impact of climate change would be profound, and only a 1°C rise in temperature could reduce wheat yield in Uttar Pradesh, Punjab and Haryana. In Haryana, night temperatures during February and March in 2003-04 were recorded 3°C above normal, and subsequently wheat production declined from 4106 kg/ha to 3937 kg/ha in this period.

Higher temperatures accompanying climate change will impact world rice production creating the possibility of a shortfall. Rainfall pattern is a very important limiting factor for rain-fed rice production. Higher variability in distribution and a likely decrease in precipitation will adversely impact rice production and complete crop failure is possible if severe drought takes place during the reproductive stages. Assessments predict a decrease in the rice production in tropical regions, but an increase of rice production outside tropical regions. This shift is of particular concern to India because lower rice production will immediately create a hunger situation on a large scale.

Chili- Research conducted by Indian Agricultural Research Institute (IARI) has shown that the grain yield of red and green chili Yield 300-350 kg/ha (for seed); 360-500 q/ha (for fresh fruits); 57-75 q/ha (for dry fruits) Plant erect with more number of branches pendent fruit bearing, non-pungent; blossom end sharp curved, dark green colour fruits turns dark red on maturity.

GREENHOUSE EFFECTS ON SOUTH INDIAN AGRICULTURE:

The greenhouse effect is a natural process that plays a major part in shaping the earth's climate. It produces the relatively warm and hospitable environment near the earth's surface where humans and other life-forms have been able to develop and prosper. However, the increased level of greenhouse gases (GHGs) due to anthropogenic activities has contributed to an overall increase of the earth's temperature, leading to a global warming. The atmospheric CO2 concentration has increased from 280 ppm to 395 ppm, scenarios of global warming indicate that the global average surface temperature could rise by 1.4 to 5.8°C by 2100 and the rate of warming is unprecedented during last 10,000 years.

STUDY ON BIO CULTIVATION:

Biological control (biopesticides)- A parasite or predator is used to control only the target species. This is a very important method of control of many pests in glasshouses and has reduced the reliance on pesticides. There area few examples in field crops are as, (a) predatory mites are used successfully to control the red

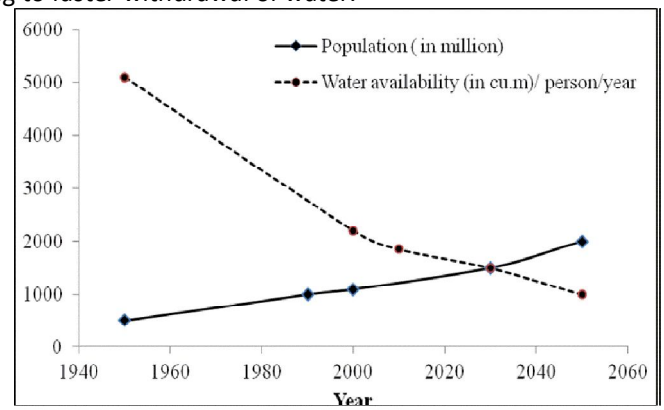
spider mite in cucumber production under glass; (b) *Bacillus thuringiensis* for bacterial control of caterpillars.

The crop is sprayed and the bacterium invades the target organism; it is very effective at controlling caterpillars including those of the cabbage white butterfly.

Barriers- Fleece or net crop covers will stop egg laying of some pests such as carrot flies; on a field scale it is expensive although a very effective option. In swedes this is the only method available to growers to control cabbage root fly as there are currently no suitable recommended chemicals.

EFFECT OF CLIMATE CONDITION ON PRODUCTIVITY:

In India, the growing population is a major concern, and there is a need to understand the availability of water in terms of increase in population growth. A decline has been projected in mean per capita annual freshwater availability and growth of population from 1951 to 2050 as shown in graph. The graph clearly indicates the 'two-sided' effect on water resources as the rise in population will increase the demand for water leading to faster withdrawal of water.



Graph: Observed and projected decline in per capita average annual freshwater availability and growth of population from 1951 to 2050.

Indian agriculture consumes about 80-85% of the nation's available water. The quantity of water required for agriculture has increased progressively through the years as more and more areas were brought under irrigation. Surface water and groundwater resources have played a significant role in irrigation and also in attaining self-sufficiency in food production during the past three decades. Availability and utilization patterns have been studied in India, and changes have been observed in surface temperature, rainfall, evaporation and extreme events since the beginning of the 20th century.

IMPACT OF CLIMATE CHANGE ON CROP PRODUCTIVITY:

Rainfall in India has a direct relationship with the monsoons which originate from the Indian and Arabian Seas. A warmer climate will accelerate the hydrologic cycle, altering rainfall, magnitude and timing of run-off. Warm air holds more moisture and it will result in an increase in evaporation of surface moisture. Climate change has a direct impact on crop evapo-transpiration (ET). Therefore, change in climate will affect the soil moisture, groundwater recharge, and frequency of flood or drought, and finally groundwater level in different areas. Effect of climate change will affect water cycle. In addition, rise in sea level will increase the risk of permanent or seasonal saline intrusion into ground water and rivers which will have an impact on quality of water and its potential use of domestic, agricultural and industrial uses. Climate change will have number of effects on agriculture.

STATISTICAL METHODS:

The results of modelling the set of factors explaining variation on innovations across households showed that the data is better in explaining differences in innovativeness, with 65% of the variance accounted for. The site explained 43% of the variation in innovativeness between households, land size explained 10 21%, membership explained 31%, climate change and agriculture training/meetings attended explained 196%, number of livelihood sources explained 22% and access to finance explained 21%. The

results infer that climate change and agriculture-related training brings higher level of variability in terms of farm level innovation. Gupta *et al*. (2010) also reported that all sorts of practical trainings for farmers and agricultural extension officers affect adaptive capacity of the farmers.

Key motivations	Key Variability /opportunities	Observed changes in different sites	Scales†		
			HH	Village	District
Transformative learning from extreme events	A severe hailstone in 2000 damaged one but not other varieties of wheat	Varietal and crop diversification (Rupandehi)	**	*	*
	Recurrent droughts in 90s and early 2000	Collaborative action for common pool resource regeneration (Udaipur)	-	**	**
	Koshi flood in 2000	Off-farm livelihood diversification, mainly out-migration (Madhepura)	**	**	**
	Cyclone Sidr 2007	Restoration of embankment and measures to reduce inflow of saline water (Kolapara)	-	**	**
	Heavy flood in 2007	Focus more on dry season crops (Kamarjani)	**	*	*
Adjusting farming with the uncertain cycle of weather events	Uncertain incidence of floods	Raise multiple varieties of rice in the seedbeds in charlands (Kamarjani)	**	*	-
	Uncertain cyclones	Cultivation of dry season crops (Kolapara)	**	*	*
	Rainfall risks	Introduction of legumes in the rainfed fields (Lamjung)	**	**	**
		Replacement of rice-wheat by maize-wheat (Madhepura)	**	*	-
		Use of less water requiring varieties (local cultivars) of crops (Udaipur)	**	*	-
	Salinity issue	Re-excavation of silted up canals and embankments to prevent intrusion of saline water (Kolapara)	-	**	-
Experimental actions to reduce the risks	Flood risks	Prepare seedbeds in the higher ground and use late varieties to cope with the post flood cultivation, fodder storage for flood season and avoid planting the same crop in the same plot in consecutive seasons (Kamarjani)	**	*	*
	Unfavorable field environment during planting (mainly due to temporary flooding)	Zero tillage of wheat (Rupandehi); zero tillage garlic, women farmers floating beds in waterlogged area, leave paddy residue in the field, seed storage in plastic containers instead of bamboo bags, replace goat by sheep which can withstand wet environment (Kamarjani)	*	-	-
	Declining groundwater table	Soil and moisture conserving machines (zero till, happy seeder,	**	**	**

		rotavator), underground pipelines and laser land leveling (Sangrur)			
	Rainfall and drought risks	Water storage tanks, and install pipelines to reduce water wastage and shift to sturdier breed of goats (Udaipur)	**	*	-
		SRI (Nalanda and Rupandehi)	*	*	-
		Direct seeded rice (Rupandehi, Punjab)	*	*	-
Market opportunities	Ecotourism	Moving away from transhumance and replace cereals with cash crops (Lamjung)	**	**	*
	Better prices of milk and vegetables	Commercial dairy and vegetables (Udaipur), replace traditional with improved breeds of cows (Madhepura)	**	**	*
	Comparative advantage	Replace rice with jute and women produce vegetables in monsoon (Kamarjani); smallholder farmers replace rice-wheat with vegetables and relatively larger sized farmers with banana (Rupandehi)	**	*	-
	Mechanization	Replace bull (used in the past for plowing) by cows or buffaloes and introduce mechanical tillage system (Nalanda and Madhepura), mechanization isintroduced entirely (Punjab) and partly (Udaipur),	**	**	**
		Char areas (traditionally left fallow and under grass production) are being intensively cultivated using power tillers (Kamarjani)	**	**	*
	Involvement of market actors	Shift to cash crops (resilient to drought and salinity) - promoted by wholesalers of Dhaka, local dealers introduce high yielding varieties, farmers cultivate maize on fallow, barren and sandy charland (as maize demand increased due to poultry business) (Kolapara)	**	*	-
†HH: Household level		**: highly observed	*: observed	-	not observed/not applicable

Table: Observed agricultural practices in relation to several drivers in case study sites

CONCLUSION

The effect of climate change poses many threats; one of the important consequences is bringing about changes in the quality and quantity water resources and crop productivity. It can be concluded that the Indian region is highly sensitive to climate change. There is also a need that government, development partners and community-based institutions design the projects considering how people will be able to adapt in the future. Planning and intervention design should use people's own ability and practice of

experimentation and innovativeness as an entry point. In the areas where participatory approaches such as farmers field school (FFS) have been successfully piloted, attempts to adapt this approach to the new challenge of climate change should be considered. In order to address the key question of what practical adaptation strategies need to be implemented, where, and by when, two important components must be considered: Assessment tools are needed to estimate climate change risks and vulnerabilities for a portfolio of development projects and Pathways for implementation of adaptation actions must be developed, so that identified risks and opportunities at the macro-level can be implemented in collaboration with stakeholders to provide relevant working solutions.

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