

# Climate Change and Food Security in India: Some Issues and Challenges

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## **ABSTRACT**

*Climate change has added to the enormity of India's food-security challenges. While the relationship between climate change and food security is complex, most studies focus on one dimension of food security, i.e., food availability. This paper provides an overview of the impact of climate change on India's food security- Some Issues and Challenges, keeping in mind three dimensions, availability, access, and absorption. It finds that ensuring food security in the face of climate change will be a formidable challenge and recommends, among others, the adoption of sustainable agricultural practices, greater emphasis on urban food security and public health, provision of livelihood security, and long-term relief measures in the event of natural disasters.*

*Climate change and its impact is a matter of great concern among all countries of the world because it has the potential to make vulnerable life on the earth. Therefore an attempt has been made here to examine the impact of climate change on the food security of India with special reference to the agro-climatic regions. The study revealed that climate change can adversely affect the all four dimensions of food security i.e. food availability, accessibility, utilization and stabilization. There is a great deal of uncertainty regarding climate change, but there are some certainties. The prospects of Indian food security under the upcoming climate change will depend a numbers of immediate measure i.e.to reduce the vulnerability of food system to climate change and other global environmental changes, which has started looming large the very existence of human kind.*

**Key words: Climate change, Food availability, Accessibility, Utilization and Stabilization.**

## **INTRODUCTION**

At the heart of the Sustainable Development Goals (SDGs) are targets to end hunger, achieve food security, and improve nutrition. For India, food security continues to be high on its list of development priorities because the country's relatively high rates of economic growth have not led to a reduction in hunger and under nutrition. India's gross domestic product at factor cost and per capita income grew at seven percent and five percent per annum, respectively, from 1990-91 to 2013-14.

However, the incidence of under nutrition has dropped only marginally from 210.1 million in 1990 to 194.6 million in 2014, and India has failed to meet the Millennium Development Goal of halving the proportion of people who suffer from hunger. About 12 Indian states fall under the 'alarming' category of the Global Hunger Index. According to the National Family Health Survey 2015-16, the proportion of children under five years who are underweight is significantly high in states such as Bihar (43.9 percent), Madhya Pradesh (42.8 percent) and Andhra Pradesh (31.9 percent)

## **Climate Change and Food Security**

Food security is both directly and indirectly linked with climate change. Any alteration in the climate parameters such as temperature and humidity which determines the growth of crop will have direct impact on the quality of the food produced. Indirect linkage pertains to catastrophic events such as floods and drought which are projected to multiply as a consequence of climate change leading to huge crop loss and leaving large patches of arable land unfit for cultivation and hence, threatening food security (Chaudhary and Aggarwal, 2007). Many studies have been carried out to examine the impact of climate change on the agriculture; some of the very significant are (Rosenzweig 1985, Sinha and Swaminathan 1991, Rathore et al 2001 and Blanc 2012). These studies shows that climate change may affect food system in several ways ranging from crop production to changes in markets, food price and supply chain infrastructure. Changing pattern of rainfall in semi-arid and sub-humid region which, may be translated to a decline in rain- fed cereal production, thereby challenging the livelihoods of billions of people due to global temperature changes as well as the rainfall uncertainty.

Climate change will affect food security through its impacts on all components of global, national and local food production systems which is projected to affect all four dimensions of food security namely food availability, access to food, food utilization and food sustainability (Ranuzzi and Srivastava, 2012). In the other words with many of the resources needed for sustainable food security already stretched, the food security challenges are huge. Climate change will make it even harder to overcome them, as it reduces the productivity of the majority of existing food systems and harms the livelihoods of those already vulnerable to food insecurity (FAO, 2008).

## **HOW DOES CLIMATE CHANGE AFFECT FOOD SECURITY?**

The World Food Summit in 1996 defined food security thus: "Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life." According to this definition, there are three main dimensions to food security: food availability, access to food, and food absorption. Thus, adequate food production alone is not a sufficient condition for a country's food security.

Food security is one of the leading concerns associated with climate change. Climate change affects food security in complex ways. It impacts crops, livestock, forestry, fisheries and aquaculture, and can cause grave social and economic consequences in the form of reduced incomes, eroded livelihoods, trade disruption and adverse health impacts. However, it is important to note that the net impact of climate change depends not only on the extent of the climatic shock but also on the underlying vulnerabilities. According to the Food and Agriculture Organization (2016), both biophysical and social vulnerabilities determine the net impact of climate change on food security.

Much of the literature on the impact of climate change on food security, however, has focused on just one dimension of food security, i.e., food production. The impact of climate change on the other dimensions of food security access and utilization – have received little scholarly attention. This paper explores the impact of climate change on India's food security by considering all these dimensions of food security.

## **Food production**

Climate change presents an additional stress on India's long-term food security challenges as it affects food production in many ways. For one, it may cause significant increases in interannual and intra-seasonal variability of monsoon rainfall. According to World Bank estimates, based on the International Energy Agency's current policy scenario and other energy sector economic models, for a global mean warming of 4°C, there will be a 10-percent increase in annual mean monsoon intensity and a 15-percent increase in year-to-year variability in monsoon precipitation. The World Bank (2013) also predicts that droughts will pose an increasing risk in the north-western part of India while southern India will experience an increase in wetness

## **Climate Change and Food Security in India**

India has many reasons to be concerned about climate change, because a majority of population depends on climate sensitive sector i.e. agriculture, forestry and fishing for livelihood. The existing problem of food security in our country, if not addressed in time, will become more acute due to change in the climate. It will become more difficult to ensure food security under the changing climate for country like India where more than one third of the population is estimated to be absolutely poor and one half of all children are malnourished in one way or another (Dev and Sharma, 2010). To examine the impact of climate change on Indian agriculture sector is quite complex as several factors are concerned in this phenomena. For the detail discussion about impact of climate change on food security we have taken the four components of food security and discuss the impact of climate change on these components in the Indian context.

## Climate Change and Food Production

The evaluation of climate change impacts on agricultural production, food supply and agriculture based livelihoods must take into account the characteristics of the agro ecosystem where particular climate-induced changes in biochemical processes are occurring, in order to determine the extent to which such changes will be positive, negative or neutral in their effects (FAO-2008 P. 21) greenhouse fertilization effect will produce local beneficial effects where higher level of atmospheric CO<sub>2</sub> stimulate plant growth. This is expected to occur primarily in temperate zones with yield expected to increase by 10 to 25%. (IPCC, 2007c) These effects are not likely to influence projections of world food supply, (Tubiello *et al.*, 2007). But in India tropical type of climatic condition prevails so here most probably the greenhouse fertilization will have negative impacts. The impact of mean temperature increase will be experienced differentially, depending on location (Ieff, Romand Kutty and Faley, 2004) for example, Moderate warming (increase of 1 to 30C in mean temperature is expected to benefit crop and pasture yields in temperate regions while in tropical and seasonally dry regions like India, it is likely to have negative impacts particularly far cereal crops. Warming of more than 30C is expected to have negative effects on production in all regions (IPCC, 2007c). It is also evident from the Fig. No 1 that how the global warming will affect the world. For climate variables such as rainfall, soil moisture and radiation, crops have thresholds beyond which growth and yield are compromised (Porter and Semenov, 2005). For example, cereals and fruit tree yields can be damaged by a few days of temperatures above or below a certain threshold (Wheeler *et al.*, 2000).

An average of 500 weather-related disasters are now taking place each year compared with 120 in the 1980s; the number of floods has increased six fold over the same period (Oxfam 2007). Increased intensity and frequency of storms, altered hydrological cycles, and precipitation variance in India also have long term implications on the viability of current and future food availability. Constraints on water availability are a growing concern, which the problem of climate change will further exacerbate. Conflicts over water resources will have implications for both food production and people's access to food in conflict zones (Gleick, 1993). Even today in India we can see many cases of water dispute which are inter-state and intra-state but in future because of climate change the scarcity of water will be further increased and intensity of these types of dispute will be more. All these factors will further compound the problem of food availability. Prolonged and repeated droughts can cause loss of productive assets, which undermines the sustainability of livelihood systems based on rain fed agriculture like India where approximately 70% cultivated land is practiced under the system of dry land farming. Drought and deforestation can increase fire danger, with consequent loss of the vegetative cover needed for grazing and fuelwood.

Climate change and Storage, processing and distribution of food grain Food production varies spatially, so food needs to be distributed between regions. The major agricultural production regions are characterized by relatively stable climatic conditions but many food-insecure regions have highly variable climates. The main grain production regions have a largely continental climate, with dry or at least cold weather conditions

during harvest time, which allows the bulk handling of harvested grain without special infrastructure for protection or immediate treatment. Depending on the prevailing temperature regime, however, a change in climatic conditions through increased temperatures or unstable, moist weather conditions could result in grain being harvested with more than the 12 to 14% moisture required for stable storage. Because of the amounts of grain and general lack of drying facilities in these regions, this would create hazards for food safety, or even cause complete crop losses, resulting from contamination with microorganisms and their metabolic products. It would lead to a rise in food prices if stockiest have to invest in new storage technologies to avoid the problem (FAO, 2008). Distribution depends on the reliability of import capacity, the presence of food stocks and when necessary-access to food aid (Maxwell and Slater, 2003).

These factors in turn often depend on the ability to store food. Storage is affected by strategies at the national level and physical infrastructure at the local level. Transport infrastructure limits food distribution in developing country like India. Where infrastructure is affected by climate, through either heat stress on roads or increased frequency of flood events that destroy infrastructure, there are impacts on food distribution, influencing people access to markets to sell or purchase food (Abdulai and Crole Rees, 2001).

### **Climate change on food access**

Food is allocated through market and non-market distribution mechanisms. Factors that determine whether people will have access to sufficient food through markets are considered in the affordability. These factors include income-generating capacity, amount of remuneration received for products and goods sold or labor and services rendered and the ratio of the cost of a minimum daily food basket to the average daily income (FAO, 2008). Non market mechanisms include production for own consumption, food preparation and allocation practices within the household, and public food distribution schemes. The approximately 70% population of India live in rural areas. For rural India where people who produce a substantial part of their own food, climate change impacts on food products may reduce availability to the point that allocation choices have to be made within the household. A family might reduce the daily amount of food consumed equally among all household members, or allocate food preferably to certain members often the able-bodied male adults who are assumed to need it the most to stay fit or continue working to maintain the family. Non-farming low income rural and urban households whose incomes fall below the poverty line because of climate change impacts will face similar choices.

Allocation issues resulting from climate change are therefore likely to become more significant in urban areas over time. Urban agriculture has a limited ability to contribute to the welfare of poor people in India because the bulk of their staple food requirements still need to be transported from rural areas (Ellin and Sumberg, 1998). In many countries the ratio of a minimum daily food basket to the average daily income used as a measure of poverty (World Bank Poverty Net, 2008) when this ratio falls below a certain threshold, it signifies, that food is affordable and people are not impoverished; when it exceeds the

established threshold, food is not affordable and people are having difficulties in obtaining enough to eat. This criterion is an indicator of chronic poverty, and can also be used to determine when people have fallen into temporary food insecurity. Owing to reduced food supply and increased prices to a sudden fall in household income or to both. Most food is not produced by individual households but acquired through buying, trading and borrowing. Climate impacts on income-earning may affect the availability of certain food products, which may influence their price. High prices may make certain foods unaffordable and can have an impact on individual's nutrition and health. Changes in the demand for seasonal agricultural labor caused by changes in production practices in response to climate change, can affect income generating capacity positively or negatively. Mechanization may decrease the need for seasonal labor in many places, and labor demands are often reduced when crops fail, mostly owing to such factors as drought, flood frost or pest. Out breaks which can be influenced by climate (FAO, 2008). Food preferences determine the kinds of food households will attempt to obtain. Changing climatic conditions may affect both the physical and the economic availability of certain preferred food items, which might make it impossible to meet some preferences. Change in availability and relative prices for major food items may result in people either changing their food basket, or spending a greater percentage of their income on food when prices of preferred food items increase.

### **Climate change on food utilization**

Food insecurity is usually associated with malnutrition, because the dieting patterns of people who are unable to satisfy all of their nutritional requirements don't consist of nutritious food grains. Declines in the availability of mild foods and limits on small-scale horticultural production due to scarcity of water or labor resulting from climate change could affect nutritional status adversely. In general, however, the main impact of climate change on nutrition is likely to be felt indirectly, through its effects on income and capacity to purchase in order to diversify their food basket. In India climate change will cause new patterns of pests and diseases to emerge, affecting plants, animals and humans, and posing new risk for food security, food safety and human health. Increased incidence of water-borne diseases in food-prone areas like U.P., Bengal, Orissa, Bihar, Andhra Pradesh and Maharashtra etc; changes in vectors for climate responsive pests and diseases, and emergence of new diseases could affect both the food chain and peoples physiological capacity to obtain necessary nutrients from the foods consumed. These will expose crops, livestock, fish and humans to new risks to which they have not yet adopted. They will also place new pressures on care giver within the home. Malaria in particular is expected to change its distribution in a result of climate change (IPCC, 2007a). In coastal area of India more people may be exposed to vector-and water-borne diseases through flooding linked to sea-level rise. Food safety may be compromised in various ways. Increasing temperature may cause food quality to deteriorate, unless there is increased investment in cooling and refrigeration processing of perishable foods to extend their shelf-life.

## Climate change on food sustainability

Many crops have annual cycles and yields which fluctuate with climate variability, particularly rainfall and temperature. Maintaining the continuity of food supply when the production process is seasonal in nature is a therefore challenging task. Droughts and floods are a particular threat to food stability and could bring about both chronic and transitory food insecurity. As we know India is a country which is more prone to drought and floods. Both are expected to become-more frequent, more intense in India and less predictable as a consequence of climate change. In rural areas which depend mostly on rain fed agriculture has the 70% of the total population of India which depends on the local food supply. Changes in the amount and timing of rainfall within the season and an increase in weather variability are likely to aggravate the precariousness of local food system. Increasing instability of supply, attributable to the consequences of climate change, will most likely lead to increases in the frequency and magnitude of food emergencies with which the global food system is ill-equipped to cope. Climate change might exacerbate conflict in numerous ways, although links between climate change and conflict should be presented with care. Increasing incidence of drought may force people to migrate from one area to another, giving rise to conflict over the access to resources in the receiving area. Resource scarcity can also trigger conflict and which could be driven by the global environmental change.

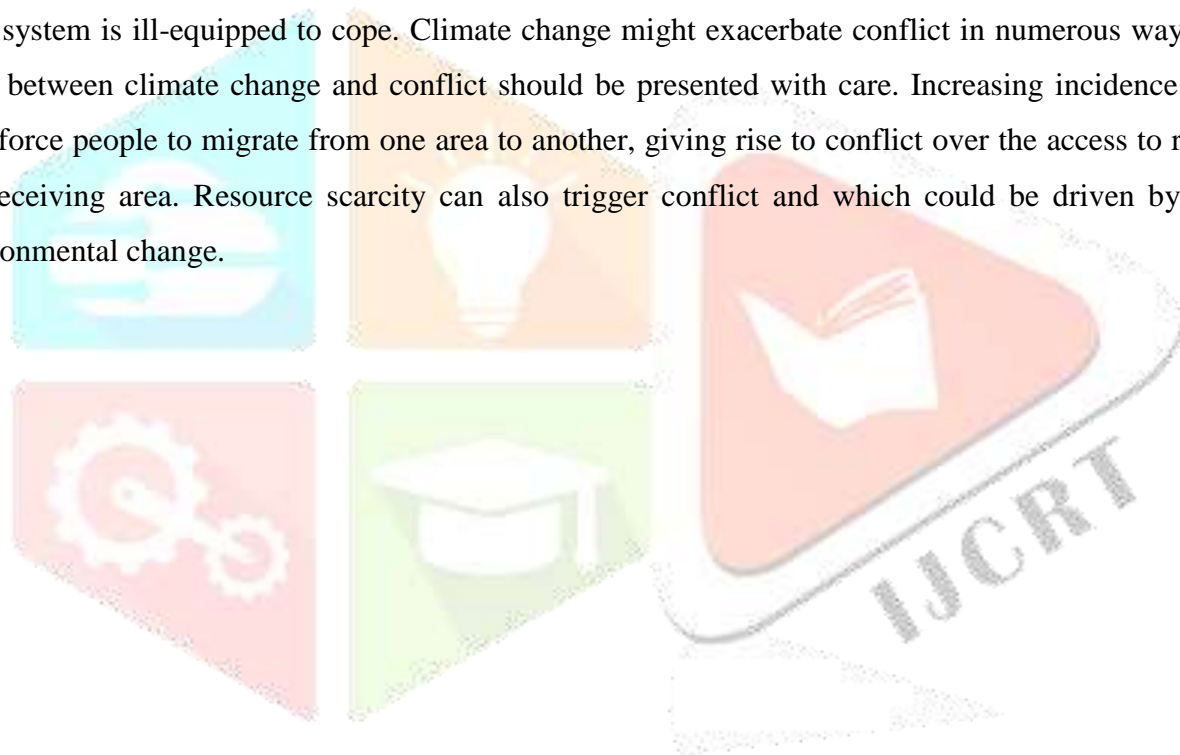
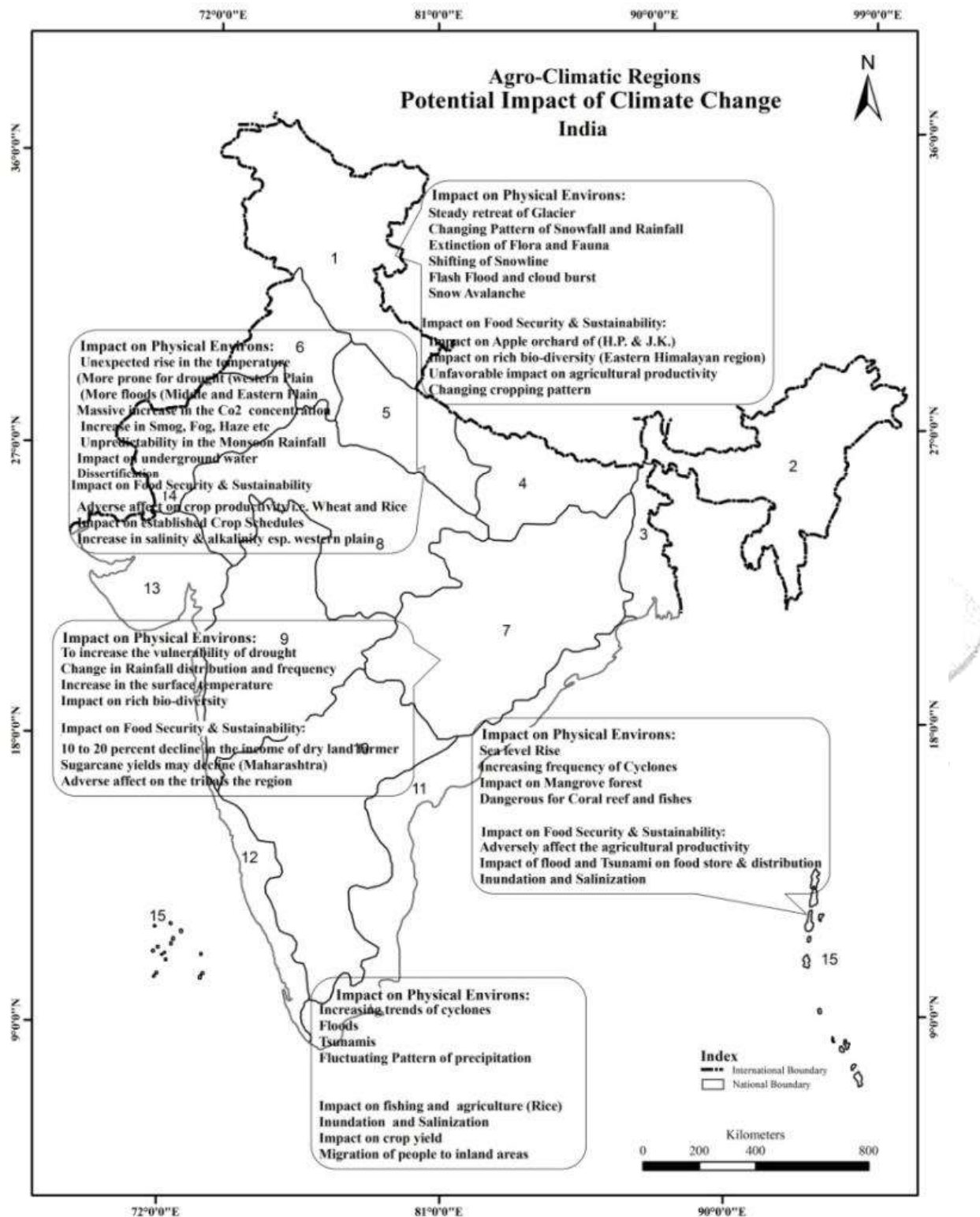


Figure No: 1



### Impact of climate change Agro-climatic regions in India

Many agricultural development projects in various parts of the worlds failed to link agro-climatic condition properly. FAO defined an agro-climate zone as a land unit delineated in terms of major climate and growing



period, which is climatically suitable for certain range of crops and cultivars. The main objective was to integrate plans of the agro-climatic regions with the state and national plans to enable policy development based on techno-agro-climatic considerations. In the agro climatic regional planning, further sub-regionalization was possible based on agro-ecological parameters. Agro-climatic zone is the concept of analyzing the geographical nature of a region from the context of its agricultural prospective. If the agricultural practices of different regions are conducted according to the agro-climatic conditions then they would be more sustainable. Genetic diversity and bio-diversity of a particular agro-climatic zone should be factored in before framing the agricultural policy for a particular zone. It is evident from the (Fig No 1) that Indian agro-climatic regions are highly vulnerable for the hazardous impact of climate change. There are many evidences that glaciers in Himalayas are retreating at a rapid pace. The Himalayan region is known as storehouse of water and spread over the states like J&K,

## CONCLUSION & SUGGESTIONS

### *Adoption of sustainable agricultural practices*

The main problem of Indian agriculture is low productivity. To meet India's growing food demand, there is an acute need for increasing productivity in all segments of agriculture. But given the vulnerability of Indian agriculture to climate change, farm practices need to be reoriented to provide better climate resilience. India needs to step up public investment in development and dissemination of crop varieties which are more tolerant of temperature and precipitation fluctuations and are more water- and nutrient efficient. Agricultural policy should focus on improving crop productivity and developing safety nets to cope with the risks of climate change.

Better management of water resources must be a key feature of sustainable agriculture. Water supply management options such as new storages and water harvesting are important, especially in the water-stressed regions of north-western India. Water use efficiency in agriculture needs to be enhanced. India's irrigation infrastructure needs to be upgraded; particular attention needs to be given to northwestern India, the country's food basket that is prone to climate-induced droughts. Despite the benefits of drip irrigation, it is still largely adopted for high-value horticultural crops. To enhance the area under micro and drip irrigation, the government should redirect the subsidy on electricity for drawing water for irrigation purposes, which has been a major contributor to declining groundwater levels, towards the adoption of drip irrigation techniques.

A four-pronged strategy is recommended for the water sector:

- ❖ Increase irrigation efficiency
- ❖ Promote micro irrigation in water-deficient areas
- ❖ Better water resource infrastructure planning
- ❖ Restoration of water bodies in rural areas

### ***Stronger emphasis on public health***

India has historically had a poor record in public health. With the worsening challenges of climate change, the country's policymakers have also paid little attention to its impacts on health. Despite the fact that the disease burden from vector-borne and diarrhoeal diseases is very high in urban slums and tribal areas of India, this area was overlooked when the original National Action Plan for Climate Change (NAPCC) was formulated. The Ministry of Health is currently formulating a National Mission for Health under the ambit of NAPCC but given the close relationship between climate change, infectious diseases and food absorption, public expenditure on health needs to be stepped up drastically.

### ***Enhance livelihood security***

Achieving food security in the context of climate change calls for an improvement in the livelihoods of the poor and food-insecure to not only help them escape poverty and hunger but also withstand, recover from, and adapt to the climate risks they are exposed to. India's National Rural Employment Guarantee Act (NREGA) of 2005 marked a global milestone in the history of poverty alleviation. NREGA has had several positive effects: increasing rural wages, reducing gender wage gaps, enabling better access to food, and reducing distress migration from rural areas. NREGA has also made an important contribution to child wellbeing, through the reduction of hunger and improvement of health and education.

Moreover, the scheme contributes to ecological restoration and natural resource regeneration in dry regions. Water conservation accounted for about half of the total projects supported by NREGA from 2006 to 2008, with 850,000 completed works. Although some gaps have been observed in the implementation of NREGA, the scheme has various benefits for the rural poor, particularly the marginalized sections, women, scheduled castes and scheduled tribes. Therefore, funding allocations for NREGA should be maintained and efforts should be made to more effectively streamline the funds to plug existing leakages.

Given the level of urban poverty, under nutrition, and lack of remunerative employment, there is a strong case for providing guaranteed employment on the lines of NREGA in urban areas as well. Such a scheme should be tailored to not only provide livelihood security to the urban poor but also create climate resilient urban infrastructure in Indian cities. Additional efforts are required for the vulnerable populations residing in the ecologically fragile coastal and forest regions.

### ***Greater emphasis on urban food insecurity***

Urban India is not only an important contributor to global greenhouse gas emissions but also a victim of climate change as poor people account for the bulk of its population. As observed earlier, climate change will have an enormous impact on urban food insecurity.

Therefore, urban food insecurity deserves serious attention. The approach towards tackling urban food insecurity must take into account both the access and absorption dimensions of food insecurity. To improve access to healthy food, effective public distribution systems need to be put in place. Efforts must be made to learn from states such as Tamil Nadu which has an effective public distribution system and has better

nutritional outcomes. To improve food absorption, living conditions in urban informal settlements need to be upgraded. The Swachh Bharat Mission, which aims to construct 10.4 million individual toilets and 0.5 million public toilets and adopt scientific solid waste management in 4,041 towns, may be regarded as a step in the right direction.

Indian cities have an extremely poor record in disaster management. Therefore, public investment in climate-resilient infrastructure should be enhanced. In India, flood control efforts, sanitation infrastructure and surveillance activities are not very effective. Better infrastructure in urban areas will minimize the disease risks caused by flooding.

### ***Long-term relief measures in the event of natural disasters***

India's disaster-management strategies are mostly inadequate, short-lived and poorly conceived. Also, much of the emphasis is laid on providing quick relief to the affected households as opposed to developing long-term adaptation strategies. Little effort is made towards addressing the long-term impacts of natural disasters on agricultural productivity and under nutrition. A recent report by NITI Aayog suggests that “the government should transfer a minimum specified sum of cash to affected farmers and landless workers as an instant relief”. For richer farmers who may want insurance above this relief, the report recommends a separate commercially viable crop insurance programme.

Given the vulnerability of Indian agriculture to climate-induced natural disasters and their long-term impacts on agricultural output, livelihoods and nutrition, such a short-sighted approach towards disaster relief will only prove inadequate. The government needs to take a long-term view of disaster relief. Moreover, given the adverse impacts of natural disasters on child nutrition, long-term under nutrition prevention programmes must be implemented in disaster-affected regions. Additional efforts must be directed towards reducing the risk in agriculture. Such schemes should be specially targeted towards small farmers.

### ***Need for more impact assessment studies***

To develop climate-resilient strategies and make adequate policy interventions, there is a need for an integrated assessment of the impact of climate change on India's food security. So far, there are fewer studies on the impact of climate change on other dimensions of food security besides production. Research efforts should be directed towards assessing and quantifying where possible the impact of climate change on under nutrition and food absorption.

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