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Climate smart agriculture: An approach for transforming and reorienting agricultural development

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INTRODUCTION

Climate change is the most severe challenge that affects country's development in 21st century. It is one of the major threats to humankind and affects many sectors like forestry, agriculture, environment and human lives as well. Climate change has brought about severe and possibly permanent alterations to our planet's geological, biological and ecological systems. Climate change will probably increase the risk of food insecurity for some vulnerable groups, such as the poor. The croplands, pastures and forests that occupy approximately 60 per cent of the earth's surface are progressively being exposed to threats from increased climatic variability. As climatic patterns change, there comes change in the distribution of agro-ecological zones, habitats, distribution patterns of plant diseases and pests, fish populations and ocean circulation patterns which can have significant impact on agriculture and food production. Climate change already affects agriculture and food security and if no urgent actions are taken, will put millions of people at risk of hunger and poverty. The expected effects of climate change – higher temperatures, more frequent extreme weather events, water shortages, rising sea levels, ocean acidification, land degradation, ecosystems disruption and biodiversity loss could seriously compromise agriculture's ability to feed themost vulnerable, thus impeding progress towards the eradication of hunger, malnutrition and poverty (FAO, 2016).

The challenge of rapidly boosting productivity is compounded by the current and expected impacts of climate change.Changes to precipitation and temperature, especially in marginal areas, are expected to reduce productivity and make production more erratic (Cline, 2008). Ensuring that agriculture becomes climate smart is a priority for addressing the need for adequate, nutritionally balanced food for a growing and more demanding population in a situation of resource limitations and climate change and variability.

Consequently, there is a need to simultaneously improve agricultural productivity and reduce yield variability over time under adverse climatic conditions. A proposed means to achieve this is increased adoption of a 'Climate Smart Agriculture' (CSA) approach (FAO, 2010). CSA, which is defined by its intended outcomes,

rather than specific farming practices, is composed of three main pillars: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change and reducing and/or removing greenhouse gas emissions relative to conventional practices (FAO, 2013a). So CSA is an important approach in agriculture to deal with the most challenging issue of the world.

Climate change and agriculture:

Agriculture and climate change are deeply intertwined. Agriculture is the backbone of economic system of most of the countries. In addition to food and raw material, agriculture also provides employment opportunities to large population. Climate change directly affects agricultural production as this sector is inherently sensitive to climatic conditions and is one of the most vulnerable sectors at the risk and impact of global climate change (Parry *et al.*, 2005). Agricultural production has always been closely linked with variations in weather. Climate change is projected to have significant impacts on conditions affecting agriculture, including temperature, carbon dioxide, glacial run-off, precipitation and interaction of these elements.In general, climate change could affect agriculture in several ways: productivity, in terms of quantity and quality of crops; agricultural practices, through changes of irrigation and agricultural inputs such as herbicides, insecticides and fertilizers; environmental effects, in particular in relation of frequency and intensity of soil drainage (leading to nitrogen leaching), soil erosion, reduction of crop diversity.

In general, climate change could affect agriculture in several ways:

– Productivity, in terms of quantity and quality of crops

– Agricultural practices, through change of water use (irrigation) and agricultural inputs such as herbicides, insecticides and fertilizers.

– Environmental effects, in particular, in relation of frequency and intensity of soil drainage (leading to nitrogen leaching), soil erosion, reduction of crop diversity.

– Rural space, through the loss and gain of cultivated lands, land speculation, land renunciation and hydraulic amenities.

– Adaptation, organisms may become more or less competitive, as well as humans may develop urgency to develop more competitive organisms, such as flood-resistant or salt-resistant varieties of rice.

Why is climate smart agriculture being a need of time?

Climate-smart agriculture is defined as an approach for transforming and reorienting agricultural development under the new realities of climate change (Lipper *et al.,* 2014). It is defined as "agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces Green House Gases (GHGs) where possible and enhances achievement of national food security and development goals" (FAO, 2013b). As per FAO estimate, by year 2050 world population will increase by one – third and food security will be required to be increased by 60 per cent. Agriculture has become a high risk profession- farmers increasingly prefer to migrate. As per NSSO 2005 estimate, in India 60 per cent of farmers are likely to be leave farming. CSA could be one such intervention towards developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change (Shalat, 2014). Hence, with available knowledge and experience use of science and technology, it is possible to make sustainable livelihood through agriculture but this requires intensive efforts at ground level – local level where agriculture exists. If agriculture can be prioritized, this can be converted into an opportunity.

CSA is an integrative approach to address these interlinked challenges of food security and climate change that explicitly aims for three objectives:

– Sustainably increasing agricultural productivity, to support equitable increases in farm incomes, food security and development,

– Adapting and building resilience of agricultural and food security systems to climate change at multiple levels,

– Reducing greenhouse gas emissions from agriculture (including crops, livestock and fisheries).

Climate smart agriculture: An overview of Gujarat State :

Gujarat stands out, amongst all the Indian states, for its economic growth. With onlyfive per cent of the country's population and six per cent of the country's

geographical area, Gujarat contributes to about 16 per cent of industrial and 12 per cent of agricultural production in India and is dominant in the manufacturing and infrastructure sectors. However, in the backdrop of mounting global concern regarding potential risks of future climate change, there is a need to ensure that Gujarat's economic performance and social progress stays resilient and capable of with standing climatic stress and shocks. In the year 2008, The Government of India released a National Action Plan on Climate Change (NAPCC) setting eight priority missions-national missions on solar energy, enhanced energy efficiency, sustainable habitats, water, sustaining the Himalayan ecosystem, greening India, sustainable agriculture and strategic knowledge for climate change-outlining a national strategy that aims to promote development objectives while yielding co-benefits for addressing climate change effectively and enhancing the ecological sustainability of India's development path. For the realization of these proposed actions at the sub national level, in August 2009, the Hon'ble Prime Minister of India urged each State Government to create its own State level action plan consistent with strategies in the National Plan. The figure below shows a schematic representation of all the policies, programmes and projects run by Govt. of Gujarat.

The state action plan on climate change:

Adhering to the spirit of the NAPCC, the SAPCC intends understanding and comprehending possible climate change impacts and will prepare strategies, with a long term vision, to convert challenges into opportunities. The development of the State action plan on climate change will help to prioritize climate change concerns in the State's planning process by means of the following steps:

– Main streaming action on climate change in Government Departments.

– Devising innovative and forward looking policies and their means of implementation.

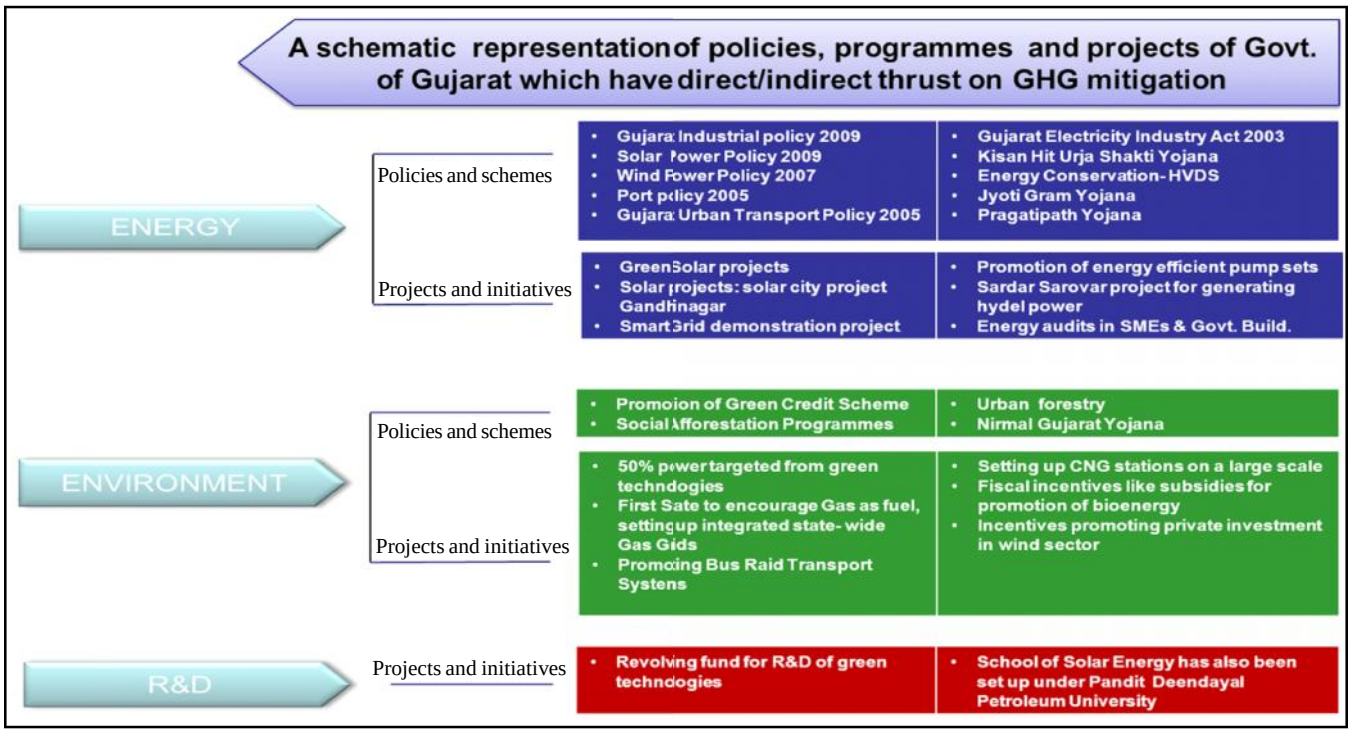
– Generating comprehensive climate change consciousness among policy planners.

– Building wide ranging strategic knowledge partnerships.

– Ensuring broad based people's participation.

– Institutionalizing capacity building at the State level.

In 2008, the Government of Gujarat executed a Memorandum of Understanding (MoU) with The Energy and Resources Institute (TERI) for building capacity on



Sources: Gujarat state action plane on climate change (Draft report, 2014)

climate change planning for mitigation and adaptation. Consequently, an "orientation programme on climate change" for senior ministers and civil servants of Gujarat was organized by TERI.

Climate change: Mitigation and adaption to the present conditions :

Climate mitigation is any action taken to permanently eliminate or reduce the long-term risk and hazards of climate change to human life, property. The terms "adaptation" and "mitigation" are two important terms that are fundamental in the climate change debate. The IPCC defined adaptation as adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploits beneficial opportunities. Similarly, Mitchell and Tanner (2006) defined adaptation as an understanding of how individuals, groups and natural systems can prepare for and respond to changes in climate or their environment. According to them, it is crucial to reducing vulnerability to climate change. While mitigation tackles the causes of climate change, adaptation tackles the effects of the phenomenon. The potential to adjust in order to minimize negative impact and maximize any benefits from changes in climate is known as adaptive capacity. A successful adaptation can reduce vulnerability by building on and strengthening existing coping strategies. In general, the more mitigation there is, the less will be the impacts to which we will have to adjust and the less the risks for which we will have to try and prepare. Conversely, the greater the degree of preparatory adaptation, the less may be the impacts associated with any given degree of climate change. For people today, already feeling the impacts of past inaction in reducing greenhouse gas emissions, adaptation is not altogether passive, rather it is an active adjustment in response to new stimuli. However, our present age has proactive options (mitigation) and must also plan to live with the consequences (adaptation) of global warming. The idea that less mitigation means greater climatic change and consequently requiring more adaptation is the basis for the urgency surrounding reductions in greenhouse gases. Climate mitigation and adaptation should not be seen as alternatives to each other, as they are not discrete activities but rather a combined set of actions in an overall strategy to reduce greenhouse gas emissions.

How to mitigate climate change?

These are some of the mitigation measures that can be taken to avoid the increase of pollutant emissions:

– Practice energy efficiency

– Greater use of renewable energy

– Electrification of industrial processes, efficient means of transport implementation, electric public transport, bicycle, shared cars.

– Carbon tax and emissions markets.

Adaptation to climate change:

In terms of adaptation measures, there are several actions that help reducing vulnerability to the consequences of climate change:

– More secure facility locations and infrastructures

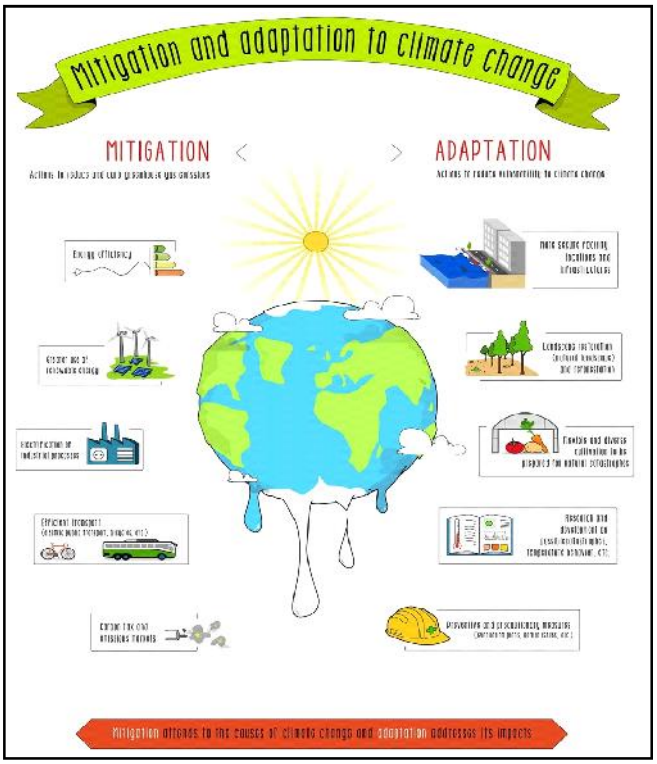
– Landscape restoration (natural landscape) and reforestation

– Flexible and diverse cultivation to be prepared for natural catastrophes

– Research and development on possible catastrophes, temperature behaviour, etc.

– Preventive and precautionary measures (evacuation plans, health issues, etc.).

In this infographic you can learn what are the



(**Source**:*https://www.activesustainability.com/climate-change/mitigation-adaptation-climate-change/*)

measures of adaptation and mitigation to climate change.

Mitigation initiatives: An overview of Gujarat:

The state of Gujarat has huge potential of harnessing 10,000 MW of Solar Power if only 0.1 per cent of land mass is set aside for the purpose. The Government of Gujarat realizing the importance of renewable energy in dealing with global warming took a bold initiative to announce the solar power policy in January- 2009 allowing investors to set up large scale solar power projects within the state and assured the purchase of power generated from such solar power plants. To scale up the solar power generation, to facilitate and promote solar roof top programmes, canal top solar photovoltaic projects and technology demonstration projects Gujarat has revised and came with new solar power Policy 2015 in a manner that does not undue burden on the consumers in the state and reduce the dependency on fossil fuels for energy security.

– New solar power policy 2015

– Gujarat wind power policy 2016

– Bio energy power generation.

New solar power policy 2015:

The State of Gujarat (the "State") intends to increase the share of renewable energy, particularly solar energy in its energy basket. It is with this intention that the State launched the Gujarat Solar Policy-2009, for which it received a very enthusiastic response. The policy resulted in a cumulative solar capacity in excess of 1000 megawatts (MW) with investment of about INR 9,000 crores. The increase of renewable energy in the total energy basket has to be done in a manner that does not add undue burden to the consumers in the State. Therefore, this Solar Power Policy-2015 (this "Policy") is intended to facilitate and promote large scale addition of solar power generation capacities in Gujarat while taking into account the interest of all its stakeholders, such as the investors, developers, technology providers, power utilities, grid operators and the consumers.

Following are the objectives of the policy:

– To promote green and clean power and to reduce the State's carbon emission

– To reduce dependency on fossil fuels for energy security and sustainability

–To help reduce the cost of renewable energy generation

– To promote investment, employment generation and skill enhancement in the renewable energy sector

– To promote productive use of barren and uncultivable lands

– To encourage growth of local manufacturing facilities in line with the 'Make in India' programme.

– To promote research, development and innovation in renewable energy.

Gujarat wind power policy 2016:

The Gujarat wind power policy 2016 will remain in effect until 30th June 2021. The aim of this policy and similar policies from 2009 and 2013 is to achieve an installed wind power capacity of more than 3 800 MW by the end of 2016. Wind projects installed and commissioned during the operative period shall become eligible for the benefits and incentives declared under this policy, for a period of 25 years from their date of commissioning or for the lifespan of the projects, whichever is earlier.

Conclusion and recommendations:

Climate is an important determinant for human health. Both weather and climatic variables can be seen as human exposures that directly or indirectly had an impact on human health. Moreover, these are not expected to remain constant, and overall likely to increase their impacts on human health. Scaling up CSA is as a long-term, non-linear process that will often require combining generalized and context-specific approaches and complex leadership. Higher temperatures and changes in precipitation and climate variability are likely to alter the geographical range and seasonality of some climate sensitive vectors-potentially extending the range and season of some vector-borne diseases, contracting them for others. Heavy rainfall and increases in water surface temperature are associated with contamination of marine and fresh water with water-borne diseases. So now it's the right time shake up our mind individually to find out the ways to comprehend ourselves from the ill effects of climate change. Leaders of climate smart agriculture projects can anticipate and plan for transitions across the major stages of scaling up (effectiveness, efficiency and expansion), while also adaptively adjusting or adding project components. Most of the decisions about how and when to implement the

adaptation options will require local input and in many case adaptation process occur at the local level. Hence, we can say that the first step in this decision-making process is to better understand the existing vulnerabilities and to consider possible adaptation strategies and options.

Recommendations:

All decisions makers- within national, state and local agencies and also institutions in the private sector and Non-Government Organizations (NGO's) - should identify their vulnerabilities to climate change impacts and the short and long term adaptation options that could increase their resilience to current and projected impacts.

Understanding biophysical, socio-economic and institutional issues at different scales and integrating these dimensions is essential to planning, implementing and monitoring CSA scaling.

While the challenges of adapting to and mitigating climate change are global in nature, agricultural development takes place at the community and household levels. Scalable CSA interventions need to be flexible enough to take into account local contexts while recognizing the impacts they can contribute to a scale.

Going forward, a review of a broader set of CSA projects could address remaining questions: Are horizontal scaling approaches sufficient to promote simple changes in practices or technology or will vertical scaling commonly be required? Is horizontal scaling necessary before vertical scaling can occur? Can vertical scaling occur within a single stage?

Gathering information about adoption and spread of CSA technologies still represents a significant challenge. A key research gap lies in estimating adoption rates for different agricultural technologies in developing countries.

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