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Climate Smart Agriculture

Bheru Lal Kumhar[1*], Satyanarayan Regar[2], Harphool Meena[1], Uditi Dhakad

[1]Senior Research Fellow,
[1]Nodal Officer,
[2]Ph.D. Research Scholar,
[2]M.Sc. Research Scholar
[1]GKMS, ARS, Ummedganj
[2]CoA, Kota
Agriculture University, Kota

*Corresponding Author
Bheru Lal Kumhar*
E-mail: prajapatiagro09@gmail.com

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INTRODUCTION

CSA technologies adaption cum mitigation under exposing of changing climate in the ways of water, nutrient, energy, weather, knowledge smart practices enhance the productivity of agricultural products. Adaption of CSA techniques up scaling be productivity of crops specially exposing of changing climate. CSA may be defined as an approach for reorienting agricultural development under the new realities of climate change. Another words "agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals". The goal of CSA is productivity, adaptation, and mitigation as the three inter linked pillars necessary.

Concept: Agriculture is at the intersection of three major challenges in the context of climate change (Saini *et. al.* 2009)

1. There is strong need to produce 60 % more food by 2050.
2. This increase in production need to occur even as the climate change are becoming more aggressive to crops, livestock and other systems globally.
3. The agriculture sector contributes 19–29 % of global greenhouse gas emissions, and would need to reduce emissions significantly in order to achieve the global goal of limiting warming.

CSA is based on 3 pillars:

Productivity: CSA aims to sustainably increase agricultural productivity and incomes from crops, livestock and fish, without having a negative impact on the environment.

Adaptation: CSA aims to reduce the exposure of farmers to short-term risks, while also strengthening their resilience by building their capacity to adapt and prosper in the face of shocks and longer-term stresses. Particular attention is given to protecting the ecosystem services which ecosystems provide to farmers and others.

Mitigation: Wherever and whenever possible, CSA should help to reduce and remove greenhouse gas (GHG) emissions. This implies that we reduce emissions for each calorie or kilo of food, fiber and fuel that we produce. That we avoid deforestation from agriculture and that we can management of soils and trees in ways that maximizes their potential to acts as carbon sinks (storage) and absorb CO_2 from the atmosphere source.

Key characteristics of CSA

1. **CSA addresses climate change:** To consider climate change for planning and development of sustainable agricultural systems is the attribute of CSA.
2. **CSA joins multiple goals:** CSA have three main goals i.e. increased agriculture productivity, enhanced resilience (adaption) and reduced (mitigation) GHGs emissions. So, trade-offs need to be made when implement CSA.
3. **CSA maintains ecosystems services:** Ecosystems provide farmers with essential services, such as clean air, water, food and materials. It is clear that CSA interferences do not contribute to their degradation.
4. **CSA has multiple entry points at different levels and is context specific:** CSA has multiple entry points, ranging from the development of technologies and practices to the embellishment of climate change models and scenarios, information technologies, and the strengthening of institutional and political enabling environments etc.
5. **CSA encourages women for their participation and engages marginalized groups:** To achieve food security goals and enhance resilience, CSA approaches must involve the poorest and most vulnerable marginalized groups. Because marginal farmers are more vulnerable to the climate change, so, they are most likely to be affected by climate change.

Dimensions of Climate Smart Agriculture

Distinctions can be made between capital saving (seed, chemicals fertilizers and pesticides, labor saving, quality improving, and risk reducing innovations. Another way of distinguishing innovations is according to their form, *e.g.* technological, managerial and institutional innovations. Technological innovations are embodied in new machinery and can be further divided into mechanical (*e.g.* tractors, cultivator, and combiner), biological (*e.g.* seeds, planting materials) and chemical (*e.g.* fertilizers, herbicides and pesticides) innovations.

Water- smart:

The efficiency of water use can be significantly increased through the adoption (resilience) of information intensive management practices that optimize the timing and amounts of application of inputs (fertilizers, herbicides and pesticides. Rainwater harvesting (RH), drip irrigation (DI), laser land levelling (LLL), and furrow irrigated raised bed system (FIRBS), SRI technology and direct seeded rice (DSR).

Energy-smart

Energy is needed in all goals along the agro-food chain in the production of crops, horticulture, aquaculture, livestock and forestry products; in post-harvest operations; in food storage and processing; in food transport and distribution; and in food preparation. Directly energy are including electricity, mechanical power, solid, liquid, coal, woods and gaseous fuels. Indirect energy related to the other hands, refers to the energy required to manufacture inputs such as machinery, farm equipment, fertilizers, herbicides and pesticides.

Zero Tillage/Minimum Tillage (ZT/MT)

Some effective residue management solutions retain plant residues and practices that minimally disturb the soil. In addition to potential increases in soil organic carbon and subsequently increased water infiltration and storage within the soil, effective crop residue management can dramatically decrease soil erosion through the protection of the soil surface from rainfall (Lal, 1997; Kumar *et.al.* 2018b).

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Carbon-smart

Mixed crop livestock management systems, in which crops and livestock are established on the same farm, are the backbone of smallholder production in the developing countries of the tropics (Herrero *et. al.* 2010). It is estimated that they cover 2.5 billion hectares of land globally, of which 1.1 billion hectares are rainfed arable lands, 0.2 billion hectares are irrigated croplands, and 1.2 billion hectares are grasslands (Haan *et. al.* 1997).

Weather-smart:

According to (WMO, 2011) weather is the state of the atmosphere at a given time and location with respect to variables such as temperature, rainfall, wind speed, and barometric pressure. Climate refers to average weather in terms of the mean and its variability over a certain time-span and a certain area. Climate change is a change in the climate that persists for an extended period of time (WMO, 2011). Climate smart housing for livestock (CSH), Pradhan Mantri Fasel Bimayojna (PMFBY), weather based crop agro advisory (CA) and crop insurance (CI).

Knowledge-smart:

Universities, research institutions, extension workers and NGO's are in a good position to bring different stakeholders together, such as farmer communities, corporate organizations and government, including its agencies. Knowledge sharing and network platforms can take the form of master farmer and farmer field schools.

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