Original Research Article

Agromet Advisory Services for Climate Smart Agriculture

ABSTRACT

Climate smart agriculture (CSA) is an approach that helps to guide action needed to transform and reorient agricultural development under the new realities of climate change. CSA manage the climate risks by adapting and building resilience of agricultural and food security system to climate change at multiple levels. CSA involves dissemination of the advance weather information to the farmers through different state of art information technology (SMS, apps and e-mail) are being taken to control and minimize of loss of crop due to pest and diseases incidences. CSA has three pillars: increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing or removing greenhouse gas emissions from agriculture. Agrometeorological Advisory Service (AAS) of India Meteorological Department (IMD), Ministry of Earth Sciences (MoES) under Gramin Krishi Mausam Sewa (GKMS) scheme contribute to collect and organize climate/weather, soil and crop information and to amalgamate them with weather forecast to assist farmers in taking management decisions. The projects like Gramin Krishi Mausam Sewa (GKMS), District Agro-Met Units (DAMUs) and IMD Mausam Website operating under the concept of CSA. By utilizing the meteorological parameters, they provide the crop specific advisories to farmers through different print/visual/radio/IT based media including short message service (SMS) and Interactive Voice Response Service (IVRS). This CSA will help the farmers in advances occurrence of pest and diseases and ultimately scheduling of prophylactic measures can be taken scientifically and judiciously.

Keywords: Climate smart agriculture (CSA), IMD, GKMS, DAMU, Agromet Advisory Services

Comment [A1]: This topic doesn't give a meaning in the broader sense.

It is just representing a company/agency/state, etc. available for providing services but NOT depicting a RESEARCH TOPIC

It should be restructured

Comment [A2]: You don't need to define the concept in the abstract

Comment [A3]: This is NOT TRUE. CSA basically doesn't involve dissemination of weather information, and the sentence doesn't fit in well.

Comment [A4]: These details are not needed in abstract

Comment [A5]: This statement doesn't make a complete meaning – it should be reframed

Comment [A6]: GKMS, DAMUs and IMD ARE NOT CSA but could be just an approach to addressing Climate Change matters

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INTRODUCTION

The UN Food and Agriculture Organisation (FAO) estimates that feeding the world population will require a 60 percent increase in total agricultural production. With many of the resources needed for sustainable food security already stretched, the food security challenges are huge. At the same time climate change is already negatively impacting agricultural production globally and locally. Climate risks to cropping, livestock and fisheries are expected to increase in coming decades, particularly in low-income countries where adaptive capacity is weaker. Impacts on agriculture threaten both food security and agriculture's pivotal role in rural livelihoods and broad-based development (FAO, 2013). Realising a food secure world has always been difficult, but it will become even more challenging under a changing climate. According to the Intergovernmental Panel on Climate Change (IPCC), a temperature increase of 2°C could affect agricultural yields by 15 per cent with current farming practices, while the FAO states that 60 per cent more food is needed by 2050 to meet the growing demand. In addition, food systems are responsible for up to a third of greenhouse gas emissions, so these must be mitigated to limit global warming. Climate-Smart Agriculture is an approach to address these challenges in an inclusive manner. (Campbell, 2017).

Climate-smart agriculture (CSA) (or climate resilient agriculture) is an integrated approach to managing landscapes to help adapt agricultural methods, livestock and crops to the effects of climate change and, where possible, counteract it by reducing greenhouse gas emissions, at the same time taking into account the growing world population to ensure food security (Lipper et al., 2014). The concept was conceived by the United Nations Food and Agriculture Organization (FAO) in 2010 in response to the need to transform agricultural development to the challenges of climate change. While built on existing knowledge, technologies, and principles of sustainable agriculture, CSA is distinct in several ways. First, it has an explicit focus on addressing climate change. Second, CSA systematically considers the synergies and trade-offs that exist between productivity, adaptation and mitigation. Finally, CSA aims to capture new funding opportunities to close the deficit in investment.

CSA has three pillars: increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing or removing greenhouse gas emissions from agriculture (Fig 1). CSA also aims to simultaneously achieve three outcomes.

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i. Increased productivity: Produce more and better food to improve nutrition security and boost incomes, especially of 75 percent of the world's poor who live in rural areas and mainly rely on agriculture for their livelihoods.

ii. Enhanced resilience: Reduce vulnerability to drought, pests, diseases and other climate-related risks and shocks; and improve capacity to adapt and grow in the face of longer-term stresses like shortened seasons and erratic weather pattern

iii. Reduced emissions: Pursue lower emissions for each calorie or kilo of food produced, avoid deforestation from agriculture and identify ways to absorb carbon out of the atmosphere (www.worldbank.org).

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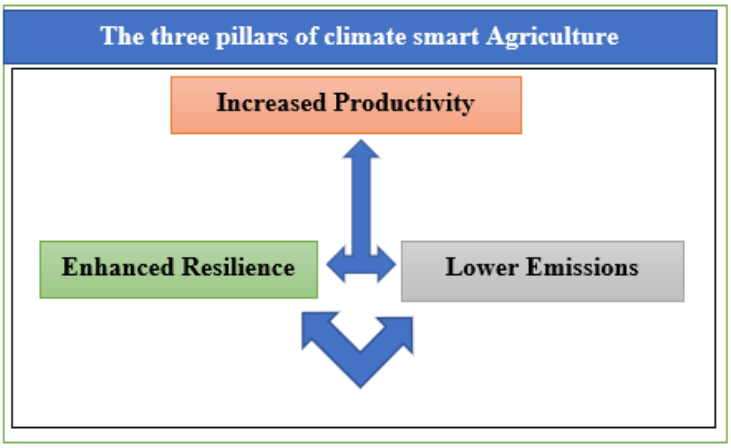

Fig 1: The three pillars of Climate-Smart Agriculture

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The overall objective of CSA is to support efforts, from local to global levels, for sustainably using agricultural systems to achieve food and nutrition security for all people at all times, integrating necessary adaptation and capturing potential mitigation. The World Bank Group (WBG) is currently scaling up climate-smart agriculture. In its first Climate Change Action Plan (2016-2020), as well as the forthcoming update covering 2021-2025, the World Bank committed to working with countries to deliver climate-smart agriculture that achieves the triple win of increased productivity, enhanced resilience, and reduced emissions. In 2020, 52 percent of World Bank financing in agriculture also targeted climate adaption and mitigation (www.worldbank.org).

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Materials and method

Agrometeorological Advisory Service (AAS) of India Meteorological Department (IMD), Ministry of Earth Sciences (MoES) under Gramin Krishi Mausam Sewa (GKMS) scheme contribute to collect and organize climate/weather, soil and crop information and to amalgamate them with weather forecast to assist farmers in taking management decisions. Weather forecast based agromet advisory provided to the farmers at district level through a network of existing 130 Agro-Met Field Units (AMFUs) located in each Agro Climatic Zone (ACZ). These agromet advisories are prepared and disseminated by AMFUs twice a week (Tuesday and Friday) covering 690 districts under (GKMS) scheme. Currently 4.37 Crore farmers are receiving SMS advisory on their mobile phones through mKisan portal. Keeping the need for Agromet Advisory Services (AAS) to be more crop and location-specific to address wide variations in weather within the, IMD is in the process of implementing block level AAS by establishing 530 District Agromet Units (DAMUs) in the premises of Krishi Vigyan Kendras (KVK) in collaboration with Indian Council of Agricultural Research (ICAR). Implementation of block level AAS would be beneficial to more number of farmers due to high resolution forecast with appropriate agromet advisories for the farmers of specific blocks (IMD, 2020). Thus the approach for CSA by the farmers can be boosted through AAS.

Comment [A17]: The whole of this part lacks the details under methods. It is just listing already established networks BUT NOT presenting how procedural protocols are used in determining sample collection and size, and how activities were executed.
Theo whole of this part should be re-written again

Comment [A18]: Is this result or summary???

RESULTS AND DISCUSSION

Role of Agromet Advisory services in Climate smart agriculture

Agro-Met Advisory Services (AAS) will be more effective if they are delivered in a clear, local language that farmers can understand. Agro-Met Advisory Services will also be supported by: (a) agro meteorological database, (b) crop conditions, (c) real-time weather, research results on crop-weather relationships, and (d) skilled manpower in multidisciplinary resources and users interface in order to make it a more successful and continuous process (Anderson, 2007). Weather and climate information can help policymakers, organizations, and community make better decisions that minimize risks and increase opportunities, improve the efficient use of limited resources, and increase crop, livestock, and fisheries production. One such adaptation strategy in which India has already made significant success is weather-based agro-advisory.

Comment [A19]: There is NO DATA collected

It is just depicting outline of activities of services the company offers

Kindly re-write this part again by considering data collection to be used for discussion

There is need for further improvement in these services particularly through preparing the weather forecast at a level smaller than a district to block than to village level, extend the temporal range of weather forecast and also aggressive extension, outreach and agro-met

advisory dissemination system. In order to operate at block level, there is a strong need to set an operational unit at District level (Singh et al., 2019). Hence, it is proposed to set up District Agro-met Units (DAMUs) in the country. These stations may be collocated with the existing Krishi Vigyan Kendras (KVKs), which are operating through State Agriculture Universities, ICAR Institutions and NGOs etc. and are funded and technically guided by ICAR.

Some of the adaptive measures communicated through the Agromet Advisory bulletins are:

- By avoiding the flowering phase overlap with the hottest period, planting dates can be adjusted to decrease the effect of temperature increase-induced spikelet sterility and reduce yield instability.
- Changing the cropping calendar to take advantage of the rainy season while avoiding extreme weather events (such as cyclones and storms) during the growing season.
- Cultivation of lodging-resistant crop varieties (e.g., short rice cultivars) that can tolerate strong winds during the vulnerable stage of crop growth.
- Development of climate-resilient cultivars; adoption of innovative farming techniques that address the management of stressed crops, plant pests, and disease
- Changes in crop planting dates to make better use of soil moisture.
- Crop sowing dates are moved ahead in a crop rotation schedule, allowing farmers to plant a second crop, possibly a vegetable with a short growing period.
- Increased evapotranspiration requires a move away from traditional crops and more towards agriculture that is not vulnerable to evapotranspiration.
- Cultivation of heat-resistant crop types based on genetic resources that are better suited to warmer, drier circumstances

For the principal crops and livestock, the agromet advisory bulletins include possible risk mitigation methods. AMFU's and DAMU's multidisciplinary and agromet scientists prepare district-level agromet advisory bulletins based on the weather forecast. Farmers and other stakeholders in the relevant district receive these messages.

Mechanism of Agromet Advisory Services

Today, IMD uses a five-tiered system to implement operational agrometeorological schemes across the country:

- In Delhi, there is a top-level policy planning body.

- The National Agromet Service headquarters in Pune is in charge of the execution.
- State Agromet Centres are in charge of coordination and monitoring.
- Definition of the agro-meteorological zone
- District or local level extension and training for input management advisory service

Dissemination Mechanism of Agromet Advisory Service

There are 130 district level Agromet Field Unit for prepare Agromet advisory and first phase of DAMU also working in collaboration with State Department of Agriculture on Tuesday and Friday. The Agromet advisory is disseminated through All India Radio (AIR), Print Media, Doordarshan, Website and SMS. Inclusion of these services will cover large fraction of farmers in the country to get the benefit. Moreover, Agro met Division; IMD is establishing linkages with the State level ICTs like Kisan Kerala, e-livestock. ICT for agriculture knowledge management needs to be establishment, etc. All FM channels of AIR and now casting centres of Doordarshan presented in Fig 2.

Comment [A20]: Do same.....

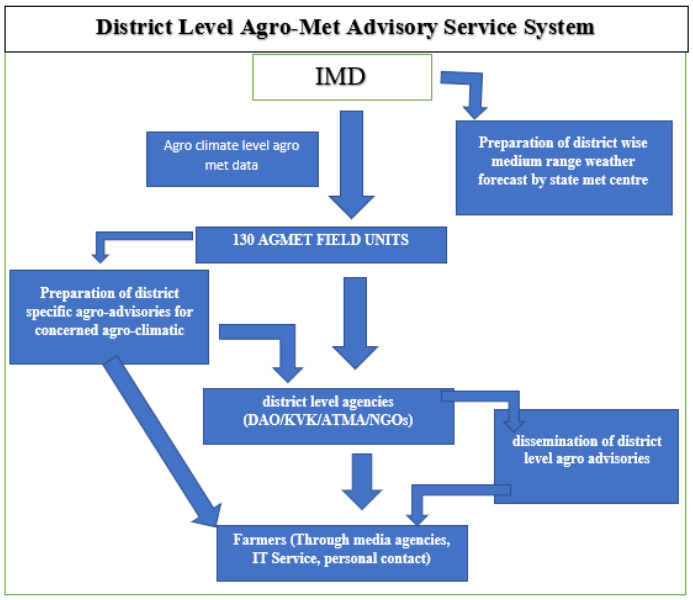

Fig 2: Dissemination Mechanism of Agromet Advisory Service

CASE STUDIES

Analysis on the impacts of the agromet advisory services on the climate smart agriculture practices by the beneficiary farmers against the risks and impacts of climate change was done by Vincent and Balasubramanian, 2021 in Anantapur district of Andhra Pradesh. The farmers in the study area have adopted the climate smart agriculture practices/technologies on account of two reasons. Firstly, "induced adoption" and secondly "wilful adoption". The increased weather aberrations and uncertain climatic conditions such as irregular rainfall, failure of monsoon, frequent drought, non-availability of other livelihood options etc., have induced them to adopt any new practice or technology that could enhance the resilience of agriculture system over the present situations.

Comment [A21]: What data support are you refereeing to????

In Colombia, farmers who had previously experienced generally reliable rainfall now must contend with increasingly frequent flooding and drought. To strengthen the resilience of Colombian farmers, the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is working with the International Centre for Tropical Rainfall (CIAT) and an alliance made up of the Ministry of Agriculture, the national agricultural research service, six producer organizations, and NGOs to develop agro-climatic forecasts and advisories. With the support of local agro-climatic technical working groups, these partners have learned how to incorporate climate and other site-specific information into their planning processes and are equipped to provide agro-climatic forecasts and management advisories that are tailored to farmers' needs and contexts. Varieties of maize, rice, beans and cassava have been identified and tested for tolerance to drought and moisture excess. More than 150,000 farmers are now receiving agro-climatic advisories and 6,000 have adopted climate-smart practices. In 2014, 170 Colombian rice farmers avoided massive losses by taking advice from their producers' federation, FEDEARROZ, not to plant in the first of the two annual growing seasons. The farmers who took the advice avoided economic losses estimated at USD 3.6 million. FEDEARROZ acted on a forecast by a team of CCAFS scientists based at CIAT. The project is eventually expected to reach 1,588,640 farmers (Loboguerrero *et al*., 2018).

Comment [A22]: What link does this part have to this research and on what data are you making reference to???

Niger is one of the tropical country which is very vulnerable to climate variability and malnutritional women and children. In response to both problems, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) trained over 10,000 women in Niger to reclaim degraded lands. Women learn restorative cultivation techniques, such as the use of zai-pits, which are dug in hardened soil and filled with manure to concentrate nutrients and water for seeds once the rainy season starts. They were also assisted in negotiating for the

long-term right to cultivate common marginal lands. These efforts to empower women to reclaim marginal lands increased productivity and carbon sequestration in soils, and strengthened the resilience of women to face climate variability.

Comment [A23]: Same.....

Climate smart villages through CSA

ICRISAT along with the Karnataka State Department of Agriculture, District watershed development, NGOs and the local community has undertaken watershed interventions in four villages of Bellary district in the mining belt of Karnataka covering 7,000 ha. This approach focuses on rehabilitating agro ecosystems and deploys a pool of climate-smart agricultural practices developed by ICRISAT which have resulted in increased crop yields and incomes of farmers. Interventions ranged from monitoring the weather, mapping soil health, and choosing climate resilient varieties to water harvesting and improved livelihoods through the watershed approach (Reddy *et al*., 2018).

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Crowdsourcing for CSA: Bolivian Andes

FAO's Fall Armyworm Monitoring and Early Warning System app encourages farmers and extension workers to report the outbreak of the Armyworm pest. Other global initiatives that provide innovative digital advisory services – such as Precision for Development (5.4 million smallholder farmer users) and Digital Green (2.3 million smallholder farmer users) – are using crowdsourced data from smallholder farmers in Africa, Asia and Latin America. These global initiatives are attracting increased funding from a plethora of private foundations, international development agencies, corporations and multilateral agencies. Compared to phone surveys and other means of remotely gathering farm-level information, crowdsourcing is a step forward as it promotes continuous interaction, fostering joint problem-solving and the co-development of locally tailored solutions (Taborga, 2021).

Comment [A25]: Is there a link on this to the research question???

CONCLUSION

The term "agriculture" in CSA is perhaps unfortunate, as we should be also focusing on broader food system issues, value chains, policy issues and crucial services (such as climate-informed advisories, insurance and credit). Technologies and practices, however, tend to get the most attention in many discussions on CSA. Furthermore, CSA often concentrates on the farm and farmers rather than on

Comment [A26]: On basically what are you concluding????

Conclusion should be done in reference to the research topic and the objective.

some of the higher level landscape issues that need to be considered. We need a broad framing of what is to be considered under CSA – anything that helps deliver on the three objectives (pillars).

CSA can therefore be understood as an approach promoting agricultural development in response to the challenges of climate change adaptation and mitigation through AAS, ultimately aiming to improve the livelihoods of people. Providing AAS to the farmers which makes them to take operations wisely and intime. CSA has gained considerable traction since 2010, with participants ranging from local farmers to global organisations. However, as the interest in CSA practices grows, it becomes increasingly important to monitor and evaluate results and interpret them in their site-specific context. Only in this manner can CSA contribute to the livelihoods of people around the world, in co-operation with the other approaches to sustainable agriculture.

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Comment [A29]: This is not relevant here since it is more of literature

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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