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Climate Sustainable Agriculture with Special Reference of Gagas River Basin (Almora District)

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ABSTRACT

The impact of climate change on agricultural practices is raising doubt over ensuring food security for billions of people, Climate change impacted production and productivity generally across the world but the impact was deeper in developing countries, the mountain ecosystem which also get impacted by the Elevation Dependent Warming (EDW) are more prone to climate change impact on agriculture activity. The modern approach of Climate smart agriculture (CSA) is perceived to play leading role by encouraging the practice of sustainable agriculture increasing adaptive capacity and resilience to climate change shocks. The varying landscape of Gagas river basin make it difficult to develop a single framework for climate change resilient agricultural practices. The Gagas river basin agricultural practices are mainly rainfed which make it vulnerable to rainfall anomaly and extreme climate events.

Key Words: Climate change, Climate smart agriculture, Elevation Dependent Warming (EDW), Global Warming.

INTRODUCTION

In Uttarakhand only 14% of the land is available for cultivation activity, the Gagas river basin situated in Almora District of Uttarakhand more than 85% of the agricultural land are hear Rainfed, 90% of the farmer in the Gagas river basin are small and marginal farmers , As large number and area is under small and marginal land holding, scale of economies cannot be availed of, and so the input cost per unit of output is higher, as large area is hill region which is prone to soil erosion due to stepp slope making it less and less fertile.

Besides the threat there is ample opportunities of increasing production and productivity of Kharif and Rabi crops in Gagas river basin by adopting sustainable agriculture practices through Climate smart agriculture. There is scope of wider improvement through bringing cultivable wasteland under cultivation, rain water harvesting, diversification of agriculture, adoption of organic farming. Post harvest technologies, strengthening of market interventions, farm mechanization to make the agriculture more remunerative occupation. Agriculture in coming years is sure to face formidable challenges from adverse climatic changes which affects food production and productivity. Rising temperatures due to global warming have already started eating up the yield of food grains and other agricultural crops. The food security challenge will only become more difficult, as the world will need to produce about 70 % more food by 2050 to feed an estimated 9 billion people, Thus, the world needs to find ways to sustainable agriculture and the answer lies in Climate Smart Agriculture (CSA).

The situation for agri-production is a two-way challenge: first, to shield the production from the effects of global warming, and second, to increase the production for a larger population in the years to come despite the symptoms of global warming. It is evaluated that without the use of CO, fertilisation, efficient solutions, and genetic transformation, each 1°C rise in the global mean temperature reduces global maize yield by 7.4%, wheat yield by 6.0%, rice yield by 6.2%, and soybean yield by 3.1%. An increase in the average temperature of 2 ^{O}C could lead to 20-40 % reductions in cereal grain output. The 5th Assessment Report by IPCC (Intergovernmental Panel on Climate Change) predicts that the temperature will increase by 2.5-5.8 ^{O}C before 2100. With such an increase, the damage to crops can only be imagined.

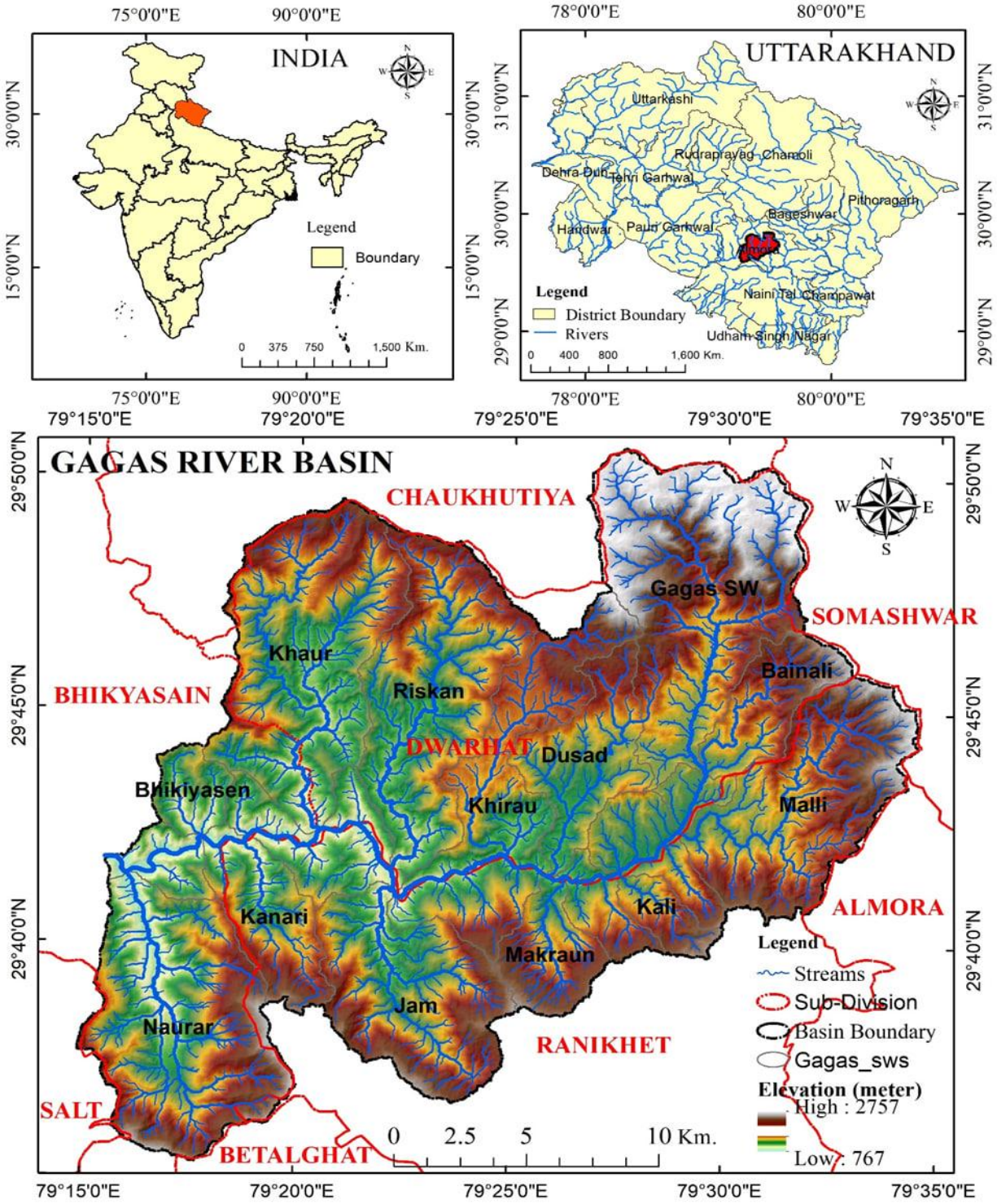
AIM OF THE STUDY

To identify the challenges posed due to climate change on agricultural activity and to identify the Potential measure for improvement of agriculture specially in Gagas river basin.

STUDY AREA

The Gagas river basin located in North Western part of Almora district of Uttarakhand, spread over an area of 512 km^2 , it is located between latitude 29° 50' 38.063" N to 29° 35' 16.752" N and longitudes 79° 34' 34.952" E to 79° 14' 50.187" E. It

is characterized by varying topography from river valley to hiily region, the agricultural activity hear is mainly rainfed, the farmer employ traditional method for cultivation with gradual shift towards new method of agricultural activity.



Method and Methodology

I have used purposive random sampling to study the problems of agriculture in Gagas river basin (Kumaun Himalaya) and to knew the perception of farmers regarding Climate Change and its consequences on agricultural activity. I went through various researches published with regard to climate sustainable agriculture as a secondary source.

The challenges with agricultural activity in Gagas River Basin

- The global warming induced climate change led to variability in climatic pattern over Gagas river basin.
- The farmers in Gagas river basin observed uncertainty in rainfall pattern in past decades.
- The rising temperature and declining precipitation led to uncertainty over the sowing and growing season of crops.
- As more than 90 % of agriculture in Gagas river basin is rain fed, the variability and uncertainty in precipitation has led to abandoning agricultural activity and it led to migration of people for alternative means of livelihood.
- The Elevation Dependent Warming (EDW) which made the hilly region to face higher consequences of Climate change has made agricultural activity and fertility of soil prone to loss there quality.
- Due to hilly terrain the slopes are prone to soil erosion thus affecting agriculture.
- To mitigate the impact of Climate change on agriculture activity there is requirement of Climate smart agriculture.

Climate-Smart Agriculture (CSA):

- Climate-Smart Agriculture (CSA) aims to achieve sustainable agriculture by addressing climate change and environmental concerns.
- CSA focuses on three main outcomes: increased productivity, enhanced resilience, and reduced emissions.
- Breeding resilient crop varieties is crucial to combat climate change impacts on agriculture.
- Climate-smart crops should tackle various challenges like pests, frosts, and extreme weather events.
- Efficient production and distribution are necessary to make climate-smart crop varieties accessible to farmers.

Climate-Smart Crop Production Practices and Technologies [1]

These practices and technologies directed to address the concern related to production as well as emissions in agriculture. Most of these practices prevent soil damage that releases carbon and water into the atmosphere, promote soil and water conservation; and increase productivity.

Use of Quality Seeds and Planting Materials of well-adapted crops and varieties

The varieties being bred to resist the detrimental effects of climate change should be resistant to the climate-related phenomenon. Droughts, flood, extreme heat waves, extreme cold, and salinity are the most common manifestations of global warming for which crop varieties are being bred. There are other impacts too, like pest attacks, higher frequencies of frosts at the seedling and/or pollination stages, high temperature at grain-filling stage, heavy rains that compress soil etc. Climate- smart crops have to take care of all these situations in order to secure food for the world population.

Biodiversity Management

All major grain crops, including wheat, rice, and most other crops, are often grown in monoculture systems that require significant investments in pesticides and herbicides.

In a cropping system, greater diversity of crops and other living organisms is an important criterion for ensuring farm resilience, economic stability, and profitability.

Integrated Pest Management

Integrated pest management involves the use of appropriate measures to discourage the development of pest populations, and keep pesticides and other interventions to levels that are economically justified, minimize the risk to human health and environment, and disrupt agricultural ecosystem as little as possible.

Improved Water Use and Management

Climate change, which will increase crop evapotranspiration, change the quantity of rainfall and rainfall patterns, and lead to greater variations in river runoff and groundwater recharge, will affect both rainfed and irrigated agriculture. So, to achieve sustainability in agriculture, water resource management comes on the top. This can be achieved through measures that conserve soil and water, with deficit irrigation that can maximize crop yields per volume of water applied, and/or more efficient irrigation technologies that can reduce unproductive evaporation losses. The integration of climate change into the planning and design of investments can considerably reduce the risks to the water infrastructure used for agriculture.

Sustainable Soil and Land Management

Integrated landscape planning and management are instrumental for achieving climate-smart agriculture.

[1] Bhaskhar Bhuwan, Climate Sustainable Agriculture, Kurukshetra: A Journal on Rural Development, GoI, 2023, Vol.71, p.p. 12-18.

Soil protection can be achieved by practicing direct seeding in combination with the sustainable management of crop residues within a broader framework of integrated soil fertility management.

The most cost-effective management strategies for sustainable intensification of crop production involve achieving a balanced cycling of nutrients through the production system and protecting the soil on the field. Nutrient cycling refers to the movement and exchange of organic and inorganic matter into the production of crops.

Sustainable Mechanization

The availability of appropriate machinery to carry out sustainable crop management practices increases productivity per unit of land. It also increases efficiency in the various production and processing operations and in the production, extraction, and transport of agricultural inputs, including coal and oil.

Tractor-operated tillage is the single most energy-consuming operation in crop production. Using smaller tractors, making fewer passes across the field, when combined with conservation agriculture, reduce CO^2 emission, and minimize soil disturbances that are common in tillage-based crop system. The timely availability of agricultural equipments such as drills, harvesters etc permits producers to plant, harvest, and process crops in an efficient manner.

To effectively implement a climate – smart agriculture strategy, there are some components that can be adopted in Gagas river basin.

- Develop climate – resistant crop varieties and involve farmers in decision-making.
- Diversify crops and organisms to promote farm resilience and profitability.
- Holistically combat climate change effects on pests, diseases, and weeds.
- Prioritize water resource management to address increasing water scarcity.
- Protect soil through integrated landscape planning and sustainable management practices.
- Enhance productivity and reduce emissions through appropriate machinery and precision farming.

Government Initiatives towards Achieving CSA

The Government of Uttarakhand implementing various scheme of Central government to mitigate the impact of Climate change, It has taken many initiatives, some of which are as follows –

National Innovation on Climate Resilient Agriculture (NICRA): Launched in 2011 by ICRA, the project aims to enhance the resilience of Indian agriculture, covering crops, livestock, and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies.

National Mission on Sustainable Agriculture (NMSA): The NMSA works through adoption of sustainable development pathway by progressively shifting to environment friendly technologies, adoption of energy efficient equipment, conservation of natural resources, enhanced water use efficiency, soil health management, location-specific practices, integrated farming, etc.

National Adaptation Fund for Climate Change (NAFCC): This Scheme was implemented during 2015-16 mainly for supporting concrete adaptation activities dealing with mitigating the adverse effects of global climate change in various sectors including agriculture.

Climate Smart Village (CSV): It is an institutional approach to test, implement, modify, and promote CSA at the local level and to enhance farmers' abilities to adapt to climate change. CSVs were piloted in two states of India: Karnal district of Haryana state and Vaishali district of Bihar state, which later spread into the districts of Punjab, Andhra Pradesh, and Karnataka.

Paramparagat Krishi Vikas Yojna (PKVY): It is an extended component of Soil Health Management (SHM) launched in 2015 under NMSA with the objective of supporting and promoting organic farming through adoption of organic village by cluster approach, which in turn results in improvement of soil health.

Biotech-KISAN: It is a scientist-farmer partnership scheme launched in 2017 for agriculture innovation with an objective to connect science laboratories with the farmers to find out innovative solutions and technology to be applied at farm level. Under this scheme, so far 146 Biotech-KISAN Hubs have been established covering 15 agroclimatic zones and 110 aspirational districts in the country.

Sub-Mission on Agro-forestry: It was launched in 2016-17 with the objective of planting trees on farm bunds.

National Livestock Mission: This Mission was initiated by the Ministry of Agriculture and Farmers' Welfare in 2014-15 focusing mainly on livestock development through sustainable approach ultimately protecting the natural environment, of ensuring bio-security, conserving animal bio-diversity and farmers' livelihood.

National Water Mission (NWM): A Mission was launched to ensure Integrated Water Resource Management (IWRM) for conserving the water sources and minimising its wastage and to optimize Water Use Efficiency (WUE) by 20 % including agriculture sector.

CONCLUSION

The development of sustainable farming system will led to protection and promotion of environmental, social and economic well being. The sustainable farming practices requires amalgamation of technologies, soil conservation method, crop rotation and integrated pest management. The other sustainable agricultural practice is organic farming, it will led to production of healthy and nutritious food, reducing soil erosion and water resource management. The adoption of modern irrigation system such as drip and sprinkler irrigation, rain water harvesting will promote sustainable agricultural practices, the agriculture activity of Gagas river basin in mainly rainfed due to which it requires special water management practices. The sustainable agriculture method has the potential to boost agricultural production an and productivity, reduce input cost and enhance the quality and quantity of crops. The hilly and undulating terrain of Gagas river basin requires the sustainable agriculture practices to ensure maintenance of soil fertility and enhance production to ensure farmer not abandon agricultural activity due to reducing income which is direct or indirect consequences of Climate change.

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