Review Article

Climate-Smart Agriculture is a new approach to farming system- A Review

Abstract

"Climate Smart Agriculture" (CSA) was born out of the converging needs of food security, human population, biofuel and adaptation, agricultural resources, climate change mitigation, and oil prices, and food pricing. This study analyses the ideas and concepts that drive community-based agriculture using the World Bank's framework. It claims that, even though the CSA promotes better multidisciplinary approach to agriculture, it operates inside a politically neutral structure that is just focused on increasing output. Depoliticization of the global food system legitimizes present policy aims and reduces power, inequality and access difficulties. Climate-smart agriculture (CSA) and sustainable intensification (SI) are mutually beneficial. SI helps adapt to climate change while reducing emissions per unit of output. CSA includes the advantages of "climate-smart food system", "climate-proof farms", and "climate-smart soils.

Keywords: Agriculture, CSA, Food Security, Sustainability, Climate resilience

1. Introduction:

A plan for converting the food and agricultural sectors into ones that are more ecologically friendly and climate-resilient is known as "climate-smart agriculture" (CSA) (Lipper et al., 2014). Sustainable agricultural production and incomes; decreasing and/or eliminating greenhouse gas emissions, and resilience and climate change adaptation, when practicable, are the three major goals of this program (Zhongming et al, 2013). CSA is defined as "agriculture that sustainably improves production, boosts resilience and mitigation (mitigation) when practicable, and facilitates the fulfilment of national food security and development objectives". Food security and development are recognized as the primary CSA goals, adaptation, mitigation, and productivity, are highlighted as the three interconnected pillars required to achieve this aim (Hussain, et al., 2022 and Srivastava, et al., 2022).

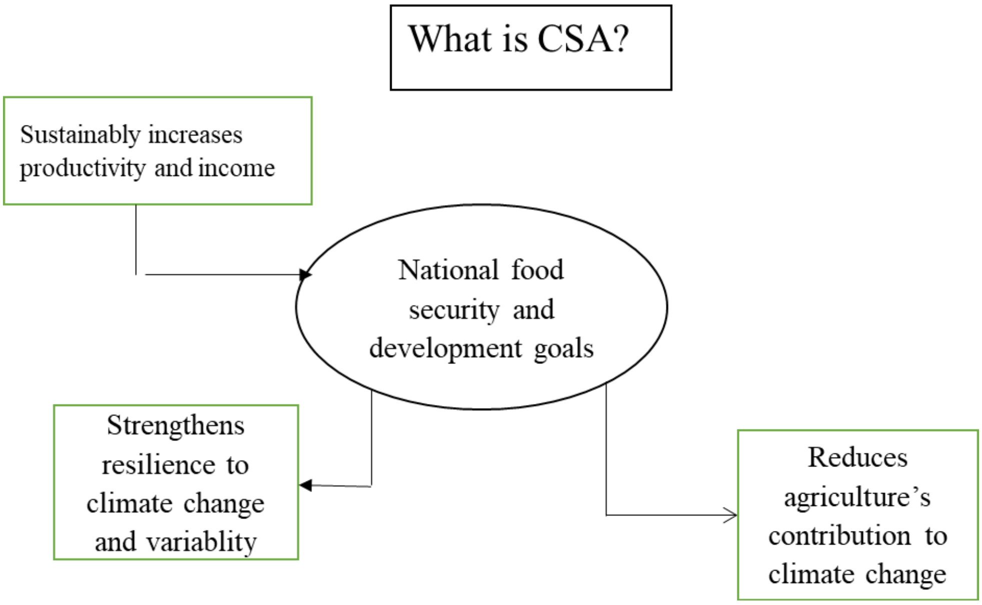

Figure 1: Schematic representation of CSA.

1.1 The 3 Pillars of Climate Smart Agriculture:

- **Productivity:** Fisheries, cattle, and farms are all part of the CSA's mission to sustainably enhance agricultural output and incomes without damaging the environment. Consequently, food and nutritional security will be improved for all pople worldwide. One of the key concepts in productivity growth is sustainable intensification (SI) (Lipper et al., 2014 and Chandra et al.,2018).
- **Adaptation:** A primary goal of CSA is to reduce farmers' reliance on specific dangers while simultaneously enhancing their capacity to adapt and flourish in the face of shocks and longer-term stresses via increased resilience. Farmers and others rely on ecosystems for a variety of services, and protecting those services is a top priority. Adapting to climate change and maintaining output depend on these services (Molua, et al.,2012 and Chandra et al.,2018).
- **Mitigation:** CSA should work to reduce or eradicate carbon emission (GHG) whenever and wherever practicable. Agriculturally induced deforestation must be prevented. Also, this maintaincarbon sinks that absorb CO2 from the air (Molua, et al.,2012 and Chandra et al.,2018).

2. Few important points:

2.1 **Global warming**: On the ideas of higher production and long-term viability, CSA is similar to other sustainable agriculture techniques. It differs, however, in that it expressly addresses adaptation and mitigation issues while also trying to provide food security for all people. Climate change. CSA is an acronym for community-supported agriculture, and it refers to a kind of sustainable agriculture that also aims to minimise greenhouse gas emissions (Gupta and Hussain, 2022).

2.2 Synergies, trade-offs, and Outcomes: CSA must go beyond the farm level to find solutions to the three issues of production, adaptability, and mitigation. The interactions between production, mitigation, and adaptation, and which occur at various levels, including the broader socio-ecological ramifications, must be considered in this process. Interventions on the farm/community level by CSAs, for example, impact current landscape systems, socially, and biologically. Similarly, a productivity-enhancing CSA should evaluate how it impacts adaptation and mitigation, and how to meet all three objectives efficiently. Farmers and decision-makers must understand the interplay of the three pillars and levels. From the farm to the legislature, CSA seeks to develop metrics and prioritisation tools that highlight these synergies and trade-offs (Gupta and Hussain, 2022 and Hussain et al.,2022)

2.3 New Financing sources: Consequently, there is a massive investment gap to satisfy food security requirements. CSA enables agricultural productivity to access climate funding for adaptation and mitigation. This involves money from the Least Developed Countries Fund, the Adaptation Fund, the Clean Development Mechanism, the Voluntary Carbon Market, and the Special Climate Fund, among other sources. The targeted contribution provided expressly for CSA by the upcoming Green Climate Fund and the Global Environment Facility Trust Fund (GEF) is the most promising of all (Gupta and Hussain, 2022 and Hussain et al.,2022)

3. Some important attributes of CSA:

- **CSA addresses climate change:** Instead of traditional farming, climate change is considered while developing sustainable agricultural systems in CSA(Gupta and Hussain, 2022).
- **CSA maintains ecosystems services:** Farmers rely on ecosystems for important services such as clean air, water, food, and materials. Interventions by the CSA must not exacerbate their deterioration. Consequently, CSA takes a landscape approach to plan and management, which draws on the ideas of however, it extends beyond the slight sectoral strategies that showed disorganised and competing land uses (Molua,2012)
- **CSA has many entrance points:** It is not a collection of activities or technology. From the development of technologies and techniques to the creation of climate change models and scenarios, information technologies to the building of institutional and political enabling contexts, it has many points of entry. As such, it integrates several interventions at the landscape, food system, policy levels, and value chain (Gupta and Hussain, 2022).

❖ **The concept of CSA is context-dependent:** As a general rule, there are no interferences that are climate-smart in every location or at every period. At the landscape level, within or among ecosystems, as well as in diverse institutional and political configurations, interventions must take into consideration the interactions between various aspects (Lipper et al., 2014 and Zhongming et al., 2013).

❖ **CSA empowers women and minorities:** The initiatives must include the poorest and most vulnerable populations to accomplish food security objectives and improve resilience. These communities are often found on marginal areas, which are particularly susceptible to climatic catastrophes such as drought and flooding. As a result, they are the most vulnerable to climate change. Another important feature of CSA is gender. Women often have limited access to and legal rights to the land they farm, as well as other productive and economic resources that may aid in the development of their adaptive ability to deal with disasters such as droughts and floods. All local, regional, and national stakeholders are encouraged to participate in decision-making by CSA (Van Aalst, 2006).

❖ **CSA indicates characteristics of millet as a climate resilience crop:** Millets can be cultivated to address high demand of increasing agricultural costs, burgeoning population, climate change to feed the whole world. These nutrient rich cereal posses many health benefits as requires less input cost and having high tolerance of biotic and abiotic stress. There is a growing need to investigate their diverse germplasms in order to utilise their natural genetic diversity for crop growth with regard to a number of agronomically and nutritionally important characteristics. Thanks to NGS technology and high-throughput GWAS systems, it is now possible to identify candidate genes/alleles/QTLs regulating such traits with hitherto imagined speed and precision, which will assist in the development of breeding lines for crop improvement. In addition, due to their common origin in the poaceae family and the existence of large synteny across their genomes, a renewed emphasis on millets has significant implications for the improvement of cereals and bioenergy grasses (Bandyopadhyay et al., 2017).

❖ **CSA promotes organic farming:** Seasonal fluctuation influenced the agronomic development and yield of three crops produced with varied organically enriched fertilisers (maize, soybean, and yam). Though the negative consequences were more obvious during the dry season, notably on maize and yam, beneficial advantages observed for some fertilisers in any season should be considered as methods to alleviate environmental stress on crops in order to sustain climate-smart agriculture. The rate of application was another major factor impacting fertiliser efficacy on crops. When applied at 2.5 t ha-1, rock-based fertiliser (RB) increased maize and soybean growth in both seasons. Furthermore, when supplied at 2.5 t ha-1 (rainy season) and 3.0 t ha1 (dry season), the RB fertiliser worked best for yam growth (dry season). Spraying plant-based PB at 2.0 t ha-1 might reduce the likelihood of low maize yield during the dry season. In both seasons, the PB at 2.5 t ha-1 rate was good for soybean. Fertilizers such as synthetic chemicals (SC) and plant-based (PB) have the capacity to increase two agronomic parameters simultaneously: plant height and leaf area development. Furthermore, SC and RB both retained greater organic carbon and potassium in the soil where they were applied. Manganese was the only heavy metal discovered in the SC (maize and yam) and Organic mixed (soybean) plots, reducing the possibility of heavy metal contamination.

4. Climate-smart farming ancestors:

In the absence of a shift in the planning and investment approach, humans risk misallocating human and financial resources, generating unsustainable agricultural systems, and contributing to climate change. This 'lose–lose' situation may be avoided by including climate change into the design and implementation of sustainable farming methods. CSA explores synergies and trade-offs across food security, adaptation, and mitigation to help inform and reorient policy (Van Aalst, 2006). Without such initiatives, the IPCC projects that agricultural and food systems would be less resilient, putting food security in jeopardy. One of the biggest threats to agriculture is climate change. The decision points in the opportunity space affect the course taken: CSA paths increase system resilience and reduce food security risks, while business as usual reduces system resilience and increases food security risks. The CSA emphasises gathering facts to identify feasible solutions and essential enablers. It gives methods for analysing alternative technologies and practises in terms of their impact on national development and food security goals. Oxygen, plant nutrition cycles, and carbon and may be regulated to improve the soil's ability to withstand extreme weather events like droughts and floods, as well as its ability to sequester carbon. Supply-side reforms must be accompanied by initiatives to shift consumption habits, decrease waste, and generate positive incentives across the manufacturing chain World Bank. (2018).

5. What is required for the successful deployment of CSA?

World Food Programme (WFP) and United Nations Environment Program (UNEP) immediate action has been addressed climate change's effect on agriculture. It is difficult for national and local decision-makers to get their hands on the evidence that they need to make sound decisions. Different policies and technologies, at all sizes, need tools to assess their effects. Barriers to the adoption of climate-change-responsive agricultural practises, as well as methodsof surmounting these obstacles, remain largely unidentified in the research base.

To better understand what works in diverse agro-ecosystems and agricultural methods and why, more thorough investigations are required. To boost people's adaptive ability, CSA is focusing on developing national and local institutions so that they have better access to resources, especiallyinformation (Razavi, 2012).

6. The ABCs of CSA:

According to the World Food Programme (WFP) and the United Nations Environment Program (UNEP), urgent action is needed in four areas to alleviate the effect of climate change on agriculture. As a result, decision-makers at the national and local levels lack sufficient information to make sound decisions (Taylor, 2014). Tools are required to assess the effects of various policies and technology of all sizes, from the local to the global. There is a significant knowledge gap when it comes to figuring out how to get farmers to embrace climate-smart agriculture methods. The CSA's efforts to rid its framework of the social economic aspects of food production also produce considerable contradictions inside its conceptual machinery. Global food security can be improved by adopting a more revolutionary strategy, it outlines four critical stages in which the politics of food emerges (World Bank Group,2013).

- ❖ **Tension 1: Metrics omitted.**

The Climate Smart Agriculture Strategy (CSA) of the World Bank is intended to offer a planning framework for determining the most cost-effective investments for increasing agricultural production in the face of climate change. The criteria that support CSA's triple-win scenarios are critical to its content. Surprisingly, no specific criteria for CSA performance are established. Within the CSA, the World Bank's focus on 'triple-win' scenarios merely exorcises complicated political factors in a way that is very supportive of the existing quo. The Bank's stance differs from that of other agencies, which are more aware of the trade-offs and value judgments that come with CSA. It shows how four unique agricultural aims production – the pursuit of profit; the contribution of agriculture to local communities in both environmental and economic terms the production of food, fibre, or fuel for sale or subsistence; and the preservation of ecologically sustainable foundations for future growth;– are expressly complex and potentially conflictual (Razavi,2012 and Taylor,2014)

- **Tension 2: A resiliency black hole.**

With regards to the World Bank's concept of "resilience," it is filled with philosophical and social inconsistencies that are difficult to reconcile. The World Bank never explicitly defines resilience, leaving the meaning of the phrase up to interpretation. We need to think about resilience from a political standpoint, not only as an abstract moral aim that applies to all social groups equally, but rather as a practical question of who benefits and who pays for it daily (World Bank Group, 2013). Advantage keeping non-optimally constructed agroecological systems may extend to their long-term social and ecological worth, as well as their resilience to shocks and pressures. Given the uncertainties of sea-change climatic changes, traditional mixed agricultural methods intentionally foster both variety and redundancy. According to the International Institute for Economic Cooperation and Development, yield maximisation may be in constant conflict with wider sustainability goals, and simple technological remedies may not be achievable or appropriate (IIED). The idea of reducing the intensification imperative to improve resilience, on the other hand, does not sit well with the CSA paradigm, which prioritises productivity gains (Townsend, R. 2015 and Plan, A. C. B. 2018).

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- **Tension 3: Pick-and-mix agriculture.**

For more than a decade, current agriculture-development practises have increasingly relied on a pattern of success tales rather than significant research. Nobody thinks about who gets to define and assess success, or for what purposes. This is exacerbated by the CSA's core principles' inherent ambiguity and a lack of a clear commitment to a participatory approach. Simplified narratives of success are utilised in the CSA literature to replace the causality analysis is a difficult task (World Bank Group, 2016). Model instances of 'triple-win' solutions are often taken out of their historical settings, stripped of their socio-political nuances, and trimmed to eliminate the messy reality of unintended consequences. Not only are the success stories chosen for the Council for Sustainable Agriculture (CSA) intended for worldwide consumption, but the tales are also included in the World Bank's country profiles, which are compiled from information about countries. In some cases, farmers in Peru are praised for employing CSA practises that are derived from 'ancient Andean agriculture,' according to the World Bank, CIAT, and CATIE (2015); in others, the Bank bemoans the lack of transformation of subsistence farming into an agricultural system that is technological and efficient, with a focus on raising earnings, reducing poverty, and ensuring food security (Akram-Lodhi, 2013).The nature of agricultural technology and agroecological practises means that they are inexorably intertwined, and it is hard to overlook the conflicts that arise between them, as Tittonell says. Because of competing pressures, intensification often results in the substitution of outside inputs for the ecosystem services supplied by biodiverse landscapes, resulting in the loss of biodiversity, localization, and nutrient cycling in the process. An important part of the Agricultural Modernization Approach (CSA) of the World Bank (WB) is built on the idea that smallholder farmers are 'excluded' from competitive market forces, and that their access to new biotechnological and environmental benefits is conditional on their inclusion in value chains. Even though many smallholders have a strong connection to the market, this might have a detrimental effect on them (Loos, et al., 2014).

❖ **Tension 4: Consumption is lacking.**

There is strong resistance to accept that farming should be rated based on its productivity and resilience. Similarly, do not reflect on current spending habits in the same way (Van der Ploeg, 2014 and Tittonell, 2014).. Despite their socio-ecological inefficiencies, conativelysumer sovereignty drives global food production toward elite consumption needs – notably the meatification of diets — CSA avoids discussing this. An example a triple-win situation may be seen in the case of reduced gasoline use, improved soil health, and reduced erosion. Using glyphosate in favour of more potent herbicides has resulted in lower toxicity for the product. Concerning reductionism, however, arises from Argentina's designation as CSA's model instance. First, the Bank may offer glyphosate-driven monocropping as a model technology since it's more productive and emits fewer pollutants than the ecologically damaging industrial farming methods that came before it. It ignores the intensive consolidation of land ownership and evictions of smallholders, continued use of carbon-intensive and chemical-intensive technologies, the massive loss of biodiversity caused by cropland expansion into forested areas, and the escalating environmental conflicts caused by groundwater contamination, glyphosate-resistant plants, and soil degradation. The produce of Argentinean soy fields, which represent 45 % of farmland, is used to support industrial cattle, a practice with severe environmental consequences (Jodha, 2012 and Krätli, 2015).

7. CSA and food security:

The food system includes agriculture, food processing, food distribution, and food consumption. Inherent potential, biophysical environment, and socioeconomic factors drive the global food system. Food safety difficulties, Pest and disease outbreaks, life cycle GHG emissions, and various aspects of supply and demand restrictions constantly threaten the global food chain. Dietary changes, increasing human population, competition for land, water, and energy threaten food system integrity, and food price instability. Food security is a result of a functional food system and its inherent potential (Pinstrup-Andersen, P. 2009).Security of food refers to a country's ability to get enough food to fulfill its dietary energy needs (Leach et al., 2010). In 1996, the World Food Summit defined food security as “physical, social, and economic access to sufficient, safe, and nutritious food to fulfill dietary requirements and food preferences for an active and healthy life”. Security of food is defined by usage, availability, stability, and access. Food security is intrinsically nutritional.

❖ Availability It refers to "the availability of adequate amounts of appropriate quality food, whether produced domestically or imported". As the world's population rises, so does the agricultural system's ability to supply food demand (Watts, 2014).

❖ It comprises "individual access to enough resources for obtaining appropriate meals for a balanced diet". Changes in actual income and food costs, as well as transportation of food grains and consumer buying power, all have a significant impact on this dimension (Jackson, 2007)

❖ Stability: It mentions the availability of households, food to people, and the general public at all times [25,26](Pinstrup-Andersen, 2009 and Leach, 2010).

❖ Health care, food, food safety, cleanliness, sanitation, and water are all reflected in this dimension. Nutritional well-being is the goal of this aspect of food security (Watts, M. (2014).

❖ A safety net for the body's nutritional needs Food security necessitates a level of nutritional safety. Food security can be achieved while simultaneously increasing the climatic resilience of crops like nutri-cereals and pulses. Aside from improving soil fertility, pulse crops also help farmers and cultivators in rural areas to maintain their livelihoods. The agricultural system is more resilient and adaptable when it has a wide variety of crops and farms (Zhardhari, 2000 and Srivastava, 2022).

Risk and uncertainty are inherent in climate change and food systems, particularly food security. Climate change has a widespread influence on all aspects of food security, including food accessibility, food costs, consumption, food production, and use. Perceiving climate change's consequences necessitates mitigation and adaptation measures incorporating environmentally friendly technology, sound land use planning, and efficient use of agricultural inputs. It is essential to have climate-smart agriculture to ensure global food security, improve rural lives, and strengthen the agricultural system and its stakeholders (Alexandratos, 2012;Gliessman, 2013; Wheeler and Braun, 2013; Porter,2014; Huyer, 2015,)

8. Climate Resilient Pathways in Agriculture:

The future of agriculture is at a turning point. Growth and development in agriculture are necessary to cope with rising declining soil fertility, food demand, land and water usage conflicts as well as the effects of global change, including climate change. We need a paradigm change in agricultural planning, innovation in food systems, and risk management to meet the demands of the greening of agriculture growth. There are several growth paths for agriculture because of the numerous biotic and abiotic challenges it faces. CSA, on the other hand, is more resilient and less vulnerable to food insecurity (Lipper et al. 2014). Vulnerabilities are exacerbated to an even greater extent by the forces of change. The CSA method, on the other hand, tries to lessen the effect of change drivers via strategies of adaptation and mitigation. Agriculture that is more in tune with the changing climate includes practises such as climate-smart agronomy, integrated agricultural systems, conservation agriculture, agro-forestry, managing crop waste, and agroforestry. The food supply chain and landscape are used to spread CSA ideas from farm to global level. CSA is propelled by the idea of an ecosystem.

Cultivating sustainable agriculture (CSA) relies on incorporating mitigation and adaptation strategies into the agricultural development trajectory. A human-mediated approach to reducing or eliminating greenhouse gas emissions (GHGs) via enhancing GHG sequestration is referred to as climate change mitigation. Crop and soil ecosystems have a significant impact on climate change mitigation options and tactics (Venkatramanan and Singh 2009; Pathak et al., 2012; Khatri-Chhetri et al.,2017).When methanogens operate on soil organic matter in lowland paddy cultivation, for example, under anaerobic circumstances, methane is created. Methane emissions may be reduced if adequate mitigating techniques are used. Irrigation for certain crops and regions Reduced methane emissions may be achieved by mid-season aeration. Ruminant methane emissions may be lowered by feeding them a protein-rich diet. Local knowledge and adaptive agricultural types are among the methods (Laderach et al.,2011; Ebi and Schmier, 2005).

Table 1: Climate change threats and required Climate Smart Agricultural Practices.

Climate Change indicator	Impact on Agriculture	CSA practice required	Reference
Extreme weather events	Loss of Crop	Improved extreme weather events prediction and early warning system	Araus and Cairns,2014
Increased flooding and waterlogging	Loss of crop or Reduce Crop yield	New crop varieties with high moisture tolerance	Törnqvist, and Jarsjö, 2012
Less precipitation	Reduce crop yield in rain-fed agriculture	Improved irrigation Technique	Armanuos et al., 2019
Saltwater intrusion	Reduce irrigation water	A barrier to saltwater intrusion	Hall, A. E. (1992)
High Temperature	Reduce Crop yield	New crop varieties with greater heat tolerance	Jaramillo et al., 2011

9. Sustainability-focused intensification in action:

Mitigation and adaptation can be achieved in a variety of ways, such as improving soil quality, which provides regulator essential such as carbon sequestration, filtering, buffering, moderating the hydrological cycle, plant nutrient cycles, and regulating the carbon, oxygen, enhancing drought and flooding resilience, and improving soil biodiversity. SI is made up of all these elements (Van Asten et al., 2011). Four CSA instances are briefly shown here.

- **Banana-coffee intercropping**: Climate change would have a significant impact on Arabica coffee, which is grown up at higher altitudes where temperatures are lower. Temperature rises have an impact on crop physiology as well as pest and disease pressure. In the 1950s, coffee production increased fast over the globe, and many governments have subsequently encouraged high input monocropping techniques for smallholders. Banana intercropping, on the other hand, has been shown to boost plot income by more than 50% in both unfertilized and fertilised circumstances in East Arica. Coffee is a shade-tolerant tree that grows in the understory. Bananas offer shade while also reducing the occurrence of coffee leaf rust. Banana intercropping has the potential to store an additional 15–30 metric tonnes of carbon per hectare, which might assist to slow the rate of global warming (Jassogne et al., 2013 and Havlík et al., 2014).

- **Livestock systems intensification***:* Viable livestock intensification might greatly aid both mitigation and adaptation. These systems vary greatly in terms of production and efficiency. Within the same agro-ecological zone, worldwide economic modelling research explored changes caused by economic incentives coming from alterations in demand and relative factor prices between now and 2030. Transitioning to more efficient, intensive systems will enhance meat and milk output per ha and per kg DM of feed by up to 30%, and family income by comparable amounts. These modifications would also reduce emissions by 736 Mt CO2 equivalent per year (almost 10% of total agricultural emissions), largely by avoiding converting 162 Mha of natural land. Despite obstacles including lack of access to markets and funding, encouraging transitions to more productive systems in suitable locations may significantly improve mitigation, adaptation, and food supplies. Next is an example of how intensification may be done (Albrecht and Kandji, 2003; Thornton and Herrero,2010).
- **Agroforestry may be used to increase the rations of livestock.:** Higher-quality ruminant diets result in lower methane emissions per unit of milk and meat, as well as increased meat and milk productivity. Feeding the leaves of trees like *Leucaena leucocephala*, which is abundantly cultivated in the tropics, is one technique to increase cattle productivity. Even a modest quantity of Leucaena leaves added to dairy calves may triple milk output per day, quadruple weight growth per day, significantly increase farm revenue, and cut methane production per kg of meat and milk by 2 and 4 times, respectively. At the same time, agroforestry trees have the potential to boost carbon sequestration. As enhanced diets would significantly lower the number of ruminants required to meet future milk and meat demand, widespread adoption of this option offers significant mitigation potential (Albrecht and Kandji. 2003; Bayala et al., 2012) .
- **Stone bunds and zaï***:* Building stone bunds along contours collects water and reduces runoff erosion. With alternative land management practises like za pits (shallow bowls filled with compost or manure where crops are grown), millet or sorghum yields may treble and reach over 1 t per ha. Soil fertility and ground water levels are typically enhanced by better land management. This enables farmers to plant vegetables near wells, enhancing revenue and diet variety. Stone bunds may so improve nutrition while also enabling farmers to adjust to changing weather (adaptation to wetter or drier climates). More manure improves soil fertility, and greater tree cover adds to additional mitigation. So, it's a climate-friendly method of

sustainable intensification. These examples demonstrate how sustainable intensification helps to both adaptation and mitigation by increasing resource efficiency and lowering emissions per unit product. While SI is a minor component of the adaptation agenda, CSA aspects like crop and livestock insurance and climate data might help SI adoption. The emphasis on sustainability may not be consistent with intensification (it may increase GHG emissions in absolute terms and per unit of production), but there are no trade-offs between CSA and SI. Other efforts that contribute to sustainable food and nutritional security include minimising overconsumption, reducing food waste, improving diets, and adhering to acceptable animal welfare standards (Landolt, 2011).

Conclusion

Many sections of the globe have poor crop yields and inadequate resilience to unfavourable circumstances. Climate change is projected to reduce productivity and increase inconsistency. Many nations have intended to use climate smart agriculture (CSA) to enhance agriculture. In this regard, the Bank expressly incorporates CSA into its long-standing modernisation narrative, which focuses on expanding supply via liberalisation, technical improvement, and the spread of modern production practises to underdeveloped countries. With the correct practises, regulations, and investments, agriculture can progress toward CSA, lowering food insecurity and poverty while also helping to reduce the danger of climate change to food security. The approach recognises that climate change mitigation and adaptation methods are nation specific and allows for trade-offs. Identifying and supporting climate-smart strategies that strengthen rural communities, boost smallholder livelihoods and employment, and minimise negative social and cultural repercussions like land loss and forced migration is critical for further research.

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