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Identifying Climate Smart Agricultural Practices Used By Small Scale Farmers

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ABSTRACT

To better understand what elements, contribute to the spread of climate-smart agriculture (CSA), the current body of research has put more emphasis on the traits of farmers. Therefore, there has been no comprehensive analysis of the many factors that promote or hinder CSA adoption. As a result, the design of interventions often ignores crucial characteristics of technologies or behaviors that might promote or hinder CSA's deployment and define its applicability. Adoption of any practice need to be based on both the farmers involved and the features of the practice itself. Therefore, it is suggested that policies with the goal of mainstreaming CSA technologies give due thought to whether or not such technologies may be used in the places at hand, and place special emphasis on the need of disseminating knowledge about such technologies and practices.

KEYWORDS Climate Change, Smart Agriculture, climate-smart agriculture, Small Scale Farmers

INTRODUCTION

"Agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals" (FAO, 2013) are all characteristics of climate-smart agriculture (CSA), which the Global Alliance for Climate-Smart Agriculture (GACSA) set out to promote in 2014. CSA offers the framework within potential synergies can be established, created, and disseminated to aid small-scale farmers in their efforts to adapt to, mitigate the effects of, and improve their own food security, despite disputes around the definition of the idea and its lack of theoretical grounding. Finding common ground between these three tenets requires innovative farming methods. In order to help family farmers cope with the consequences of climate change, this article presents a seven-step framework for co-designing and adopting CSA choices inside an open innovation platform. Farmers, non-governmental organizations, and academic researchers all worked together on these current initiatives to enhance agricultural systems in a sustainable way.

Sustainable gains in production and resilience (adaptation), reductions or elimination of greenhouse emissions (mitigation), and The UN Food and Agriculture Organization characterizes climate-smart agriculture (CSA) by its ability to advance national food security and development goals. The World Bank and the International Fund for Agricultural

Development (IFAD) are just two of the many organizations that have publicly declared their support for CSA. These supporters draw attention to some salient distinctions in the CSA method. Risk assessments for CSA projects, in the first place, need to be more thorough and accurate if they are to account for the fact that climate change poses not just new risks but also interacts with and exacerbates preexisting vulnerabilities. Options that contribute to climate resilience and food security and development objectives and carbon reduction should be ramped up, as should those that provide "multiple benefits" for sustainable agricultural intensification.

LITERATURE REVIEW

Jeetendra Prakash Aryal et.al (2018) Because of the potential effects of climate change on agricultural production and food security, climate-smart agriculture is particularly important in India. This study analyzes the factors that influence the likelihood and level of adoption of multiple CSA practices, such as seeds of stress-tolerant varieties, minimum tillage, laser land leveling, site-specific nutrient management, and crop diversification, among 1,267 farm households in 25 villages in Bihar and Haryana in the Indo-Gangetic Plains. To evaluate the variables that influence the rate of adoption, we used a multivariate probit model, which permits the simultaneous study of a large number of adoption options, and an ordered probit model. Several variables, like as individual and family dynamics, have been demonstrated to affect the likelihood and extent of CSA adoption, plot features, market access, and major climatic dangers, and these parameters are interconnected with the adoption of the different CSA techniques. Therefore, in order to solve most of the problems associated with CSA adoption, the research advocates for changes in agricultural policy.

Rinku Singh et.al (2017) Sustainable food production is a major problem in the twenty-first century because of environmental issues including climate change, population growth, and the depletion of natural resources like soil and biodiversity. The agricultural industry is very susceptible to the effects of climate change. Although the Green Revolution greatly increased agricultural output, it did so at the expense of the environment, most notably climate change. The excessive use of fossil fuels, natural resources, agrochemicals, and equipment put the ecological stability of agroecosystems at risk. Furthermore, it posed a danger to time-honored methods of farming. Agriculture is one of the biggest industries that helps the most people make a living and also contributes to global warming. The time has come to adopt a climate-smart strategy for agricultural sustainability. Sustainable food production in a warming world is drawing greater interest in traditional agriculture. This article promotes conventional farming as a climate-smart strategy for long-term food security and discusses the link between global warming and the agricultural sector.

James D. Ford (2014) Although adaptation is essential to climate policy, our knowledge of whether or not it is really happening is limited and splintered. Based on a thorough investigation of the peer-reviewed and grey literature as well as policy documents to extract evidence of adaptation activities, this study describes and characterizes the existing degree of adaptation in 47 vulnerable 'hotspot' states in Asia and Africa. One hundred academic articles, sixteentyone documents from the grey literature, and twentyseven national communications to the United Nations framework convention on climate change made up the 760 adaptation efforts evaluated. Since 2006, there has been a substantial rise in the number of documented modifications. African and low-income countries, especially those receiving adaptation funds, are reporting the highest rates of adaptation; these countries are doing both preparatory work and more concrete adaptations to reduce vulnerability; and national governments, NGOs, and international institutions are driving these efforts, with little input from lower levels of government or collaboration across nations. There is no evidence that vulnerable populations including the poor, children, indigenous peoples, and the elderly are being specifically targeted by adaptation programs, which is especially concerning given that North Africa and Central Asia have some of the greatest gaps in adaptation policy and practice.

Charles Wambugu (2014) As part of the MICCA pilot project in Kaptumo, Kenya, this paper uses participatory assessment methodologies with experts and farmers to identify and evaluate climate-smart agricultural practices. The overall goal of the development program is to improve lives and production in the dairy farming sector while also integrating climate change adaptation and mitigation.

Rivaldo A. Baba Kpadonou (2017) There is a growing interest in soil and water conservation (SWC) measures in water-limited areas since water stress and soil sterility are the main obstacles to increasing agricultural output in drylands. To better understand the challenges associated with the widespread implementation of eleven specific on-farm SWC techniques, we used a collaborative analytic strategy that included multivariate and ordered probit models. The vast majority of farmers (99%) engaged in some kind of manure application, crop rotation, contour vegetation barriers, or another of the eleven techniques taken into account here. Seventy or more percent of farmers employed no more than three methods, and less than 30 percent utilized four to nine methods. Some techniques are supplementary to others, while some might even be used in place of them. The research of adoption and intensity of adoption revealed that SWC techniques need substantial investment of time, energy, and resources. When a family's land holdings and labor needs are proportionate to the number of migrants in the family, then the household is more likely to expand its usage of SWC techniques. The findings of this in-depth research project will be useful in developing a nuanced comprehension of SWC practices in the West African Sahel. As a whole, it should help policymakers increase the adoption of sustainable SWC approaches in growing climate-smart agriculture in developing drylands.

CLIMATE-SMART AGRICULTURE FOR SMALLHOLDERS

Small farmers and ranchers need a solution that benefits everyone involved. High production and revenue are needed, but only if there is also a plan to mitigate the effects of climate-related calamities and lessen agriculture's carbon footprint. As a result, a new agricultural paradigm has arisen to address the interconnected problems of global warming, farming, and hunger.

To successfully promote sustainable development and guarantee food security in a changing climate, "climate-smart agriculture" (CSA) is described as a concept that leads the activities required to adapt and reorient agricultural systems (FAO, 2013). The CSA method, which places a focus on adaptability, aids smallholder farmers and other stakeholders on all scales in determining which agricultural practices are most suited to their specific circumstances.

There are three basic aims of CSA that aim to solve the economic, social, and environmental challenges faced by smallholders (FAO, 2013):

- **Productivity.** CSA works to boost agricultural output and earnings from agriculture in a way that doesn't harm the environment so that everyone has enough to eat. One of the major ideas behind this pillar is sustainable intensification, which places an emphasis on increasing production while simultaneously decreasing emissions per unit of output.

- **Adaptation**. The goal of community supported agriculture (CSA) is to help smallholder farmers adapt to climate change so that they can keep producing food and keeping the environment healthy. Its goal is to strengthen farmers' resilience in the face of long-term challenges while mitigating the effects of short-term threats.

- **Mitigation.** For every calorie or kilo produced of food, fiber, or fuel, CSA promotes methods and tools that cut or eliminate greenhouse gas emissions. This may be done by reducing the amount of land cleared for agricultural purposes and making better use of the carbon sequestering abilities of soils and trees.

It is imperative that smallholder farmers make the transition to climate-smart agriculture since they are on the front lines of the fight against climate change and the protection of our food supply. There are several CSA technologies and practices (CSA T&Ps) that may be used after one reaches one of the seven CSA entry points (CCAFS, 2018):

1. Controlling the soil. CSA interventions range from those implemented on individual farms, like contour plowing or tillage with tied ridges, to those implemented on larger landscapes, like land terracing, contour stone bunds, or reforestation, all with the intention of improving soil quality and protecting against water runoff and erosion.

2. Crop production. Crop selection, plant breeding of better yielding and stress-tolerant crop varieties, alterations to cropping patterns, crop and agricultural nutrient management, and other ecosystem management measures may all boost crop production and resilience.

3. Water management. Supplemental irrigation and rainwater harvesting are two examples of climate-smart water management strategies with the goal of lowering the likelihood of crop water stress and subsequent yield loss. Water conservation and reduced methane emissions are two additional benefits of alternating wetting and drying and other CSA technologies.

4. Livestock management. Animal health and heat tolerance may be improved with the use of CSA Technology and Practices (T&P). Feed management, enteric fermentation, and manure management are three other ways in which CSA may help cut greenhouse gas emissions.

5. Forestry and agroforestry. In order to improve tree cover, decrease deforestation, and boost carbon sequestration, CSA advocates for sustainable forest management through afforestation, reforestation, and agroforestry.

6. Capture fisheries and aquaculture. Sustainable intensification of production, the use of better-integrated systems, enhancement of stock, and reduction of disease-related losses are all ways in which CSA hopes to achieve its goal of raising productivity and ensuring the continued prosperity of those who rely on fisheries and aquaculture for a living.

7. Energy management. The CSA envisions a future in which renewable energy sources such as bioenergy, solar energy, hydro, geothermal, and other sustainable techniques of utilising biomass power farms for food production.

CSA stands out from other approaches to agriculture and sustainable development because of its unique features and emphasis on micro- and small-scale farmers (CCAFS, 2018):

1. Planning and management in CSA are more comprehensive and integrative because they use a landscape-level approach to promoting ecosystem preservation. CSA plans for and develops sustainable agricultural systems that explicitly account for and respond to climate change. Since small farmers are particularly susceptible to climate change's repercussions, this comprehensive and all-encompassing strategy stands to help them.

2. CSA is context-specific. It delves into how biophysical and socioeconomic and political forces interact in a given environment. It uses participatory methods to take into consideration the many interests at play, from large corporations to local governments to individual smallholder farmers.

3. When applied to food systems, landscapes, value chains, and even policies, the CSA idea may go well beyond a simple collection of techniques or technology. This can aid in resolving issues faced by smallholder farmers by fostering innovation in approaches as varied as climate change models and scenario planning; information and communication technologies; insurance and risk management systems; value chains; and the fortification of institutional and political enabling environments.

4. The rural poor, women, indigenous peoples, and other disadvantaged groups are some of the most at risk from climate change, thus CSA gives them first priority. Stakeholder participation in decision-making facilitates the development of collaborative networks that lead to the identification and successful implementation of effective CSA solutions.

The Community Supported Agriculture (CSA) model provides smallholder farmers with a broad range of technologies and practices that may be implemented at the farm and field levels to increase productivity and resilience. Farmers may make their farms more sustainable and climate-resilient via the use of enhanced seed types, ecological engineering, and water-saving technology. The problems of climate change and food insecurity, however, need concerted, group effort. It is anticipated that increased agricultural output and significant reduction of GHGs from agricultural operations would come from the broad implementation of CSA. All the stakeholders at all the levels, but especially the smallholders, need to work together to scale up and out of CSA if it is to have a substantial effect.

METHODS

Theoretical Structure This study presents a framework for thinking about the viability of CSA activities, based on their social, technical, economic, and environmental acceptability. There are several factors outside farmers' socioeconomic status that affect the rate of agricultural technology adoption. This way of thinking is different from the common one, which puts emphasis on the features of the technologies or practices themselves that may have a major impact on their uptake or spread.

Adoption or transfer may not occur instantly after technological intervention or introduction. In order for technology to be transferred or adopted, several factors must be in place. Both the site of intervention and the nature of the necessary technologies influence the kind of CSA measures that may be taken. The qualities of the CSA technologies or practices and their applicability to a range of settings in terms of social, technological, economic, and environmental compatibility are, nevertheless, important considerations for potential adapters.

Different from the decision-making process involved in adapting an existing technology, technology adoption focuses on the use of emerging technologies. This article examines the methods already in use in the area(s) of research. How effectively the CSA packages mesh with the values and customs of the target community is what is meant by "social compatibility." The technical compatibility discusses the adaptability and effective implementation of the packages. Both the financial impact of implementation and the potential impact on the agricultural system and the environment are addressed in the environmental compatibility section. Figure 1 presents a conceptual framework showing how applicability indicators affect CSA deployment. Farming in 2020, 9 times the FO

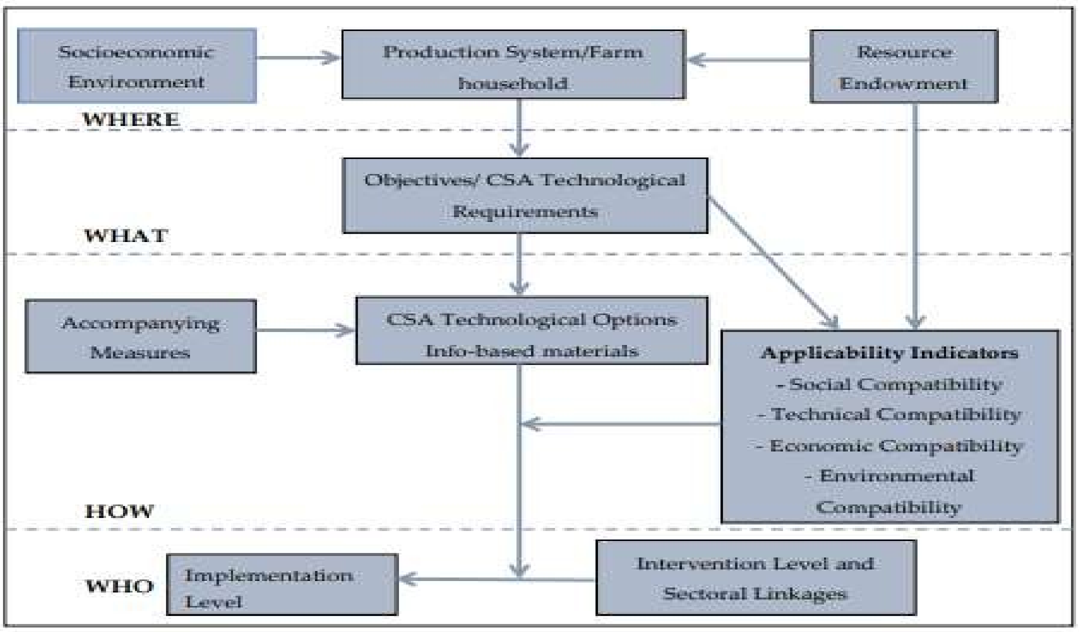

Figure 1. Conceptual framework

DATA ANALYSIS

You can see the results in Table 1. Results from an analysis of the acceptance level index for each practice showed that agroforestry and cover crop planting were well-received by farmers in Mthonjaneni Municipality, while agroforestry, cover crop cultivation, and diet improvement for animals were well-received by farmers in uMhlathuze Municipality. A combined study shows that agroforestry, cover crop production, and animal feed modification are all widely supported by KCDM farmers.

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Table 1. Farmers' Perception of Social Compatibility of Climate-Smart Agricultural Practices.

Climate-Smart Agricultural Practice	Level of Social Acceptance														
	Mthonjaneni					uMhlathuze					Combined Analysis				
	A No (%)	N No (%)	NA No (%)	ALI	CA	A No (%)	N No (%)	NA No (%)	ALI	CA	A No (%)	N No (%)	NA No (%)	ALI	CA
Planting of Cover Crops	84 (77.1)	25 (22.9)	0 (0.0)	193	High	163 (74.7)	55 (25.2)	0 (0.0)	381	High	247 (75.5)	80 (24.5)	0 (0.0)	574	High
Agroforestry	85 (78.0)	18 (16.6)	6 (5.5)	190	High	171 (78.5)	29 (13.3)	18 (8.3)	371	High	256 (78.3)	47 (14.4)	24 (7.3)	559	High
Crop Rotation	80 (73.4)	29 (26.6)	0 (0.0)	189	Medium	141 (64.7)	61 (28.0)	16 (7.3)	343	Medium	221 (67.6)	90 (27.5)	16 (4.9)	532	Medium
Mulching	87 (79.8)	15 (13.8)	7 (6.4)	189	Medium	153 (70.2)	48 (22.0)	(17 (7.8)	354	Medium	240 (73.4)	63 (19.3)	24 (7.3)	543	Medium
Use of Organic Manure	81 (74.3)	26 (23.9)	2 (1.8)	188	Medium	134 (61.4)	66 (30.3)	18 (8.3)	334	Medium	215 (65.8)	92 (28.1)	20 (6.1)	522	Medium
Efficient Manure Management	78 (71.5)	31 (28.4)	0 (0.0)	187	Medium	141 (64.7)	61 (28.0)	16 (7.3)	343	Medium	219 (67.0)	92 (28.1)	16 (4.9)	530	Medium
Integrated Crop-Livestock Management	77 (70.6)	31 (28.4)	1 (0.9)	185	Medium	148 (67.9)	43 (19.7)	27 (12.4)	339	Medium	225 (68.8)	74 (22.6)	28 (8.6)	524	Medium
Crop Diversification	79 (72.5)	25 (22.9)	5 (4.6)	183	Medium	137 (62.8)	53 (24.3)	28 (12.8)	327	Medium	216 (66.1)	78 (23.9)	33 (10.1)	510	Medium
Planting of Drought- and heat-tolerant Crops	75 (68.8)	31 (28.4)	3 (2.8)	181	Medium	128 (58.7)	58 (26.6)	32 (14.7)	314	Low	203 (62.1)	89 (27.2)	35 (10.7)	495	Low
Conservation Agriculture	77 (70.6)	23 (21.1)	9 (8.3)	177	Medium	135 (61.9)	50 (22.9)	33 (15.1)	320	Low	212 (64.8)	73 (22.3)	42 (12.8)	497	Low
Diet Improvement for Animals	78 (71.5)	20 (18.3)	11 (10.1)	176	Medium	162 (74.3)	54 (24.8)	2 (0.9)	378	High	240 (73.4)	74 (22.6)	13 (4.0)	554	High
Improved Grazing	75 (68.8)	25 (22.9)	9 (8.3)	175	Medium	140 (64.2)	67 (30.7)	11 (5.0)	347	Medium	215 (65.8)	92 (28.1)	20 (6.1)	522	Medium
Use of Wetlands	76 (69.7)	21 (19.3)	12 (11.0)	173	Low	136 (62.4)	46 (21.2)	36 (16.5)	318	Low	212 (64.8)	67 (20.5)	48 (14.7)	491	Low
Soil Conservation	74 (67.9)	20 (18.3)	15 (13.8)	168	Low	147 (67.4)	38 (17.4)	33 (15.1)	332	Medium	221 (67.6)	58 (17.7)	48 (14.7)	500	Low

In Mthonjaneni Municipality, agroforestry has strong social and environmental backing, whereas mulching received strong support only in the technical area. In contrast, Mthonjaneni Municipality residents reported a low level of support for improving animal diets across the technical, economic, and environmental areas. There was minimal support for growing drought- and heat-resistant crops in the economic and environmental spheres, respectively. Low levels of acceptability were found for soil protection in the social and technical domains, and for wetland usage in the social and environmental domains.

Both the technical and economic benefits of mulching and the environmental benefits of using organic manure were widely accepted. However, there was little social, technological, or commercial backing for developing drought- and heat-resistant crops. Social acceptability of conservation agriculture was poor, and technical acceptance was even lower. In uMhlathuze Municipality, Both the social and environmental benefits of wetland use and the economic benefits of agroforestry were found to have low acceptance rates.

The technical, economic, and environmental categories of the KCDM's combined research all gave organic manure a thumbs up. Cover crop planting was well received in the KCDM's social and technical domains, while mulching was well received in the KCDM's technical and economic sectors. However, when looking at the social, technological, and economic factors together, the KCDM found low acceptance for cultivating drought- and heat-tolerant crops. There was little backing for conservation agriculture in either the social or technical spheres. Wetland use and environmental preservation were found to have low acceptance in the KCDM, while soil conservation and technical protection were shown to have even lower acceptability.

The results presented have shown how the sampled farmers evaluated the CSA strategies based on their characteristics. Figure 2 is a simplified illustration of a small-scale agricultural system that may benefit from CSA operations.

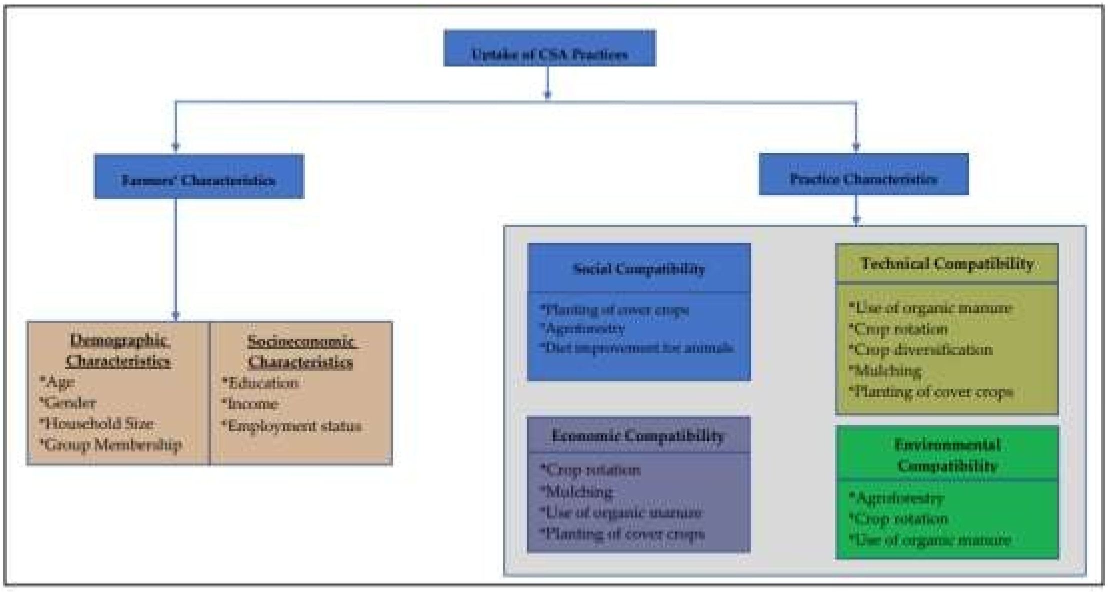

Figure 2. A schematic representation of the dynamics of the uptake of climate-smart agriculture (CSA) in the small-scale farming system.

CONCLUSION

Therefore, this research departs from that standard strategy by zeroing on on the characteristics of CSA procedures. The results show how farmers' opinions about the qualities of the highlighted CSA practices impact their general attitude toward adopting them. High, medium, and low levels of acceptability of the indicated CSA practices were determined based on analysis of the replies obtained from the farmers. The CSA policy framework should also include financial strategies and resources to encourage farmers to use CSA technology best suited to their geographic region. The assessment of farmers' degree of acceptability was used to build a composite score that was then used to create these groups. The acceptability level index reflects the degree to which respondents approve of each of the listed CSA behaviors from the point of view of the practices' compatibility with the environment.

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