



EXPLORING FARMERS' PERCEPTIONS OF CLIMATE SMART AGRICULTURE: EMPIRICAL EVIDENCE FROM NORTHERN NIGERIA.

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ABSTRACT

The aim of climate-smart agriculture (CSA) is to help farmers increase productivity, adapt their methods, become resilient to climate impacts and reduce their greenhouse gas emissions. However, there has been little published research on the perceptions and knowledge of farmers as to how this approach can fulfill its potential, especially in Africa. This paper presents a study based on interviews and group discussions conducted among farmers in some rural communities in Northern Nigeria. It reveals that the strength of CSA lies in its ability to integrate agricultural productivity with environmental targets and address the livelihood needs and cultural biases of local farmers. It also identified differences in the perception of different groups within society. For example, the younger farmers who possess little farmland showed optimism in the potential of the CSA approach to address livelihood and environmental challenges while the older farmers with larger farmlands were generally uncertain and suspicious. The analysis of interviews presented could be used to identify target groups on which to focus CSA, assuming that groups with a significantly greater proportion of farmlands could have more impact on the environment. The study suggests a continuous effort is made to develop knowledge and build capacity of local farmers and experts. Lessons from this study are important in developing the knowledge and capacities that will make CSA a reality. Further studies across Africa which take local specificities and priorities into consideration are needed.

Keywords: Knowledge, attitudes, agricultural innovations, rural farmers, Katsina State.

INTRODUCTION

Globally, scientific evidence has shown that climate change and variability (CCV) pose severe risks for agriculture, particularly the small landholders and subsistence farmers in developing countries (Gregory, Ingram, and Brklacich 2005; Morton 2007; Müller et al. 2011; Wheeler and von Braun 2013). As the 5th Assessment Report (AR5) of the IPCC and others show that by 2050, the impact of climate change on food security would be very marked across Africa and Nigeria (Bosello et al. 2017; Niang et al. 2014). In some parts of Nigeria, projected temperature changes between 0.5°C and 4°C have been predicted in different regions (Abiodun et al. 2013; Niang et al. 2014) while marked differences in precipitation have been experienced in most parts of Nigeria (Odekunle 2006; Ogunbenro and Morakinyo 2014; Tarhule and Woo 1998) as a result of significant changes in the intensity, frequency and seasonality of rainfall (Nigerian meteorological agency (NIMET) 2012). For example, the declining length of the growing season, rising sea levels and changing ground water have become common occurrences both in the northern and southern parts of Nigeria (Abiodun et al. 2013; Nigerian meteorological agency (NIMET) 2012). The impacts on crop and animal production are wide spread across Nigeria (Adejwun 2006; Apata 2006; Matthew, Abiodun, and Salami 2015) and as a result, the yields of major crops - maize, rice, sorghum, millet, cassava, beans and sugarcane - are expected to decline in Africa and south Asia (McCarthy et al. 2001; Rosenzweig et al. 2014).

Therefore, urgent innovative approaches and region specific policy intervention are required to adapt agriculture both to

current and future impacts of climate change as well as mitigating emissions from unsustainable agricultural practices and combating desertification in the north and coastal erosion in the South (Ekpa, Tsado, and Bodaga 2018; Ojoko, Yusuf, and Oni 2017; Terdoo and Olalekan 2014). CSA practices are useful, but despite its potential, rural farmers' perspective of its suitability to address the challenges of climate change is not assessed. For example, the farmer's perspective of CSA may reveal their understanding and the viewpoint they have formed about its practices in Nigeria. Hence, it will demonstrate the way they regard CSA practices and techniques, because people's perceptions automatically influence their behavior (Ferguson and Bargh 2004). Accordingly, understanding CSA from the perspective of rural farmers in the region is important for its success in many ways. Firstly, it determines the extent of its adoption, how the transition from traditional practices to CSA will take place and how fast CSA knowledge will be transferred from older farmers, who are knowledgeable, to the younger generations of farmers who are less experienced (Terdoo and Adekola 2014).

Secondly, understanding CSA from the farmers' perspective is key to measuring its success. This may be in terms of how many people have adopted CSA practices, how many new people are willing to adopt it in the future and how much of it has improved farm yields and the lives of farmers practicing it in the region. Lastly, understanding CSA from this perspective will determine their local policies to aid its widespread adoption. Understanding the farmers' perspectives on CSA in this way will give further insights into sustainability issues that can be easily

overlooked, especially at farm and community levels. Also, it can help to reveal CSA aspects that need to be scaled up and areas which can be improved upon. This indigenous perspective has proved very important in addressing environmental problems especially those relating to climate change and variability at local level (Emanuel Mkowa, 2014).

The farmers' perspectives on agricultural policies, technology, technique and practice has proven to be key to the rapid adoption and success of both old and new innovations in the sector in Nigeria. Evidence has shown that laudable policies aimed at increasing agricultural productivity, reducing rural poverty and managing environment in the past were out right abandoned by farmers and local communities (Enete and Amusa 2010; Iwuchukwu and Igbokwe 2012). While some of the policies/technologies adopted by farmers appeared to be yielding positive results, they were suddenly pushed aside by farmers because their perceptions. Examples of some of these include: River Basin Development Authorities (RBDAs), 1973; Operation Feed and Nation (OFN), 1975; National Accelerated Food; Production Programme (NAFPP), 1972; the Directorate for Food, Road and Rural Infrastructure DIFFRI, 1986; National Agricultural and Land Development Authority; (NALDA), 1991; Better Life Programme for Rural Women (BLP), 1987; Family Support Programme (FSP), 1994; and National Poverty Eradication Programme (NAPEP), 2001 (Mapfumo et al. 2013; Ojonemi and O 2015). Reasons for this failure, such as lack of proper funding of key projects relevant to the success of the policies, corruption, inadequate farmer education and extension services, among other things were generally mentioned (Iwuchukwu and Igbokwe 2012; Ojonemi and O 2015). However, one issue repeatedly stated to have contributed significantly to policy failure in Nigeria has been that the farmers' perspectives and priorities on such things as livelihood needs and cultural biases were continuously overlooked at all levels and across scales, including at planning and formulation, implementation and evaluation stages (Iwuchukwu and Igbokwe 2012; Ojonemi and O 2015; Olatomide and Omowumi 2014; Sanyal and Babu 2010; Tsokura Agber, Iortima, and P.I., Imbur 2013).

There are few published reports regarding perspectives and knowledge of farmers as to how CSA can fulfill its potential, especially in Africa. This study aims to address that oversight. Focusing on the northern region of Nigeria, this paper broadly ask: How can climate smart agriculture be best integrated into agricultural practices in region? The paper further ask five sub questions to help determine this: (i) do farmers think CSA is specific enough to address the challenges of climate change they face? (ii) can the success (or failure) of CSA be adequately measured? (iii) considering the local situation, is CSA achievable? (iv) is CSA realistic or idealistic? and (v) can the objectives of CSA be achieved in a timely manner?

LITERATURE REVIEW

Climate-smart agriculture (CSA) can be described as an integrated approach that draws heavily upon a combination of simple climate friendly innovative farming techniques. It aims to contribute to achieving sustainable development goals by helping smallholder and subsistence farmers in low income regions attain food security in the face of increasing climate change challenges (FAO 2010, 2013). The CSA approach has three main intertwined goals, namely: (i) sustainably increasing

agricultural productivity and incomes; (ii) adapting and building resilience to climate change; and (iii). reducing and/or removing greenhouse gases emissions (FAO 2013). Therefore, CSA approaches, interventions or technologies are expected to contribute to achievement of CSA goals by enhancing the capacity of over 500 million of the poorest and most vulnerable small landholders who produce as much as 80 percent of the food consumed in Africa and Asia to respond effectively to adverse impacts of climate change and variability (Branca et al. 2011; Chandra, McNamara, and Dargusch 2017; Terdoo and Olalekan 2014).

While the potential of CSA approaches, interventions or technologies in reducing small landholders' exposure and sensitivity to multiple climatic and economic pressures is being demonstrated by the agricultural research community world over (Chandra, et al. 2017; Khatri-Chhetri et al. 2016; Notenbaert et al. 2017; Partey et al. 2018; Sain et al. 2017), the adoption of CSA options is still not widespread and often met with skepticism among small landholders, especially in rural northern Nigeria (Terdoo and Olalekan 2014). Consequently, most rural farmers current responses to climate variability and change in the region such as irrigation and water control measures, chemical fertilizer and herbicides application, and timing/shifting cropping date, fall-short of CSA options. Most of these responses tend to result in maladaptive outcomes (e.g., soil quality degradation, greenhouse gases emissions, among others) (Hoyos, 2016; Terdoo, 2019).

Several reasons have been advanced to explain slow adoption rate of CSA options. Some scholars have argued that the current framing of CSA has failed to address the issues of equity and recognition that would have addressed the entrenched power relations that constrain or block the emergence of more 'pro-poor' forms of agricultural development, including equal market access, adaptation to climate change, or carbon sequestration and storage in developing countries (Chandra, McNamara, and Dargusch 2018; Chandra, McNamara, et al. 2017; Karlsson et al. 2018). Others scholars argue that the concept of CSA is too loose, which gives legitimacy to *environmental, development and farmers' organisations promoting the very practices CSA seeks to oppose* (Anderson 2014; Brandt et al. 2017; Eriksen et al. 2011). *Still other scholars have attributed limited uptake of CSA approaches, interventions or technologies by small landholders in Africa and Asia to institutional challenges* (Ampaire et al. 2017; Meinzen-Dick, Bernier, and Haglund 2014; Totin et al. 2018), *especially the inability to promote the role of local institutions in adaptation to climate change* (Agrawal 2008). *These arguments highlight the common bias in CSA literature, which tends to concentrate on extrinsic issues such as the concepts of CSA, its practices and determinant (factors) more than intrinsic issues such as the role of local knowledge, attitudes and perceptions that can potentially facilitate CSA adoption* (Alomia-hinojosa et al., 2018; Jha et al., 2020; Meijer et al., 2015; Naess, 2013; Terdoo & Adekola, 2014).

While the role of knowledge, attitudes and perceptions in uptake of agricultural innovations among smallholder farmers has been acknowledged both in theoretical and empirical literature on agriculture, there is insufficient understanding of how local knowledge and perspectives and social context may influence

the uptake of CSA options among small landholders in northern Nigeria. Consequently, this study fills this gap by exploring perspectives on CSA held by rural farmers in northern Nigeria. By providing a place-based analysis of rural farmers' perceptions of CSA in a farming community in northern Nigeria, this study will contribute to the growing debate about the role of knowledge, attitudes and perceptions in the adoption of agricultural innovations and technologies in the sub-Saharan Africa-a region where such research is relatively scant.

METHODOLOGY

Study area

The field study was conducted in Darawa-a small mixed farming community located near the Take-off Site of Federal University in Dutsin-Ma Town of Katsina State in the northern part of Nigeria. Geographically, the Darawa community lies along latitudes 12° 26' N and longitudes 07° 29' (Figure 1). The community forms a part of Dutsin-Ma with an estimated population of about 169,829, of which about 90% is

predominantly agrarian, deriving its livelihoods from agriculture especially in grain farming and cattle rearing (National Population Commission, 2006).

Agricultural practices in the region are dominated by small landholders and subsistence farmers, cultivating 2 hectares or less (Terdoo and Adekola 2014). Unsustainable practices such as slash and burn, deep tillage (also referred to as hoeing), unplanned and over-grazing of livestock, lack of agroforestry practices and indiscriminate cutting of trees and shrubs are commonplace, hence exacerbating the climate change and desert encroachment in the region (Terdoo and Olalekan 2014). The region has characteristics similar to Sudan and Sahel Savannah. The climate of the region is semi-arid, classified as tropical wet and dry climate (AW) in the W. Koppen's scheme. Rainfall and temperatures vary significantly across the region. Annual rainfall ranges from 300 mm to 700 mm. Mean monthly maximum temperature varies between 28° C and 40°C (Akor, 2012).

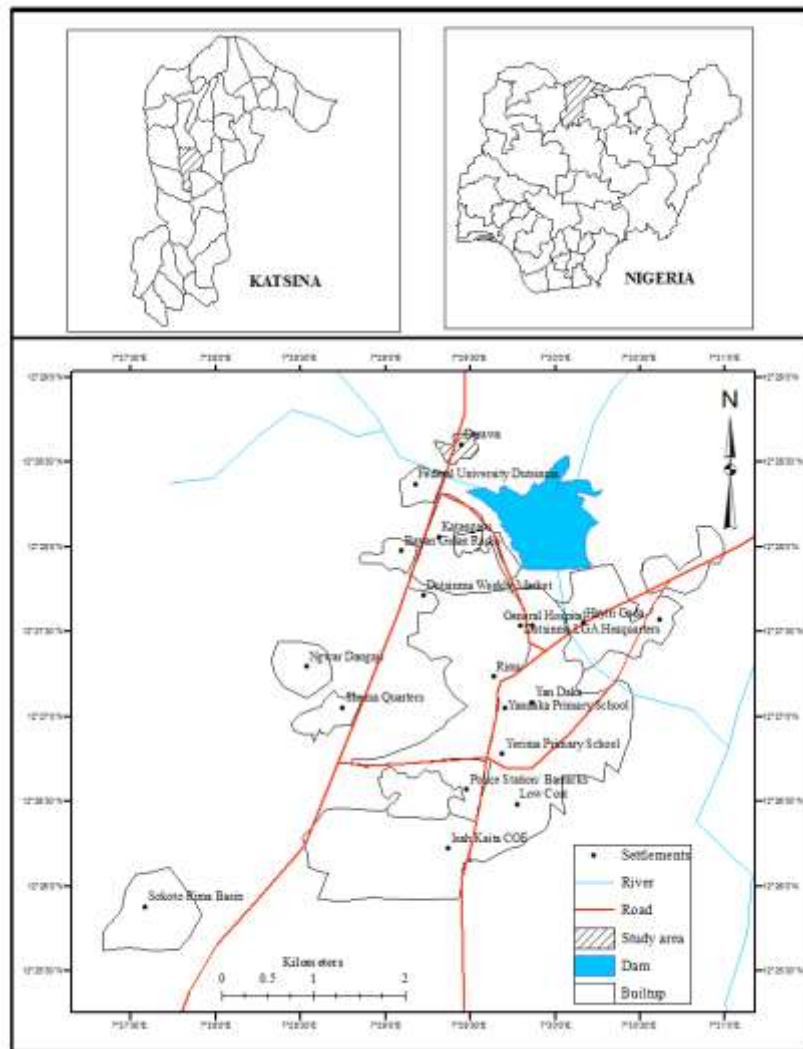


Figure 1: Map of Dutsin-Ma Showing Darawa.

Method of Data collection

Sampling design and size

This study investigated how rural farmers' local knowledge of CSA practices, interventions and technologies may influence their uptake as well as their integration in local agricultural practices. In order to capture the farmer's perspective and knowledge of CSA, a qualitative strategy (semi-structured interviews and group discussions) was used both in the process of data collection and analysis. A purposive snowball sampling approach was used to select research participants (i.e., farmers) in the study area (Schutt 2012). This sampling approach has been successfully applied to a number of related studies (Belliveau, Smit, and Bradshaw 2006; McCubbin, Smit, and Pearce 2015; Raymond and Robinson 2013).

Since Darawa community comprised of about 29 houses (rough count at time of interview) an exploratory sample size (n=20) was used (Bryman 2016). (See also Belliveau et al. 2006; Nicholas and Durham 2012 for studies which, used similar sample size). Given the prevailing Islamic culture in the community, which tends to restrict public interaction of women, a total of 18 male and 2 female were interviewed. 7 interviewees from ages 49 or less were regarded as young farmers while 13 from ages 50 and above were termed older farmers. Moreover, 17 of the interviewees have no formal education while 3 attended primary education. Lastly 19 of the interviewees were of low income status.

Interviews

A total of 20 debt interviews that lasted about 2 hours were conducted face-to-face with farmers (having ≤ 2 ha) between

August and September 2014. At the start of each interview and discussion, the concept of CSA was introduced to the respondents as entailing agricultural practices, such as the use of cover crops, crop rotation and intercropping, no-tillage, organic manures, water harvesting and management systems, and improved pasture management employed to enhance crop and animal yields, income, reduce greenhouse gases emissions and build resilience to climate change and variability impacts. Farmers then grasp the meaning of CSA despite their low level education. In the next step, additional concepts that underpin the research questions such as: specificity, success (or failure), achievement, measurement, realistic or idealistic of CSA practices, innovations and technologies were all explained to the respondents and operationalized. Thus, by putting one or multiple questions to the respondents during the interview sessions, data was collected cutting across all the thematic areas of the study outlined here.

The interviews were transcribed and saved in word documents. An open-coding technique used in Reid and Caldwell (2007) was adapted to organise and assist interpretation of the information gathered from the interviews and group discussions (Reid & Caldwell, 2007). For each section of the interview or group discussion, responses were coded and categorized into various themes and sub-themes, with illustrative quotations retained to characterize the described farmers' perceptions on adoption of CSA practices, innovations and technologies relating to their specificity, success (or failure), achievement, measurement, realistic or idealistic of CSA practices.

RESULTS AND DISCUSSION

Farmers views on the suitability of CSA to address the challenges of farming in northern Nigeria.

The specificity of CSA goals in Northern Nigeria

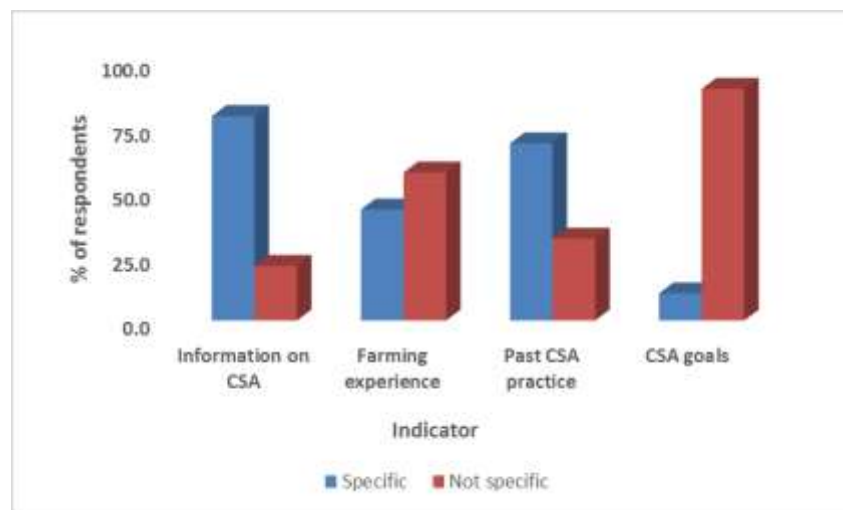


Figure 2: Farmers perspectives on the specificity of CSA goals to address the challenges unsustainable farming in Northern Nigeria.

Farmers' views were sought on whether the goals of CSA and its current and possible practices of CSA in the region are

specific enough to address the challenges of climate change in

Northern Nigeria. The results are illustrated in Figure 2, which shows that 68.4% of the respondents were of the opinion that the CSA goals are specific enough to address most of the challenges confronting farmers, such as decline of crops and animal productivity, water scarcity and soil erosion, while 31.6% of the respondents were of the opinion that CSA goals as currently portrayed are not specific enough to address the challenges confronting them at the moment. Their views were based on reasons ranging from their years of farming experience, in the case of older farmers, information about the successes of CSA and personal feelings, in the case of younger farmers. For example, 21.1 % of young farmers based their opinion on information about CSA and not necessarily on experience and practice, while 15.7%, on practical experience of the application of some CSA practices, especially in the use of organic fertilizers and 31.6%, on the view that they considered CSA practices to be environmentally friendly and so capable of addressing challenges of unsustainable agricultural intensification in the region.

On the contrary, about 21% of the older farmers felt that CSA goals, as they are presently articulated and practiced, are not specific enough to address the challenges of unsustainable intensification of agriculture in the region. When asked for further reasons to their views, they simply say that the challenges are too numerous and complex to be easily addressed by CSA approach. This group opined that agricultural intensification in the region can only be achieved through practices such as use of chemical fertilizers, cutting of trees in the farms, practices and goals which CSA is opposed to and seeks to reverse. Based on the opinions of the farmers, it is obvious that, although majority of farmers see CSA as a helpful approach to addressing some of the challenges confronting them, for many, their views were not yet based on evidence from many years of farming experience. As such, much work is needed in education and agricultural extension to convince farmers using evidence-based proofs of the successes of CSA, so that its adoption will be scaled up in the region.

Farmers perspectives on the possibility of measuring CSA success in northern Nigeria

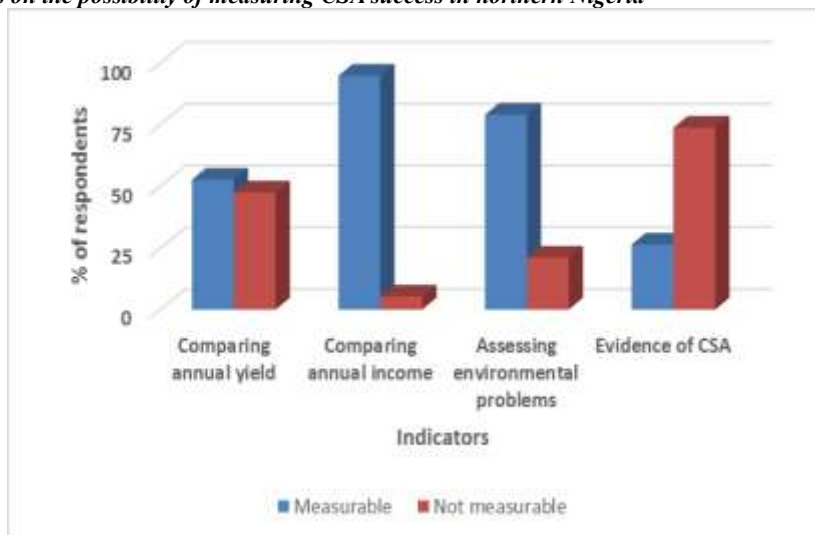


Figure 3: Farmers views on the possibility of measuring CSA success

Farmers views on measuring the possibility of CSA success is illustrated in Figure 3, which reveals a significant over-all response of 73.7% while only about 27.3% of the respondents were of the view that CSA success cannot be measured in the region in the present. Furthermore, reasons were sought regarding the responses (Figure 3). Thus, 47.4% of interviews cited yield as the major factor for measuring the success of CSA. According to them, CSA success can be measured by comparing yield per plot of farmland with the previous years when CSA practices were not employed in the region. Another group of farmers (5.2%) referred to comparison of previous year's income with present year's income when CSA is employed.

Lastly, about 21.1% of the interviews referred to observation of CSA ability to reduce environmental problems caused by

farming. Specifically, if we can observe that CSA practices have reduced the challenges of soil erosion, deforestation, and increase soil fertility we constantly experienced on our farms. Moreover, 26.3% of the interviewees cited lack of evidence of CSA practices to address their problems on farm as the reasons. Their responses are *CSA cannot be measured because we are not sure it will work for us....[...]* and *beside we have not tested it, but the use of chemical fertilizer has worked for us*. The above perspectives touch on key issues CSA seeks to promote. The issues of CSA's ability to increase farm yield and income annually and reduce environmental problems over the time. Consequently, strengthening and scaling up farmer adoption of CSA in the region lies in its ability to integrate agricultural productivity with income and environmental targets (FAO 2014).

Farmers perspectives on the possibility of attaining CSA goals in Northern Nigeria

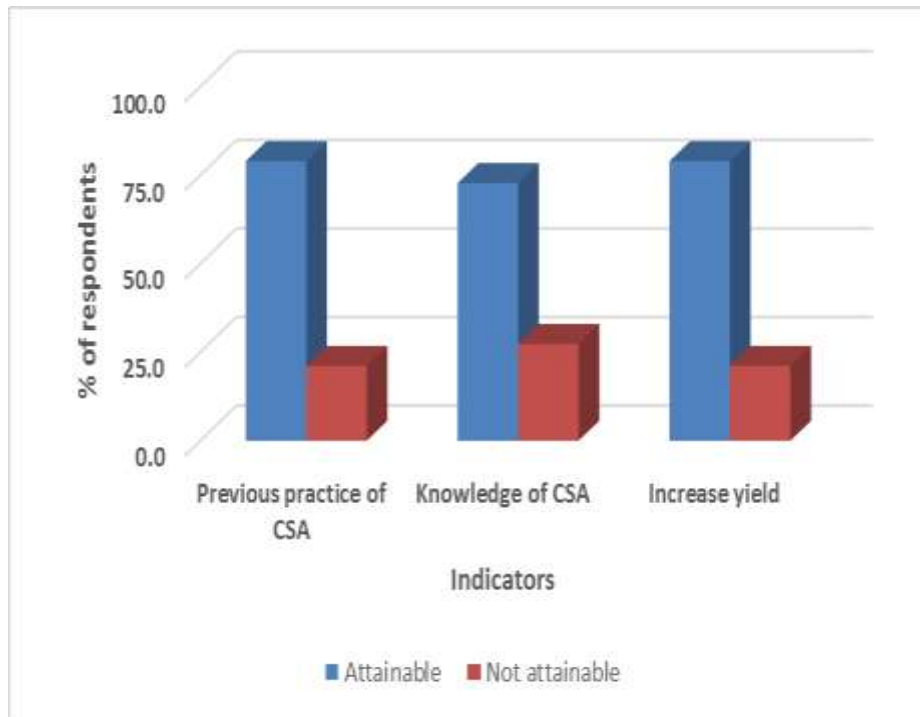


Figure 4: Farmers views on the possibility of Attaining CSA goals in Northern Nigeria

Furthermore, farmer's perspectives on whether CSA goals are attainable were also assessed and the results (illustrated on Figure 4) show that while 84.2% of the respondents see the possibility of attaining CSA goals in the region, about 15.8% of the respondents doubt the possibility of attaining CSA goals in the area. For example, 21.1% of the farmers said their past farming experiences are useful for adopting CSA practices and hence its goals (Figure 4). According to the group, *in one way or the other we have used CSA practices in their traditional practices*. Moreover, about 42% of the interviewees were rather conditional about their reason. In their worlds *if (we) farmers are given the proper knowledge of it and if we can practice it continuously, then CSA can be attained in the region*. Furthermore, while about 21.1% of the respondents cited increases in yield as a determining factor to attainment of

CSA goals in the region, they felt that can only be achieved *if CSA can truly increase our farm yields as being portrayed*.

Despite the overwhelming support above, about 15.8% of respondents, this being a group of older and knowledgeable farmers, were skeptical and pessimistic about CSA. According to them, CSA cannot be attained in the region because *we lack the knowledge of it*. From the foregoing, one key issue of importance to CSA practice and to attainment of its goals in the region is the belief in its ability to not only address the climatic and environmental concerns of farmers, but also their livelihoods needs. This calls for continuous farmer education programmes and agricultural extension services in the region as these can go a long way to address farmers' skepticism about its success (Awotide, Karimov, and Diagne 2016; Zossou et al. 2009).

Farmers perspectives on whether CSA is realistic or idealistic

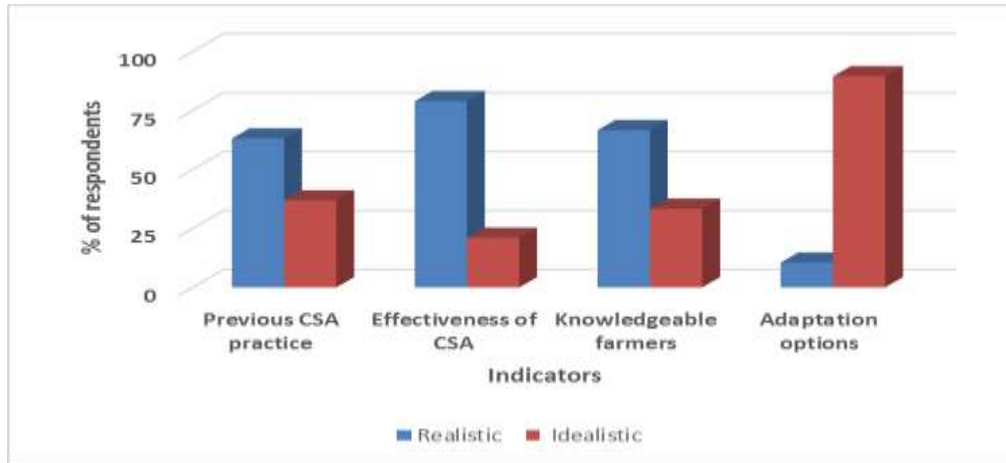


Figure 5: Farmers perspectives on whether CSA is Realistic or idealistic

In addition to attaining CSA goals above, Figure 5 above presents farmer's perspectives on whether attainment of CSA objectives in the region is a realistic or an idealistic agenda. The Figure (5) reveals that 68% of farmers in the region strongly perceived CSA to be a realistic agenda. In contrast, 31.6% perceived it as an idealistic agenda (Figure 5). Moreover, about 36.8% of the interviewees who see CSA as a realistic venture also endorse CSA practices such as rainwater harvesting, site-specific integrated nutrient management, contingent crop planning and laser land levelling (Khatri-chhetri et al. 2017). In addition, about 21.1% say they felt it is realistic because *based on what they know and heard, CSA appears to be working in terms of increasing yield and reducing environmental challenges*. While about 10.5% of the interviewees say CSA is realistic but only *for knowledgeable and educated farmers*. On the other hand, about 21.1% of the respondents were of the view that CSA's goals are still at best an idealistic agenda. This

group cited lack of knowledge of CSA in the region as their reason. One of the interviewees stated: *we don't know it (CSA). No one has told us what to do (about CSA) and we (farmers) are not sure we will get results from practicing it (CSA) in our farms*. While about 10.5% in this group simply said *we don't have alternative sources of income and energy if we stop cutting down trees in our farms*. Based on the result of the interviews presented in this section, for CSA knowledge to continue to spread among local farmers in low income regions, the need to build farmer capacity to adapt to shocks of climate change and that of the agricultural extension workers to facilitate adaptation practices, has become apparent (Lipper 2015). This knowledge will be key to helping farmers identify livelihood options available within their reach and diversify their livelihood activities to buffer the shocks and the risks whenever they occur on their farmers (Vermeulen et al. 2012).

Farmers perspectives on the possibility of achieving CSA goals in a timely manner

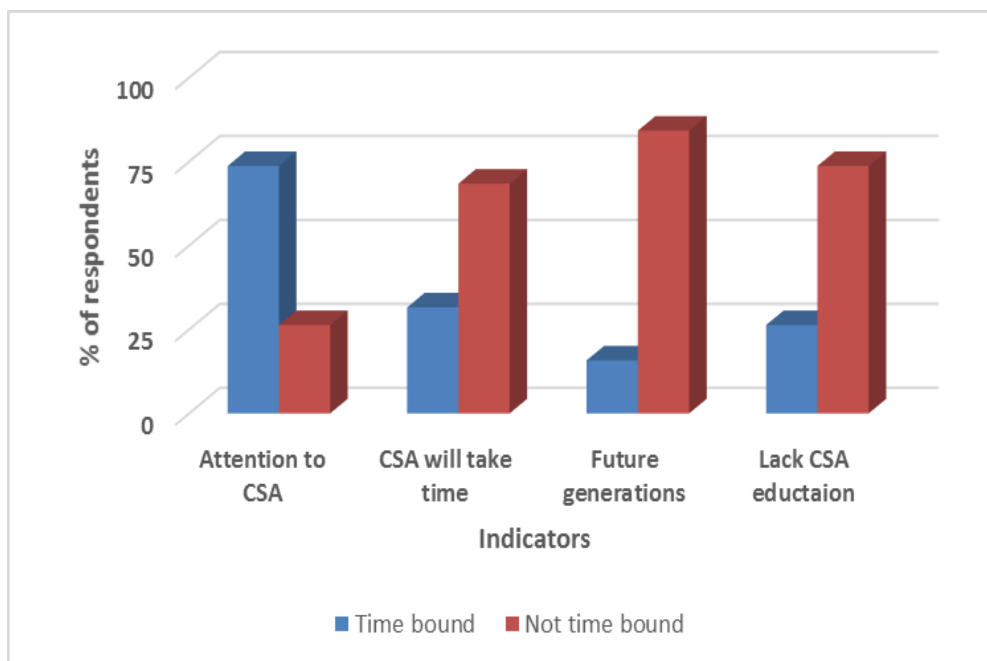


Figure 6: Farmers perspectives on the possibility of achieving CSA goals in a timely manner

Lastly, the possibility of achieving CSA goals in a timely manner and if CSA is something that is outdated or that can only be achieved by future generation in their society was also assessed. The result shows that on the whole, only 26.3% of respondents were of the view that CSA objectives as presently presented can be achieved in timely manner (Figure 6). While none of the interviewees considered CSA practices to be outdated, the majority, about 73.7%, were of the view that CSA objectives can only be achieved in the future. Even the 26% of farmers who see the possibility of achieving CSA objectives in a timely manner, based their opinion on the condition that farmers pay close attention to CSA practice in the region.

On the other hand, out of the 73.7% of respondents who felt CSA can only be achieved by future generations, about 31% were of the opinion that CSA is something that will take a longer time to achieve. Furthermore, about 15.8% of farmers in the area simply see CSA objectives to be achieved by future generations. When asked why they think so, they could not provide any explanation. However, 26.3% of the respondents explained further why they felt CSA objectives as presented cannot be achieved immediately. According to them, *majority of us (in the region) lack the education, technology, funds and hard work that is required to attaining CSA goals in a timely manner*. In their explanation, reference is made to what can be considered the four important factors to increasing farmer’s adoption of CSA in the region. These are farmer education on CSA practices, farmer access to basic technology to facilitate adoption of CSA, farmer finance and farmer personal motivation and determination to adopt and continue to practice CSA (Partey et al. 2018). It is expected that if these issues are addressed in increasing measure, adoption of CSA in the region may be scaled up to some extent.

CONCLUSION

Analysis of the interviews with farmers on their perspectives of CSA fulfilling its potential in the region showed two general groups of opinions among interviewees. First, the group with optimism for CSA to fulfill its potential, characterized by young and less knowledgeable or experienced farmers. Second, the group who were generally uncertain and suspicious of CSA’s ability to fulfill its goals in the region characterized by older and experienced farmers. Interestingly, the study found farmer’s perceptions were strongly in favour of integrating agricultural productivity with environmental targets but weak in addressing the livelihood needs and cultural biases of local farmers. The results proved otherwise the general perspectives that increase agricultural productivity and environmental targets could generally increase farmer’s interest and motivation to adapt CSA practices. Instead, farmers raise more concerns on income and livelihoods, educational, CSA technology and practices, farmer personal motivation and determination to adopt and continue to practice CSA.

Based on the insight from this study, it is concluded that in scaling up CSA adaption to other regions, changes in the emphases and prioritization of CSA’s goals are needed to resolve general suspicions and uncertainties about CSA’s ability to address livelihood needs and cultural biases of local farmers. Programmes and projects addressing income generation activities should be designed and discussed with farmers during awareness programmes on CSA. Furthermore, issues concerning educating farmers on the basic CSA practices and farming technologies and techniques must be urgently changed for CSA to address current challenges of unsustainable farming in northern Nigeria. Training of farmers and retraining of agricultural extension workers in sustainable agricultural land management (SALM) are also needed. While at the same time, value addition and market must be created for farmers to sell their produce and improve household income. Monitoring and evaluation of CSA in the region should focus on assessing the annual increase in farm yield, annual increase in income and

how CSA practices have reduced environmental challenges confronting farmers over the time in the region.

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