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# Assessment of Farmers' Perception and Adoption of Conservation Agriculture Practices Case Study Fune L.G.A Damagum Yobe State

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## *Abstract*

The study assesses farmer's perceptions and the extent of adoption of conservation agriculture (CA) practices in Damagun, Yobe State, Nigeria. Conservation agriculture, characterized by minimal soil disturbance, crop rotation, and permanent soil cover, is vital for sustainable farming, especially in semi-arid regions like Damagun. Using a mixed-methods approach, the research evaluates factors influencing adoption, farmers' awareness, and the perceived benefits and challenges of CA. Findings reveal that while some farmers recognize the long-term benefits of CA, adoption rates remain low due to socioeconomic and institutional barriers. Recommendations for scaling adoption include targeted extension services, financial incentives, and capacity-building initiatives. The study area is Damagum Local Government Area (LGA) of Yobe State, Nigeria. Geographic Coordinates of Damagum is located around Latitude: 11.7333° N, Longitude, 11.9667° E. Damagum is, approximately 60 kilometers southeast of Damaturu the state capital Yobe State is located in the Northeastern part of Nigeria, within the Sahel region. The study area has a semi-arid climate with two distinct seasons: a wet season that lasts from May to October, and a dry season that lasts from November to April. The study revealed that majority of responders 30 (30%) are at the age group of 31 – 40 years, while 25 (25%) are at the age group of 18 – 30 years, 25 (25%) are at the age group of 51 and above years respectively, 20 (20%) are at the age group of 41 – 50 years. The study also revealed that majority 70 (70%) of the respondents are aware of Conservation **Agriculture practice, while 30 (30%)** of the

respondents are not aware of Conservation **Agriculture practice.** A majority of farmers have heard of conservation agriculture practices, which is a positive sign for its potential adoption. However, 30% of farmers are unaware, suggesting a need for more awareness campaigns.

**Keywords:** Perception, Adoption, Conservation, Agriculture, Practice, Extent.

## *Introduction*

Though the Nigerian economy predominantly depends upon petroleum oil, agriculture still remains an important sector of the country's economy. This is as a result of the numerous roles which the sector plays in contributing to the wellbeing of the citizenry. The sector is equally responsible for the provision of food for the citizens, generation of employment for about 60 – 70 percent of the country's population, production of raw materials for local industries, markets for industrial goods and a major foreign exchange earner through export of cash crops (Pius, 2016).

In order to affirm the potential of Agriculture, Agricultural practices such as soil and water conservation appear to be a step in the right direction to meet global food demands in a more environmentally sustainable manner (Fontes, 2020).

From this assertion, it can be deduced that if the productivity of farmer will improve, efforts would need to be made by concerned authorities and stakeholders in agriculture to find means through which farmer's efficiency in the use of soil resources would be enhanced. If the soil and water resources at the farmer's disposal are used efficiently, productivity will increase and this will ultimately lead to improvement in the standard of living of the farmers. Therefore, no effort is supposed to be spared in an attempt at making the farmers more productive.

Achieving this feat of enhanced productivity may continue to be a mirage if the resources are not used in a sustainable way. Land and water are the most important resources required for agricultural productivity. Since all forms of life including plants, animals, macro and microorganisms depend on the land for sustenance, the soil must be continuously kept fertile and productive. This is against the backdrop of the fact that productivity would continue to decline, and thereafter it would continue to lower agricultural export revenue and increase food insecurity (Darkwah *et al.,* 2019). Therefore, there is a need to augment the soil back. One of the ways to ensure this is by effectively utilizing conservation practices. Studies have explored and recommended conservation measures which can enhance soil fertility and increase crop yield sustainably in the wake of climate change (Kimaru-Muchai, *et al.*, 2020). The nutrient status of the soil in the north-east region of Nigeria has been found to be generally low despite the potentials that the zone has for production of rice, vegetables and maize crop (Chude*et al*., 2012). This low nutrient status was attributed to the land use practices of the farmers which were found to be inimical to plant growth and development.

For instance, the continuous use of agricultural lands without allowing for a year or two years fallow period is one of the major features of farming in the northern part of Nigeria despite the vast agricultural land that the region has. In some States such as Bauchi, Kano and Plateau, farmers have consistently cultivated the same piece of land for over twenty years and this basically is the reason why these areas use fertilizer more than other areas in the country as the soil has become very poor in fertility due to continuous removal of its nutrients (FDA 2009). Moreover, the farmers engage in a diversity of subsistence agricultural practice which include crop farming, livestock rearing, fishing, wine tapping – all of which are virtually dependent on the natural environment (IFAD, 2010). Farmers in Nigeria are ordinary citizens who inhabit the agricultural and rural areas located outside towns and cities of the country, constituting up to 90% of Nigeria's rural population of about 79.5 million in the preceding one decade or so (World Bank, 2010, IFAD, 2010).

Conservation agriculture which is aimed at enhancing food security and sustainable use of agriculture resources was initiated by the Federal Ministry of Agriculture and Rural Development in collaboration with development partners and other agencies involved in agricultural development. This was targeted at farmers all over Nigeria and especially the Northern region that faces the challenges of desertification, drought and erratic rainfall. The conservation practices were also aimed at reducing the effect of heavy (machineries) which has led to formation of hard pan and destruction of soil structure. Though, agricultural mechanization has the potential of making farming operation less laborious and reducing the cost of production, the effect of this practice in the long-term especially on the soil that is cultivated continuously without a period of fallow is decrease in productivity.

This is because prolonged exposure of agricultural land to intensive cultivation by tractors has the tendency of causing structural degradation which can lead to formation of compaction and erosion.

Therefore, there is a need to augment the soil back. One of the ways to ensure this is by effectively utilizing conservation practices. Studies have explored and recommended conservation measures which can enhance soil fertility and increase crop yield sustainably in the wake of climate change (Kimaru-Muchai, *et al.*, 2020).

**Background of the Study**

Conservation practices involve the application of practices that are economically viable, socially acceptable, environmentally friendly and technically appropriate for the planting of arable crops; which in turn reduces soil erosion, increases soil fertility, increases soil organic matter and improve agricultural productivity (Alhassan and Abu, 2019). Conservation practices include conservation tillage, crop rotations, use of legumes in rotation, mulching, agroforestry cover cropping, use of manure as a part of a crop nutrient management plan, intercropping, precision agriculture, integrated pest management and other conservation nutrient management practices, strip cropping, Contour farming (Ahuchaogu *et al,* 2022; Gong, Bergtold and Yeager, 2021).

Several dimensions of massive land degradation in semi-arid areas led to low agricultural productivity and decreased food security and farm income (Ngoma, *et al.,* 2021). The problem of increased food insecurity is due to declining yields of food crops which are attributed to many causes that include: The use of conventional farming systems, low utilization of new technologies, decline in soil fertility, regular droughts, and low and erratic rains with uneven distribution (Arslan, 2017)

There are more noticeable consequences of farming systems today relative to the previous experience because of the growing call for agricultural practices that are sustainable and preserve the environment (Shrestha & Clements, 2003). To supply the needs of today without compromising the potentials of tomorrow, agricultural practices that aim to increase per capita productivity trend needs to be done sustainably. Sustainable agricultural practices have assumed a challenging dimension owing to hike in food prices and energy, changing climate, water shortage, degraded biodiversity including budgetary exigency (Laurett *et al*., 2021; AE AbdelRahman *et al.,* 2022) Moreover, population growth has risen with the demand for nutritious diet, water and other agricultural harvests thereby mounting more pressure on agricultural resources. Government and other proponents of development in advanced economies have advocated for food security by using practices that are sustainable (Kassam et al., 2009). Attaining food security in Nigeria is crucial, but has encountered economic and developmental challenges like deteriorating eating pattern, distress sales of assets to provide daily nutrition among the average families (Ajani, Adebukola & Oyindamola, 2006). Moreover, one of the Sustainable Development Goals (SDG) demands that no individual should go hungry regardless of their status. Programs such as Special Program for Food Security (SPFS), Root and Tuber Expansion program, Fadama development projects, community oriented agriculture and rural development projects and providing infrastructures have been established to ensure that Nigerians are food secure (Ojo & Adebayo, 2012). In spite of government's efforts to attain food security, the impact remains largely unfelt especially among the rural population who are primary producers. Then, efforts to simultaneously improve agricultural productivity and keep the system sustainable demands appropriate methods of land stewardship such as agricultural conservation.

The most essential benefits of conservation agriculture are increasing irrigation efficiency by reducing soil erosion and maintaining soil moisture content (Bondarovich *et al.,* 2021) and minimizing wind and water erosion using leaving agricultural crops' residues on the soil surface (Das *et al.,* 2020). Conservation agriculture also contributes to the management of energy consumption and reduction of environmental pollution (Nandan *et al.,* 2021), preserves soil nutrients, increases soil organic matter, reduces pests and diseases, and controls weeds using crop rotation (Pardo *et al.,* 2021).

These traditional agricultural methods/practices have been found to be the primary factors for ecological imbalance, environmental deterioration, erosion, food insecurity (Eheazu and Uzoagu, 2021), Therefore, adapting growing food demand to sustainable farming practices is one of the world's significant challenges (FAO, 2021; A.E AbdelRahman *et al*., 2022).

Sustainability is one of the main components of agricultural production that will lead to food security and the maintenance of production resources for current and future generations (2021; Valizadeh *et al*., 2022a). CA helps to maintain a safe environment and promotes sustainable agricultural production. It gives the opportunity to harvest higher crop yields at minimum production costs without degrading soil fertility and water. As such, cover crops aid CA system, not only to better soil characteristics but also to enhance the capacity for a prolific biodiversity. With this, farmers are more well-informed about mulching, though argument persist that mulching is only achieved using crop residues. Nonetheless, small farms produce small biomass which hinders them from the 30 percent recommended mulch cover to practice CA, other reports have suggested leaf litters and grasses as equally good materials. (Global assessments of agricultural land show some 106 million hectares under CA cultivation or in part no-till systems (FAO, 2021). The potential and the actual level of CA adoption by smallholder farmers has also been questioned (Brown et al. (2017). Limited access to land, informal land tenure systems , insufficient technical know-how , irregular extension services, difficult access to agricultural inputs and markets, and smallholders' impatient desire to quickly reap returns on the resources invested, are factors that deter the adoption of CA. Giller et al. (2009), argued that CA maybe profitable to farmers cultivating medium to large-scale automated farms, it is simply not cost effective for resource-poor farmers and their farming systems.

**Statement of Problem**

Agriculture in semi-arid regions like Damagum, Yobe State, is faced with significant challenges, including low soil fertility, erratic rainfall, and soil erosion. These challenges have led to declining crop yields, food insecurity, and reduced income for smallholder farmers. Conservation agriculture (CA), which includes practices such as minimum tillage, mulching, and crop rotation, has been recognized globally as a sustainable farming approach to address these issues. Despite the potential of CA to address issues like low crop yields and soil infertility, adoption in Damagum is limited. Understanding farmers' perceptions, socio-economic conditions, and institutional constraints is essential for developing effective strategies to encourage CA adoption.

**Objectives of the Study**

The main objective of the study is to assess farmers' perception of conservation agriculture and to identify various conservation agriculture practice available in the study area. The findings from study is significant because it helps to provides insights into farmers' perception and adoption of conservation agriculture practices. Lastly helps in contributes to the development of effective strategies for promoting conservation agriculture practices among farmers. The study focuses on specific aspects related to conservation agriculture (CA) practices, the farmers involved, and the geographical and thematic considerations. The study involves smallholder (Vegetable farmers) in Damagum as the primary participants. Both male

and female farmers, irrespective of their educational or socio-economic background, are included.

**Literature Review**

The adoption of CA system and practices in the field, involving both herbaceous and woody crops, bring multiple benefits in terms of the quantity and variety of soil mites, mainly in cereal crops, where they have been most studied. Several trials have shown that in CA fields, around 35% more of these beneficial organisms present, and many of them are efficient predators of harmful organisms. These values are even higher in CA systems with woody crops, with an increase of up to 85% in vineyards managed with groundcover, compared to those under conventional tillage and bare soil management. Bacteriophage nematodes presence helps to control plant diseases. CA brings clear benefits through an increase in these organisms. Several studies show that the adoption of CA in arable crop systems lead to an increase in the number of these creatures of between 14% and 21%. These values are much more conclusive for groundcovers in woody crops, where the improvement in the number of nematodes can be as high as 70% (Kienzle *et al*., 2013).

Soil fauna refers to living organisms that live and carry out their biological activity in the soil profile. They play a key role in maintaining soil health and are therefore essential for ensuring that agricultural ecosystems are productive and regenerative. Within the soil fauna, there are key organisms that allow identification of soil quality in relation to the variety and quantity of soils, such as soil mites, nematodes, springtails, and earthworms. To make CA techniques more accessible to smallholder farmers, there is a need for technical and business management training of entrepreneurs focused on developing and delivering locally adapted agricultural equipment. Such training must recognize that 70% of smallholder farms in SSA rely exclusively on manual labor, and only about 10% uses engine powered sources (Corbeels *et al*., 2014). Draught animals contribute to the remaining 20-25 % of farm power supply.

The Conservation Agriculture (CA) system and its practices pay special attention to maintaining a healthy ecological base to underpin sustainability, promoting biodiversity, and strengthening the resilience of the system. Farmland supports a wide range of wildlife, including vertebrates. Although many species depend on natural habitat for food and shelter, production areas provide essential forage and breeding habitat for many species (Holland, 2004). CA supports small vertebrate biodiversity in different ways. For example, crop biomass cover including stubble provides cover in winter and breeding habitat in spring. Crop biomass and weeds, if allowed to remain after harvest, provide seeds that serve as food. The increase in soil organic matter favours the biodiversity of arthropods that can serve as food. Avoiding or minimizing mechanical soil disturbance maintains burrows that may be established in crop fields. Undisturbed soil conditions also provide the best possible environment for biodiversity to reach its full potential. Tillage does not exist in nature; nature has evolved to thrive in the least disturbed soil possible (Day et al., 2020).

**Farmers' Perception of Effectiveness of Adaptation Strategies to Climate Change in Northwestern Nigeria**

World over, climate change has become one of the greatest challenges threatening the existence of all living organisms. The phenomenon brings about changes in the weather patterns which pose serious environmental problems to man and the rest of the ecosystem. It upsets the seasonal cycles, hampers water supply, affects agriculture and farming systems as well as the general food production and causes sea levels to rise. Climate change has also caused floods, landslides, drought, and famine, among many other challenges (Intergovernmental Panel on Climate Change [IPCC], 2007). Although, all evidences have established a global impact of climate change, the effects are being felt more by developing countries, especially those in Africa (Nigeria inclusive) due to their poor social and economic capacity to cope adequately with the change (Oyekale, 2015).

Climate change has been defined by IPCC (2007), as a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that can persist for an extended period typically decade or longer. Climate change is caused by two major factors; the biophysical/biogeographical and human (anthropogenic) activities. The biogeographical factors are natural processes which include changes in the eccentricity of the earth's orbit, changes in the obliquity of the plane of ecliptic and changes in orbital procession while the human factors are urbanization, population explosion, industrial development, widespread use of land, broad scale deforestation, major technological and socio-economic shifts with reduced reliance on organic fuel and accelerated uptake of fossil fuels (Odjugo, 2010).

Agricultural production is generally controlled by many factors including the genetic characteristics of crops and livestock, soils, climate, among others. Out of all these factors, agricultural production is mostly dependent upon climate particularly in developing countries. Any disruption to the climate will severely affect the agricultural system (Danbaba, 2007). The entire agricultural processes and food systems, such as soil and water resources, crop, livestock and poultry production, among others, are therefore, very sensitive to climate change (Antle, 2010). Nigeria (North-western region inclusive) as a developing country is plagued by myriad impacts of climate change on agricultural development (Farauta, *et al*, 2011).

With the great challenges of climate change on agriculture, there is need to manage its impact either through mitigation or adaptation strategies. Adaptation strategy is the ability of a system to adjust to climate change (including climate variability and extremes), moderate potential damage, and take advantage of opportunities or cope with the consequences (IPCC, 2001). Studies have proven that climate change will continue to be problematic to agricultural production, unless appropriate adaptation measures are employed. With suitable adaptation strategies therefore, vulnerability of agriculture to climate change can be reduced greatly and numerous opportunities can be enhanced (Smit & Skinner, 2002). Several adaptation strategies to the impact of climate change on agriculture in the semi-arid region of Nigeria (including the North-western region), have been suggested by Adeshina & Adekunle, (2011) as provision

of accurate and timely weather forecasting, enhancing agricultural extension services, expanding and optimizing existing irrigation infrastructures, among others.

With increasing concern about the deepening effects of climate change on agriculture over the years, several studies have been carried-out about the impact, causes, effects and possible adaptation strategies to the problem in Nigeria (e.g. Abiodun & Olabimpe, 2007). However, little or no attention have been paid to deeply study the effectiveness of the adaptation strategies in helping farmers cope adequately with the effects of climate change particularly in the North-western Nigeria. The interests of most of the previous studies were on establishing the numerous adaptation strategies employed by farmers with little attention on the most effective coping strategies applied for crop production by farmers in the region. It is therefore imperative that empirical study is carried out to ascertain the effectiveness of adaptation strategies used by farmers in coping with the impacts of climate change which this study focuses on using North-western Nigeria as a case study. This will be achieved by examining the effects of climate change in North-western Nigeria and assessing farmers' perception of the effectiveness of adaptation strategies to climate change in the study area.

**Factors Influencing Awareness and Adoption of Conservation Agricultural Practices**

The level of adoption of an innovation is determined by a combination of factors. Many of these factors are socio-economic while others are institutional in nature. Socio-economic factors are the demographic variables of the farmers such as age, sex, education, size of his farm, his level of income etcetera. The institutional factors are the circumstances that prevail around the farmers such as membership of organization, effectiveness of the extension agents involved in the extension farmer-input-linkage services. Okunade, (2006) found that the communication ability of change agent influenced the know-how and adoption of improved farm practices among women farmers in Osun State, Western Nigeria. The level of support in form of subsidies and loans that the farmers enjoy also goes a long way in influencing the willingness of the farmers to seek information about any practice with the aim of adopting it. Characteristics of the innovation are other factors that determine the adoption level of such innovation. These include observability, cost, relative advantage, compatibility, triability and complexity of the recommendations (Van Den Ban and Hawkins, 1988).

Technologies such as conservation agricultural practices cannot lead to increase in food productivity if the farmers are not knowledgeable in the various component areas of the package and are ready to adopt the practices. In his own submission, Yau (2005) reported that the poor trend of conservation agriculture practices as reflected in Northern Nigeria was a result of the perception that farmers had about the practices which again boiled down to the poor knowledge among the farmers of what the programme portends. Apart from being an acquired construct, knowledge also has other attributes as it can be measured, changed and transferred. Change in knowledge may occur if an individual is persuaded or influenced by others or if that person acquires new experiences about the issue in question. Knowledge goes a long way in influencing behavioural pattern of an individual. This is supported by Ezeiburo

*et al.* (2008) in their studies among cassava farmers in Abia State, Nigeria. They inferred that poor knowledge is a major contributor to low uptake of innovations among farmers. Jibowo (2004) identified four main methods through which knowledge can be acquired. These are authority, personal experience, reasoning and scientific methods.

Adeniji (1996) identified age, education, farm size and income as some of such variables that affect adoption. Also, in their study of farmer's involvement in agricultural activities in Borno State, Gwary *et al.* (2008) found a significant relationship between the farmers' agricultural activities and their social-economic variable such as family size, annual income and number of years of involvement in farming. The adoption of conservation practices being a package that seeks to replace the farmers' old practices will depend on the awareness and knowledge level of the farmer and his ability to try the practices on his own farm. Maiangwa (2006) in his study of socio-economic variables associated with adoption of agro-forestry in the north-west zone of Nigeria found that level of education, labour availability, farm size, land security, access to credit affect the rate of adoption of the innovation. Furthermore, adoption of innovation can be likened to abandoning the known for the unknown and therefore involves some level of risk on the part of the farmers. The extent to which this risk will be taken will largely depend on the level of formal education of the farmer and his income as resource poor farmers will not invest their finance on practices that they are not thoroughly knowledgeable about.

The process of adoption of improved farm practices is a complex one which involves a sequence of thoughts and actions (Anthony, 2007). It is a mental process which will ultimately lead to making a choice by an individual as he goes through the journey from first hearing about a new idea to the complete and full incorporation of the idea into the total system of his behaviour. This is a journey under uncertainty which begins from the point at which the farmer becomes aware through the point of development of interest, mental evaluation, trial before adoption. This exercise may terminate at any point on the continuum if the farmer becomes disillusioned due to lack of knowledge or not being very sure of what the outcome of his new venture will be. It is during this period that socio-economic factors of the farmer bring their pressure to bear on the farmer as he tries to make up his mind on whether or not to adopt a given innovation. Another factor that may determine the type and level of risk that a framer may be willing to take is age. Farmers that are still relatively young in age tend to take more risks than old farmers as they are still more agile and ambitious. Adeola, *et al.* (2008) found that as farmers increase in age, their enthusiasms to participate in new programmes dwindle. This inference was drawn from the negative correlation that they discovered between age and adoption in their studies among cassava farmers in Oyo State.

**Types of Conservation Agriculture**

According to FAO 2014, the idea of minimizing soil disturbance was introduced in the 1930's as a soil conservation system to counter the Dust Bowl in the United States, but the term "conservation agriculture" was not coined until the 1990s. Only recently has CA been

promoted on the basis of its climate adaptation and mitigation benefits. CA is now widespread in parts of the Americas, as well as Australia. In the tropics, Brazil has the longest experience with CA, where the principles have been practiced since the 1970s and CA now covers over 25 million hectares. CA spread from Brazil to other South American countries, and is widely practiced in Paraguay and Uruguay as well. African farmers have adopted CA in the last 15 years, but at slower rates. Little data is available on adoption in Asian countries.

a. **Minimum or No-Tillage Agriculture:** This is a types of agricultural practice where the Farmers reduce or eliminate plowing, leaving crop residues on the soil surface to improve soil structure and moisture retention. Benefits of such practice were; Reduces soil erosion and compaction, enhances water infiltration and retention, Improves soil organic matter and microbial activity. Challenges of such a practice were; Initial high costs of no-till equipment, requires herbicide use for weed control in early stages (Cane, 2008).
b. **Cover Cropping:** This is a types of agricultural practice where the Farmers Growing specific crops (e.g., legumes, grasses) between main crop cycles to protect and enrich the soil. Benefits of such practice were; Reduces soil erosion and suppresses weeds, enhances soil fertility by fixing nitrogen (especially legumes), Improves biodiversity and reduces pest outbreaks. Challenges of such a practice were; Additional cost of seeds and management, may compete with cash crops for water and nutrients if not well-managed (Ramírez-García et al., 2015).
c. **Crop Rotation and Diversification:** This is a types of agricultural practice where the Farmers had an Alternating different crops in the same field across seasons to maintain soil fertility and reduce pest and disease buildup. Benefits of such practice were; Reduces reliance on chemical fertilizers and pesticides, improves soil structure and nutrient cycling, Enhances resilience to climate change. Challenges of such a practice were; requires careful planning and market demand for alternative crops, some farmers may lack knowledge of effective rotation schedules (Mupangwa, *et al.* 2017).
d. **Agroforestry:** This is a types of agricultural practice where the Farmers had an Integrating trees, shrubs, and crops in the same farming system to enhance ecological balance. Benefits of such practice were; Increases carbon sequestration and reduces greenhouse gases, provides additional sources of income (fruit, timber, fodder), Improves soil fertility through nitrogen-fixing trees. Challenges of such a practice were; Takes time for trees to mature and provide benefits, may require more labor and knowledge to manage effectively (Akinnifesi, *et al* 2011).
e. **Mulching:** This is a types of agricultural practice where the Farmers had to Applying organic (straw, leaves) or synthetic (plastic sheets) materials to cover the soil surface. Benefits of such practice were; Reduces evaporation and retains soil moisture, prevents weed growth and soil erosion, improves soil organic matter as organic mulch decomposes. Challenges of such a practice were; Takes Requires labor to apply mulch regularly, Organic mulch may attract pests if not properly managed (Erenstein, 2002).

f. **Integrated Soil Fertility Management (ISFM):** This is a types of agricultural practice where the Farmers had to Combining organic (compost, manure) and inorganic (fertilizers) soil amendments to optimize nutrient availability. Benefits of such practice were; Balances nutrient supply for crops, enhances soil microbial activity and long-term fertility, Reduces dependency on chemical fertilizers. Challenges of such a practice were; Access to organic materials may be limited, requires knowledge of proper application methods (Bilalis et al., 2003).

**Level of Adoption Conservation Agriculture among Farmers**

Agricultural production remains the main source of income for rural communities in sub-Saharan Africa, providing employment for more than 60 percent of the population and contributing about 30 percent of the region's gross domestic product (Musa, 2021). With likely long-term changes in rainfall patterns and shifting temperature zones, climate change is expected to significantly affect agricultural production, which could be detrimental to the region's food security and economic growth. According to the Intergovernmental Panel on Climate Change (IPCC) (2007), the relationship between agriculture and climate change is a topic of increasing concern. Amid climate change projections, global agricultural production is expected to decline, posing a threat to global food security (Ogbeide-Osaretin and Olotu 2022). However, it is also important to note that agriculture accounts for a significant portion of global emissions each year, increasing as production is intensified or expanded to meet rising demand. Furthermore, it is estimated that up to 80 percent of global deforestation is attributable to agriculture (Kissinger *et al*., 2012; Elizabeth, *et al*., 2017).

The IPCC Fourth Assessment Report projects that climate change could reduce yields by up to 50 percent in some high-risk regions, including sub-Saharan Africa (Elizabeth, *et al*. 2017). According to this report "warming in Sub-Saharan Africa (SSA) is expected to be greater than the global average and rainfall will decline in certain areas. Also, cereal production growth for a range of crops in SSA is projected to decline by a net 3.2 percent in 2050 as a result of climate change".

Climate-Smart Agriculture (CSA) therefore represents a set of strategies that can help combat the above stated challenges of climate change by increasing resilience to weather extremes, adapting to climate change and decreasing agriculture's greenhouse gas (GHG) emissions that contribute to global warming (Steenwerth *et al*. 2014). Climate variability and extremes are a major cause of increased food insecurity, with impacts affecting all aspects of food security (Tripathi *et al*., 2016). Therefore, climate change will not only lead to lower food production and availability, but also lower food quality (Alehile *et al*., 2022; Tripathi *et al*., 2016). Smallholder farmers are one of the most vulnerable groups to climate change and variability. Climate change leads to wearing out of all efforts made by farmers in savings and resources accumulation. Mutabazi and others. (2015) argued that households lacking effective risk prevention are more likely to be more vulnerable to poverty and other vulnerability traps.

Food production is expected to increase by 60% to meet increased food demand, a target that cannot be achieved through normal responses to climate change (FAO, 2013). Therefore, farmers should take adaptation measures to minimize the impact of climate change. These adaptive strategies must result in increased food production without depleting natural resources. One of the most important strategies for sustainable food production is climate-friendly agriculture. It is defined as "agriculture that sustainably increases productivity and resilience (adaptation), reduces/removes greenhouse gases (mitigation), and improves national food security and achievement of development goals". (FAO, 2013). The CSA's goal is not to introduce new sustainability principles, but to integrate the details of adaptation and mitigation into sustainable agricultural policies, programs and investments (Lipper & Zilberman, 2017).
Oyawole *et al*., (2020) examined women empowerment and adoption of climate-smart agricultural practices in Nigeria. Using the empowerment score and women empowerment gap for each household which were derived from the Abbreviated Women's Empowerment in Agriculture Index, a multivariate probit model which controlled for the influence of gender and women empowerment on climate-smart agricultural practices' adoption was estimated. The study made use of data from the ECOWAS-RAAF-PASANAO survey conducted in Nigeria in 2017. The results show that men are significantly more empowered than women in four out of the five domains of empowerment and are more likely to adopt crop rotation. However, female plot managers have a higher likelihood of adopting green manure and agroforestry, while no significant gender differences in the adoption of organic manure and zero/minimum tillage were found.
Nugun *et al*., (2021) determined the impacts and barriers to adoption of climate-smart agriculture (CSA) practices in North-Western Nigerian drylands. Mixed methods design was employed with thirty smallholders per community selected from a baseline study of 220 smallholders from the two study communities. Smallholders were engaged in a farmer participatory learning and action (PLA) on CSA adoption for resilience. Impacts of PLA were evaluated six months' post-implementation and barriers for adoption explored. Pre- and post-PLA training indicated a change in confidence to adopt some CSA practices. Both communities showed greater confidence ($p < .05$) related to solving climate-related problems and the use of fertilizer. Communities differed in relation to other factors: Kofa exhibited improved confidence (71.4%) in solving water challenges while Zango showed greater confidence (76%) in relation to solving environmental problems. They found gender-responsive CSA promote women participation in farming.

**Study Area**

The study area is predominantly agricultural, with most residents engaged in farming, livestock production, and trading. The main crops grown in the area include maize, sorghum, millet, and cowpeas. Livestock production is also common, with many residents keeping cattle, goats, and sheep. Agriculture is the backbone of Damagum economy, providing livelihoods for the majority of the population. Farmers sell their produce (e.g., grains,

vegetables, and livestock) in local markets. Livestock markets are a major attraction, with traders from other parts of Nigeria coming to buy and sell animals. Many women and youths engage in small-scale trading of goods such as foodstuffs, clothing, and household items. The town's strategic location along a major road makes it a transit point for goods and people, creating opportunities for transportation-related businesses. Activities such as milling grains, processing dairy products, and making local snacks (e.g., masa, kilishi) are common. Some residents engage in crafts like pottery, weaving, and blacksmithing, producing items for local use and sale. Many households operate small shops or stalls selling basic goods like soap, sugar, and cooking oil. Primary and secondary schools provide basic education, but access to quality education is limited.

Damagum is a Local Government Area (LGA) in Yobe State, Nigeria. Geographic Coordinates of Damagum is located around Latitude: 11.7333° N, Longitude: 11.9667° E. Damagum is, approximately 60 kilometers southeast of Damaturu the state capital Region, Yobe State is located in the Northeastern part of Nigeria, within the Sahel region. Nearby Towns and Cities of Damagum; Damaturu (state capital), Potiskum, Fika and Gashua. The study area has a semi-arid climate with two distinct seasons: a wet season that lasts from May to October, and a dry season that lasts from November to April. The average annual rainfall is around 600 mm, with temperatures ranging from 22°C to 40°C. Tropical savanna climate with distinct wet and dry seasons. Rainfall is limited and often erratic, making agriculture challenging. The vegetation is predominantly Sahel, with scattered shrubs, grasses, and occasional trees adapted to arid conditions. The terrain is generally flat, with sandy soils that are prone to erosion and degradation.

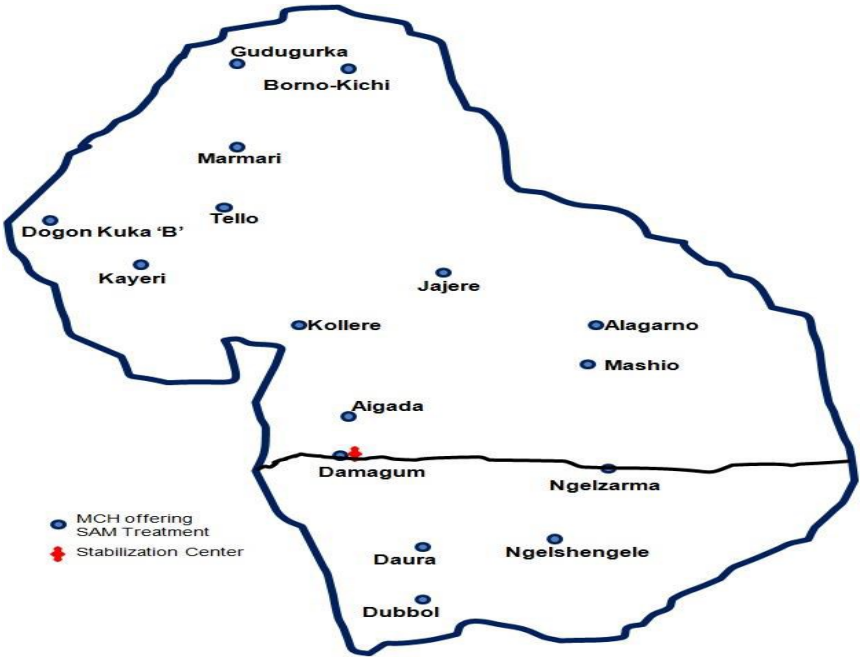



**Figure 1: Map showing the study Area**

**Sampling Procedure**

According to the 2006 census, the population of Damagum Local Government Area is approximately 120,000 people. However, this number is likely to have increased since the last census. The instrument of data collection for this research is both closed & open ended questionnaire. This was carefully designed for collection of data in accordance with the specification of the research questions. The closed ended questionnaire was divided into two (2) part; one (a) contain demographic information of the respondent, while the second part (b) contains items that are related to the objective of the study while the open ended questionnaire allow the respondent to provide answers in the space provided.

A research design is a systematic plan to study a scientific problem. The design of a study defines the study type (descriptive, correlational, semi-experimental, experimental, review, meta-analytic) and sub-type (e.g., descriptive-longitudinal case study), research question, hypotheses, independent and dependent variables, experimental design, and, if applicable, data collection methods and a statistical analysis plan. Research design is the framework that has been created to seek answers to research questions.

Burns and Grove (2003) define a research design as "a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings. Parahoo (1997) describes a research design as "a plan that describes how, when and where data are to be collected and analyzed". The study adopts a mixed-methods approach, combining qualitative and quantitative data collection methods to gain a comprehensive understanding of farmers' perceptions and adoption of CA.

**Source of Data**

Both primary and secondary data were used for this study. The primary data were obtained using questionnaire. The administration of the questionnaire required respondent to provide responses and were recorded accordingly. Secondary data was obtained from published material, journals, books etc. and relevant information was extracted from records of pass projects.

**Method of Data Analysis**

The data collected will be analyzed for the study by using both descriptive and inferential statistics tools such as frequency distribution, percentage and chi-square analysis. The general formula for simple percentage are shown below:

**Percentage**

$$\frac{\textbf{Total number of people agreed}}{\textbf{Total number of the respondents}} \textbf{ X } \frac{\textbf{100}}{\textbf{1}}$$

**RESULTS**

**SECTION A: DEMOGRAPHIC INFORMATION**

**Table 1: Demographic Characteristics**

| Demographic variables | Frequency | percentage |
|---|---|---|
| **Age range** | | |
| **18-30** | 25 | 25% |
| **31-40** | 30 | 30% |
| **41-50** | 20 | 20% |
| **51 and above** | 25 | 25% |
| **Gender** | | |
| **Male** | 55 | 55% |
| **Female** | 45 | 45% |
| **Education type** | | |
| **Formal Education** | 82 | 82% |
| **Non-formal Education** | 18 | 18% |
| **Educational level** | | |
| **Primary Education** | 9 | 9% |
| **Secondary Education** | 31 | 31% |
| **Tertiary** | 60 | 60% |
| **Farm Size (Acres)** | | |
| **1-2 Acres** | 15 | 15% |
| **3-4 Acres** | 25 | 25% |
| **5-6 Acres** | 40 | 40% |
| **7 and Above** | 20 | 20% |
| **Experience (years)** | | |
| **1-5 Years** | 26 | 26% |
| **6-10 Years** | 29 | 29% |
| **11-15 Years** | 18 | 18% |
| **16 and Above** | 27 | 27% |
| **Source of income** | | |
| **Farming** | 55 | 55% |
| **Trading** | 19 | 19% |
| **Civil Servant** | 16 | 16% |
| **Other** | 10 | 10% |

**Source: field survey, 2025**

The above Table 1 revealed, that the majority of responders 30 (30%) are at the age group of 31 – 40 years, while 25 (25%) are at the age group of 18 – 30 years, 25 (25%) are at the age group of 61 and above years respectively, 20 (20%) are at the age group of 41 – 60 years. This indicate that the sample is fairly evenly distributed across age groups, with a slight increase in

the 31-40 age range. This may indicate that conservation practices are being considered by farmers across different age categories, but potentially with more interest among those in their 31 – 40 years. The Above Table 1 revealed, that Majority of the respondents are 55 (55%) are Male, these finding as supported by the view of (Oyetunde-Usman *et al*., 2021) men were more likely than women to use agroforestry. This prediction backs up prior research that males control farming resources and, as a result, easily embrace practices that require more resources, while 45(45%) of the respondents are Female. The gender distribution is relatively balanced, with a slight male majority. The percentage of female farmers engaging in conservation practices is notable and may suggest that women are equally invested in farming practices like conservation agriculture.

**The Above Table 1 revealed that Majority 82 (82%) of the Respondent, have Attended Formal Education, while 18 (18%) have not Attended Formal Education**. Most respondents who pursued formal education, which may imply that they are more likely to be exposed to or understand modern agricultural techniques, including conservation agriculture. **The above Table 1 revealed that Majority 60 (60%) of the Respondent have attendant** Tertiary **education, while 31 (31%) of the Respondent have attendant** Secondary **education, 9 (9%) of the Respondent have attendant** Primary**, education respectively.** The highest level of education varies, with a substantial portion having completed secondary education or higher. Higher education levels may lead to greater awareness of the importance of sustainable farming practices, including conservation agriculture. The above Table 1 revealed that majority 40 (40%) of the respondents have (5 – 6) Acres of land. These findings correspondingly with findings of Deininger et al. (2008) found that farm size was substantially connected to the likelihood of investing in conserving soil and water. As a result, a farmer with a larger farm has more financial resources and greater area to devote to enhancing technology adoption. They can also purchase more advanced and sophisticated technologies, as well as the ability to bear risk if the equipment fails to function properly. While 25 (25%) of the respondents have (3 - 4) Acres of land, 20 (20%) of the respondents have (7 and above) Acres of land and 15 (15%) of the respondents have (1 - 2) Acres of land. The majority of farmers have moderate-sized farms (3-6 acres), with a few owning larger farms (7+ acres). Larger farms might be more likely to implement sustainable practices, but smaller farms can also benefit from conservation agriculture.

**The above table 1 revealed that majority 29 (29%) of the respondents have 6 – 10 years of farming experience.** These finding as Correspondingly by the view of, Menale (2010) found that years of farming experience was associated with the adoption of numerous conservative agricultural practices (CAP) methods for the reason that it mirrors capital, which alleviates liquidity limitations in applying the practices. They discovered that farm houses with large farms have greater chances to use current technology than farmers with smaller farm sizes. **While 27 (27%) of the respondents have 16 years and above of farming experience, 26 (26%) of the respondents have 1 - 5 years of farming experience, 18 (18%) of the respondents have 11 – 18 years of farming experience** A diverse range of experience levels

is present, from new farmers to those with more than 15 years of experience. Experienced farmers might have different views on conservation agriculture due to their established methods, but they may also be more open to improvements. The above Table 1 revealed that majority 55 (55%) of the respondents indicate that farming is their primary source of income, 19 (19%) of the respondents indicate that Trading is their primary source of income, 16 (16%) of the respondents indicate that working in government is their primary source of income, and 10 (10%) of the respondents indicate that they have alternative source of income. Most respondents rely primarily on farming for their income, suggesting that they may be highly invested in practices that can increase their farm productivity and sustainability, such as conservation agriculture.

**SECTION B: PERCEPTION OF CONSERVATION AGRICULTURE PRACTICES**

**Table** 2: **Perception of Conservation Agriculture Practices**

| Variables | Frequency | Percentage |
|---|---|---|
| **Awareness of Conservation Agriculture** | | |
| **Yes** | 70 | 70% |
| **No** | 30 | 30% |
| **Perceived Benefits of Conservation Agriculture** | | |
| **Improved soil fertility** | 18 | 18% |
| **Reduced soil erosion** | 32 | 32% |
| **Increased crop yields** | 13 | 13% |

**Source: field survey, 2025**

The above Table 2 revealed that majority 70 (70%) of the respondents are aware of Conservation **Agriculture practice, while 30 (30%)** of the respondents are not aware of Conservation **Agriculture practice.** A majority of farmers have heard of conservation agriculture practices, which is a positive sign for its potential adoption. However, 30% of farmers are unaware, suggesting a need for more awareness campaigns. The above Table 2 revealed that majority 32 (32%) of the respondents indicated that **Conservation Agriculture practices helps to reduced soil erosion,** these finding as supported by the view of (ACT, 2005) conservation agriculture also adopts pragmatic approaches to minimize soil erosion, reconstitute the organic matter, maintain soil moistness and fertility**, 18 (18%)** of the respondents indicated that **Conservation Agriculture practices helps to improved soil fertility, 13 (13%)** of the respondents indicated that **Conservation Agriculture practices helps to increase crop yield and 7 (7%)** of the respondents indicated that **Conservation Agriculture practices helps in many ways in other gain more profit and output.** The most valued benefits are reduced soil erosion (32%) and improved soil fertility (18%), which highlights the need for practices that address these issues. Increased crop yields were also mentioned but less frequently Nyathi & Minde (2010) opined that keeping soil unexposed is among the primary principle of **Conservation Agriculture**. As such, cover crops aid

**Conservation Agriculture** system, not only to better soil characteristics but also to enhance the capacity for a prolific biodiversity.

**Summary**

The main practices of Conservative Agriculture system such as no-tillage and groundcovers benefit small mammal fauna. The principle of no or minimum soil disturbance, implemented in annual crops through no-tillage practices prevents the destruction of burrows, thereby promoting small mammal populations. Similarly, maintaining a continuous soil cover with crop biomass and cover crops, provides shelter and food due to the increased seed availability and soil improvement, which enhances the supportive fauna that serves as food. Crop diversity and rotation introduce heterogeneity and complexity to the agricultural landscape, resulting in flora biodiversity, including root system diversity. This also favour fauna biodiversity by providing various habitats for species diversification. Studies reflect the ecosystem services provided by the enhanced biodiversity of small mammal fauna, such as weed seed predation and the control of certain crop pests. However, Conservative Agriculture system can promote an increase in small mammal abundance, particularly in annual crops, which could potentially lead to infestation. The rise in bird predator diversity and abundance in Conservative Agriculture system can contribute to population control, as well as incorporating cover crop species that aid in small mammal population control due to their lower palatability. With woody crops, the risk of infestations is lower in mature tree plantations. While there might be a risk of damage to roots and seedlings in young populations, this could also be managed by implementing groundcovers species and mulches that help control small mammal populations. Moreover, mulching and groundcovers enhance predator populations, further contributing to small mammal control.

**Conclusion**

The study highlights the potential of Conservative Agriculture to address agricultural and environmental challenges in Damagum. However, adoption remains low due to various socio-economic and institutional barriers. Addressing these challenges requires a multi-stakeholder approach to promote Conservative Agriculture effectively.

**Recommendations**

Based on the findings of the research the following recommendations were made;

1. **Awareness Campaigns:** Conduct targeted awareness campaigns to educate farmers on the principles, benefits, and long-term impacts of Conservative Agriculture practices. Use farmer-to-farmer demonstrations and media platforms to reach more farmers.
2. **Capacity Building and Extension Services:** Strengthen agricultural extension services by increasing the number of trained personnel and improving their accessibility to remote areas. Provide hands-on training programs for farmers to ensure proper implementation of Conservative Agriculture techniques.

3. **Financial Support and Subsidies:** Offer subsidies or grants to reduce the high initial costs associated with Conservative Agriculture adoption, such as purchasing cover crops, mulch, and no-till equipment. Facilitate access to microcredit and agricultural loans tailored to smallholder farmers.
4. **Policy and Institutional Support:** Develop and implement policies promoting sustainable agriculture practices, including Conservative Agriculture Partner with NGOs and international organizations to provide technical and financial support for Conservative Agriculture adoption.
5. **Addressing Cultural Barriers:** Work with community leaders and farmer associations to address cultural resistance and emphasize the compatibility of Conservative Agriculture with local practices.
6. **Improving Market Access:** Develop infrastructure and policies to connect farmers to local and regional markets, incentivizing the adoption of sustainable practices that can enhance crop quality and quantity.

**Suggestions for Further Studies**

Based on the findings of the studies the following suggestion for further studies were made in other to address these areas, future research can provide deeper insights into how to overcome the barriers to Conservative Agriculture adoption and enhance its effectiveness in promoting sustainable agriculture in Damagum and beyond;

1. **Longitudinal Studies:** Conduct long-term studies to measure the impacts of Conservative Agriculture adoption on soil health, crop yields, and farmers' livelihoods over several years.
2. **Cost-Benefit Analysis:** Perform a detailed cost-benefit analysis of Conservative Agriculture practices to provide farmers and policymakers with evidence of its economic feasibility.
3. **Climate Change Adaptation:** Examine the role of Conservative Agriculture in improving farmers' resilience to climate change, particularly in semi-arid regions like Yobe State.
4. **Regional Comparisons:** Compare Conservative Agriculture adoption rates and factors influencing adoption in Yobe State with other regions in Nigeria to identify best practices and scalable solutions.

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