POTENTIAL ROLE OF TRADITIONAL AGROFORESTRY IN CLIMATE CHANGE MITIGATION IN RURAL COMMUNITIES OF OYO STATE, NIGERIA

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Abstract
Traditional agricultural lands have potentials to sink and absorb large quantities of carbon through the trees originally present on the land as well as those introduced. Thus, agroforestry is becoming widely recognised not only in terms of agricultural sustainability but also in issues related to climate change adaptation and mitigation. In this study, farmer's awareness and participation in agroforestry practices as well as their knowledge of the importance of trees in mitigating the impacts of climate change were assessed. Two communities were randomly selected in two local government areas (LGAs) (Atisbo and Saki East), located in the dry woodland savannah region of Oyo State, Nigeria. In each community, 11 farmers were selected and administered questionnaires. The data were analysed using descriptive statistics. Sixty eight percent of the respondents identified that trees were present on their farms even before they started cultivation, while 31% only cultivated arable crops. Most of the farmers were interested in planting more fruit trees (29%), than timber species (11%) while, others were willing to plant both fruit and timber species (20%). However, 47.7% of the farmers as against 52.7% mentioned that trees tend to compete with arable crops if not pruned regularly. A large number of the respondents (77%) confirmed their awareness of the impacts of climate change on the larger environment, but 58% mentioned that climate change was not adversely affecting farming activities. In addition, only 18% of the respondent did not accept that trees could help in mitigating the impacts of a changing climate on the environment. *Vitellaria paradoxa, Parkia biglobosa* and *Gmelina arborea* were the most common tree species found in the farms. Farmers required more intervention from government and research organisations in climate change education, provision of seedlings, subsidies and infrastructure for them to be motivated to increase tree populations on their farmlands.

Key words: adaptive management, climatic variation, farm forest, rural farmers
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Introduction

Agroforestry has been proposed as a natural resource/ land use management system that provides workable solutions to land and forest degradation as well as biodiversity loss in the tropics. It is a dynamic and ecologically based effort to integrate trees in farming and livestock production in order to achieve species diversity and sustainability of production thus increasing social, economic, and environmental benefits (Leakey *et al.*, 2006; Oke and Odebiyi, 2007). Traditional agroforestry systems are farming systems in which

planted trees or stands present on the land before farming commenced, have been integrated as part of the socio-economic and ecological agro-ecosystem. This agroforestry practice support natural resource conservation through in situ conservation of trees; reduce pressure on remnant forests and create suitable habitats for plants and animals on farmlands. Traditional agroforestry practices have been successfully used for adaptation of environments and ensure food security for local people (Odebiyi *et al.*, 2004; Conroy *et al.*, 2011).

Traditional agroforestry systems provide an opportunity for sequestering carbon thus potentially mitigating the impacts of climate change and enhancing the adaptive capacity of agricultural systems in tropical and subtropical regions. One of the major aims of current agricultural research is to increase the productivity and resilience of agricultural systems. As a matter of fact, the ability of a system to increase productivity relates directly to the ability of such a system to accumulate and retain carbon. The integration of trees would potentially improve the resilience of agricultural systems and largely increase the capacity of such systems to cope with adverse climatic variability (Albrecht and Kandji, 2003; Jose, 2009).

Developing countries are more prone to the impacts of climate change because of their low capacity for adaptation. Particularly, the Nigerian agricultural sector is vulnerable and relies mainly on natural factors, putting rural populations at risk. Climate change is a threat that might affect the country's ability to meet urgent rural development demands including the improvement of food security, poverty reduction, and provision of an adequate standard of living for the growing population (Ayinde *et al.*, 2011; Olajuyigbe *et al.*, 2013).

There has been a major emphasis on improving the productivity of agricultural systems as well as increasing soil carbon stocks in degraded lands through enhanced productivity. Agroforestry provides a unique opportunity to reconcile the objectives of mitigation of and adaptation to climate change (Kandji *et al.*, 2006; Jose, 2009). However, the amount of carbon sequestered in agroforestry systems depend largely on the physical structure and function, environmental and socio-economic factors, choice of tree species as well as management decisions (Albrecht and Kandji, 2003).

This study examined the potential role of traditional agroforestry practices in climate change mitigation as well as the awareness of rural farmers on the contribution of trees to ecosystem functioning in two local government areas of Oyo State, south-western Nigeria.

Methodology

The study was carried out in Atisbo and Saki East Local Government Areas (LGAs) in the north-western part of Oyo State, Nigeria. The Atisbo LGA (Latitude 8° 18'N and

Longitude 3° 13'E) has eight major communities which are: Ago-are, Agunrege, Tede, Irawo, Sabe, Baasi, Ofiki and Owo communities; while Saki East LGA (Latitude 8° 11'N and Longitude 3° 23'E) has five major communities which are: Ago-Amodu, Sepeteri, Ogbooro, Oje-Owode and Agbonle. The population of Atisbo and Saki East LGAs were estimated at 110,792 and 110,223, respectively by the 2006 National Population Census. The study areas are located in the dry woodland savannah ecological zone with a predominantly agrarian population and some mining activities where precious stones such as tourmaline and tantalite are extracted.

Two communities (Sabe, Baasi; Ago-Amodu and Oje-Owode) were randomly selected from each LGA and then questionnaires were administered to 11 farmers in each community. The data collected were analyzed using descriptive statistics. Information were sought on demographic and social status of the respondents, access and ownership of land, presence and benefits of trees on farms and the farmers knowledge on the impact of climate change. Chi-square analysis revealed there were no significant differences in the response of respondents from the four communities; therefore data were pooled before analysis.

Results and Discussion

A vast majority of the farmers were male (97.7%) and above middle age (56.8%) with the oldest farmer (70 years old) interviewed, still actively involved in farming (Table 1). Age is a crucial factor in agricultural production, with the expectation that younger farmers would be more productive than more elderly ones. A previous study revealed that labour availability was a major problem and most communities had an aging farming workforce (Ademola *et al.*, 2012). This could be attributed to the continuous migration of younger men and women to cities in search of other jobs.

Farming is a male dominated activity in this region (see Table 1) because most women are involved in processing and marketing of food and fruit products such as cassava flour, yam flour, honey, groundnut oil, shea butter (*Vitellaria paradoxa* Gaertn. F.) and locust beans (*Parkia biglobosa* (Jacq.) Benth.) (Ademola *et al.*, 2012; Jimoh and Asinwa, 2012). Most of the farmers (90.91%) were married and responsible for large households (for example, one farmer was the head of a family with over 50 members). These large households provide labour support and make farming activities less tedious. A high number of children are an indication of family wealth in rural areas. These children provide an added labour advantage for increased agricultural productivity (Matanmi *et al.*, 2011; Ademola *et al.*, 2012).

A greater proportion of the farmers interviewed had no formal education (52.27%) and this may limit the ability of respondents to access information, understand and adopt new

innovation. However, none of the respondents had problem with accessing land with most farmers inheriting their farmlands through ancestral lines (Table 1).

Table 1 Distribution of personal characteristics, educational attainment and land access of respondents (n= 44 respondents)

Variables	Frequency	Percentage %
Age		
<20	1	2.27
21-40	6	13.6
41-50	12	27.27
>51	25	56.8
Sex		
Male	43	97.73
Female	1	2.33
Marital Status		
Single	3	6.82
Married	40	90.91
Widowed	1	2.27
Educational Attainment		
None	23	52.27
Primary	13	29.55
Secondary	6	13.64
Tertiary	2	4.55
Household Size		
1-3	0	0
4-6	5	11.36
>6	39	88.64
Access to land		
By Inheritance	27	61.36
By rent or lease	3	6.82
Gift	14	31.82

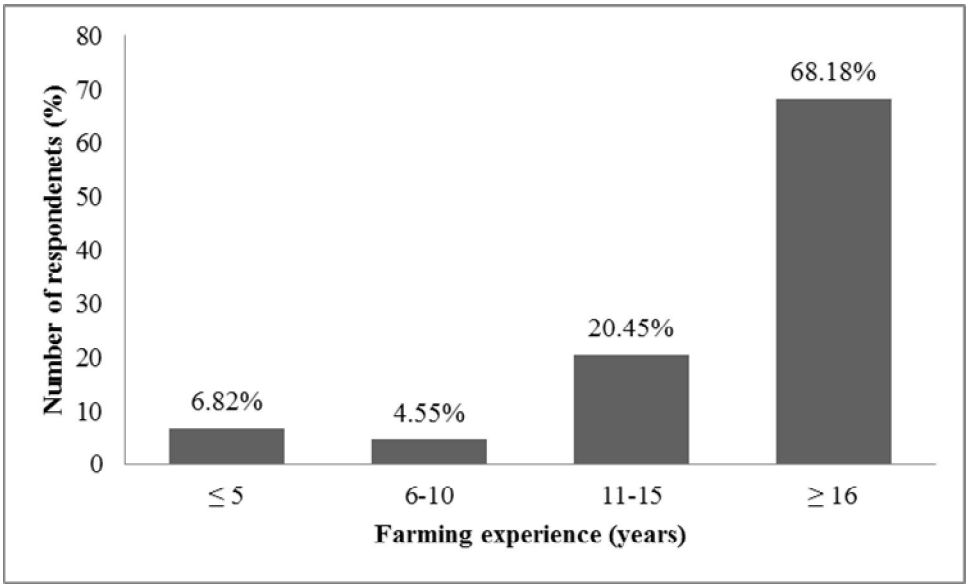

Figure 1: Work experience of farmers interviewed in the two local government areas

Information on current and past farming practices have revealed that rural people have a wealth of indigenous knowledge on tree-crop combinations that maximize productivity, enhance crop success, provide fodder during dry seasons and stabilize soils (Bayala *et al.*, 2007; Oke and Odebiyi, 2007; Matanmi *et al.*, 2011). A large percentage of farmers had vast experience (68.18%) with the oldest respondent having over 40 years of farming experience (Fig. 1). To this end, over 68% of respondents had a combination of trees and arable crops on their farmlands while the remaining cultivated only arable crops. Fruit trees such as *Parkia biglobosa, Vitellaria paradoxa, Anogeissus leiocarp*us (DC) Guill. and Perr., *Anacardium occidentale* L. as well as timber species such as *Gmelina arborea* Roxb. were predominant on farms in combination with a wide range of arable crops such as yam, maize, cassava, beans etc. These combinations diversify farm products and farmers are able to assess the benefits of tree-crop interactions. The trees serve multiple purposes and farmers derived food, domestic energy, medicinal and economic benefits from them (Albrecht and Kandji, 2003; Odebiyi *et al.*, 2004; Jimoh and Asinwa, 2012). Only 6.8% of the respondents did not meet trees on their farms when they started cultivation. However, respondents indicated their interest in planting more trees on their farms, with 29.5% preferring an integration of fruit tree species into their farms (Fig. 2). Oke and Odebiyi (2007) opined that local farmers had a higher interest in planting and retaining fruit trees than timber species because of the opportunity to use the products domestically and to sell them in the local markets. In addition, the tenure system and long gestation period of timber species discourage their retention on farmlands.

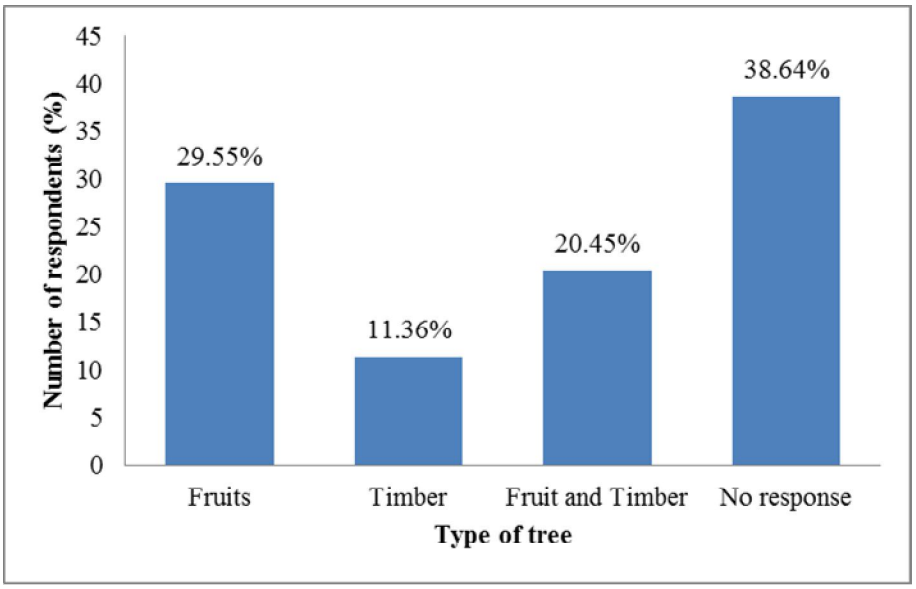

Figure 2. Type of trees that respondents were willing to integrate into their farmlands

Most farmers agreed that not pruning trees resulted in competition with arable crops with 47.7% stating that trees were competing with their crops while 52.7% did not observe any competition. Invariably, losses in crop yield due to tree-crop interactions are compensated for by the economic benefits from harvesting marketable tree products. Also, in extremely hot conditions (which are predicted to be more frequent in future); the shading effect of evergreen trees could reduce losses in yield due to excess heat in the open areas of farms (Jonsson *et al.*, 1999). Though, a significant number of the respondents (77.3%) were aware of the impact of climate change, most farmers did not think that climate change was affecting farming activities and crop production (Fig. 3). Most farmers (84.1%) seemed to recognize the importance of trees in mitigation and adaptation to climate change while 79% of them affirmed that trees played a major role in soil stabilization and fertility. For example, a large number of farmers used inorganic fertiliser (45.5%) inputs but almost all (95.5%) agreed that trees provided nutrients for the soil and could be beneficial to crop growth and development (Fig. 4).

Even though agroforestry systems store less carbon than forest ecosystems, they contain a significantly higher carbon stock than croplands or pastures. Thus, the introduction and proper management of trees in croplands or pastures has a great promise for carbon sequestration as well as ecosystem rehabilitation (Albrecht and Kandji, 2003; Kandji *et*

al., 2006; Leakey *et al.*, 2006). Unfortunately, farmers in the study area were not clearly informed on the carbon sequestration potentials of trees in their farmlands. Besides the biophysical resilience, which allows the various components of the agroforestry systems to withstand shocks related to climate variability; the presence of trees in agricultural croplands can provide farmers with alternative or additional sources of income, thus strengthening the socioeconomic resilience of rural populations.

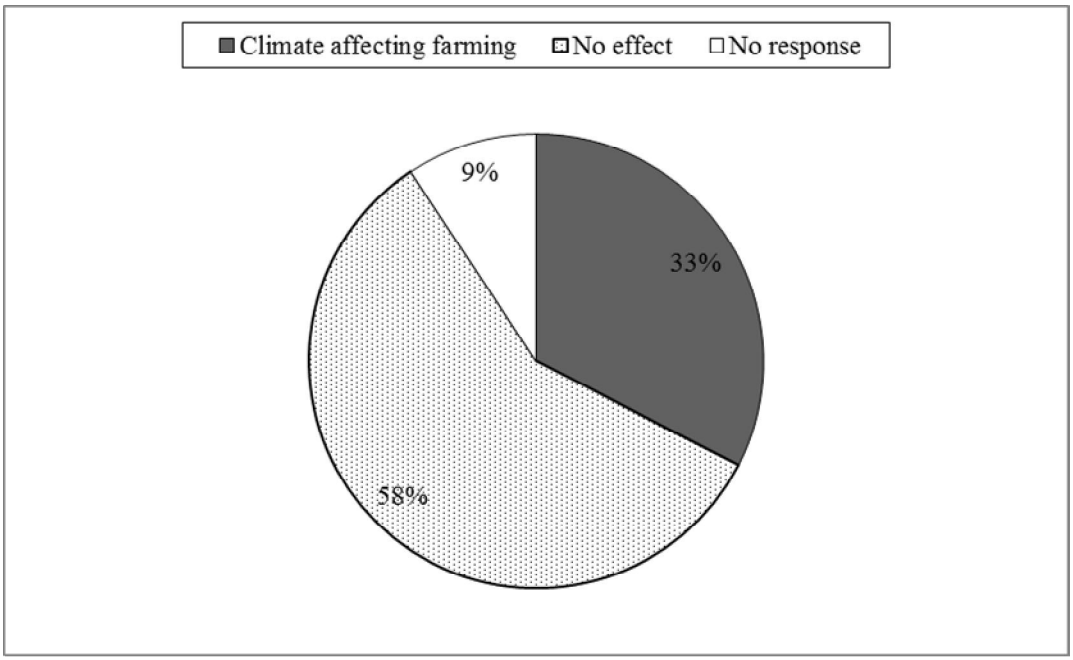

Figure 3: Perception of farmers on the impact of climate change on farming activities

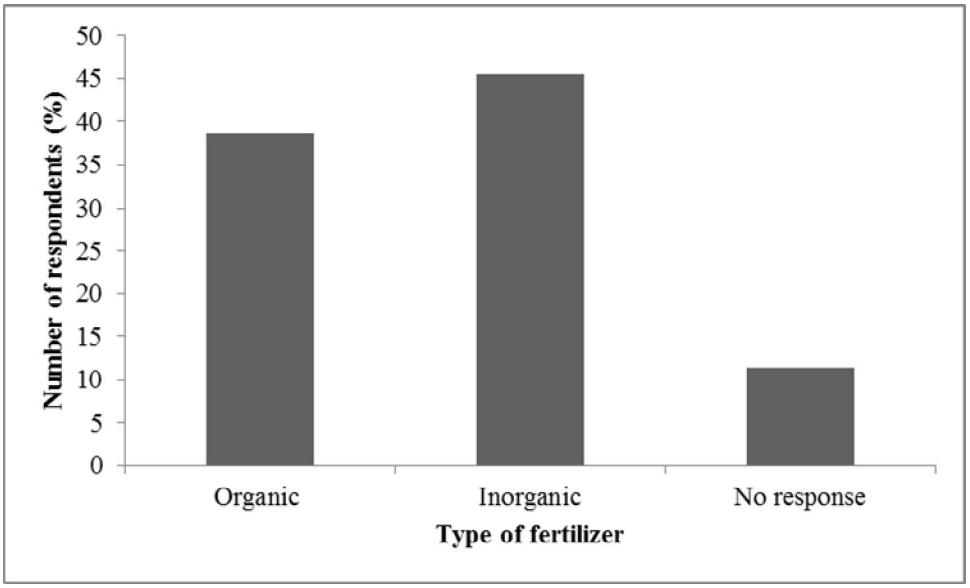

Figure 4. The type of fertilizer used by respondents during cultivation of arable crops

Conclusion

Rural farmers are among the most vulnerable to the impacts of climate change because their adaptive capacity is limited by their huge dependence on natural factors and a lack of complementary inputs and established institutional support. Respondents suggested that government and research institutes could encourage adoption of intensive agroforestry practice through the provision of loans, subsidies on farm inputs, raising of and supply of choice tree seedlings (especially fruit trees) as well as forestry extension services including provision of mechanized equipment.

The promotion of traditional agroforestry could create a synergy between efforts to mitigate climate change and adaptation of vulnerable communities to the negative impacts of climate change. However, further research is required to substantiate the potentials of such synergy. In addition a bottom up approach that would employ adaptive management strategies is essential if the system will be locally accepted and implemented.

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