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FARMERS PERCEPTIONS TOWARDS AGROFORESTRY SYSTEMS IN BABANOSA AREA, WEST KORDOFAN STATE

Kamal Eldin Mohammed Fadl[1]* and Ali ElaminAbdallahAhmed[2]
[1]Agricultural Research Corporation, Sudan
[2]Forestry National Corporation, West Kordofan State, Sudan
*Corresponding author: kamaleldin2001@yahoo.com

Abstract

This study was conducted in Eltemada, Boli and Umghoghai villages at Babanosa area in El-salam locality, South Kordofan State during 2012 and 2013. The objectives were to (1) identify and assess the most important agroforestry systems, (2) to investigate the main factors that affecting the sustainability of the systems, (3) to determine the important field crops that cultivated with trees and (4) to evaluate the effect of the agroforestry systems on the yield of the traditional field crops. For accomplishment of these study 80 questioners was designed and distributed in the selected villages. After the data collection data was analyzed by using descriptive statistic. The results showed that the most important agroforestry systems in the study area are parkland cropping system (58%), boundary planting (26%), wind-breaks (13%) and alley cropping (3%).The most important forest trees in the study area are *Acacia senegal* (32%), *Ziziphus spina- christia* (28%), *Balanites aegeyptiaca (*26%), *Sclerocary birrea* and *Guera senegalensis* (3%). The main field crops in the study area are groundnut (44%), sorghum (35%) and roselle (21%). The results showed that yield of groundnut and sorghum is higher under agroforestry systems compared with the mono-cropping system. The results showed that the majority of respondents (70%) prefer to cultivate field crops in agroforestry system, while (30%) prefer to cultivate the field crops in a mono-cropping system. The cultivation methods used in the study area include shifting cultivation (52%), mono-cropping (36%) and intercropping (12%).The majority of respondents (94%) showed that trees improve soil fertility in their farm land. The benefits from trees in farm land include improvement of soil properties (36%), protecting the farm land from wind erosion (28%), improvement of micro-climate (24%) and source of income which was indicated by (12%) of the respondents. The study recommended that modern agroforestry system such as improved fallow system and alley cropping should be introduced in the study area and multi-purpose trees such as *Acacia senegal*, *Fedherbia albida* and *Sclerocarya birrea* that improve soil fertility and diversify farmers income should be maintained.

Keywords: Parkland cropping, agroforestry, crop yield, soil fertility

Introduction

South Kordofan State is one of the three States North, West and South comprising Greater Kordofan Region. The total area of the region is about 82,000 Km^2, located between latitudes 90° 45′ and 12° 45′ N, and longitudes 29° 15′ and 32° 30′ E (IFAD, 2000). The region is now composed of seven localities. These are Kadugli, Dilling, Rashad, AbuGibaiha, Talodi, Salam and Lagawa (El Tahir *et al*., 2010).

The region economy is dominated by agriculture and livestock production. A recent study has demonstrated that 70% of family income comes from selling crops, 9% from livestock, 7% from forest products, 7% from remittances and petty trading each, especially among female-headed households (Shakir, 2006).

The major field crops in Kordofan region include: millet, sesame, sorghum, groundnuts, roselle, water melon and a variety of horticultural crops from small irrigated gardens. Traditionally rainfed agriculture involved the bush fallow system in which filed crops are cultivated in the clearances of forest land and cultivation of the field crops such as groundnut, sesame and roselle for several years and after crops productivity was decline the area is left to fallow and then a new forest area is cleared for cultivation and so on (Fadl and Elsheikh, 2010).

In southern apart of the region many trees are deliberately retained on cultivated land. These trees include *Acacia senegal*, *Balanites aegyptiaca*, and *Zizphus spina- christi*. However, except for gum Arabic plantations most of the trees growing naturally and in many areas the trees are declining in density and diversity due to the slow natural regeneration in the face of drought, desertification and the massive increase in human and animal populations (Bunderson *et al*., 1990). Worldwide, the concept of rational use of resources for sustainable production has captured international attention. In this respect scientific literature emphasized the significant role of agroforestry as a tool for sustainable management of land resources particularly in fragile ecosystems such as Kordofan sands (Fadl, 1999).

Agroforestry encompasses a large range of land-use practices and is practiced in both modern and traditional forms around the world. Currently, almost 1.2 billion people or 20% of the world's population depend on agroforestry products and services for their livelihoods (ICRAF, 2006), and approximately 1.8 billion people make some use of agroforestry products and services (Leakey *et al*. 2005). A more recent study by the World Agroforestry Center suggests that these numbers may in fact below and that nearly half of the world's farmlands have at least 10% tree cover, spanning more than 10 million square kilometers in total (ICRAF, 2009).

Environmentally, agroforestry has the potential to reduce pressure on natural forests, serve as windbreaks and erosion barriers, facilitate the movement of pollinators, and enhancement the soil nitrogen fixation as well as a wide variety of other benefits (Franzel and Scherr, 2002). Economically, agroforestry can supply households with tree products, medicines, livestock feed, and timber. Examples of the social benefits of agroforestry include shade for meetings areas, religious practices, and the aesthetic value of the landscape. Within

the landscape surrounding protected areas, agroforestry can be used to protect biodiversity and help alleviate deforestation (Gascon *et al.,* 2004).

Recently, the natural resources in the region show a general trend of deterioration. In particular, the tree cover is declining in density and diversity. The most sever is the expansion of crop production in marginal areas using practices incompatible with resources maintenance (Bunderson, 1985). The resources degradation is particularly acute in the northern part of Kordofan region which is fragile to prevailing crop activities. Land preparation involves completer tree felling and removal of grasses; followed by hand hoe cultivation is contributing to resource degradation. This has resulted in severe losses in soil fertility and significant declines in yields of crops and trees (Fadl and Gebauer, 2004).

In the light of the above introduction, the overall objective of this study is to characterize the existing agroforestry systems in Babanosa area, and to find out the major factors affecting the sustainability of those systems. The specific objectives are (1) to identify the most important agroforestry systems in the study area, (2) to determine the major filed crops used in different agroforestry systems, (3) to investigate the effect of agroforestry systems on yield of traditional field crops and (4) to investigate the major constrains of agroforestry systems and practices in the study area.

Material and methods

Study area

This study was conducted at El-Salam Locality (Babanosa) which is one of 8 localities (El-Salam, Abyei, Lagawa, Kadogli, El-Dilling, Taloudi, Abu-Gubeiha, and Rashad.) comprising Southern Kordofan State. The Locality is located in the North-East part of the State and lies between latitudes 11^{o}, 50^{-} - 11^{o}, 00^{-} N and longitudes 27^{o}, 30^{-} - 28^{o}, 35 E, with an area of 10930 km^{2}. Administratively, the locality divided into four administration units namely, El-Fula, Kejaira, Babanosa and El-Teboon

For accomplishment of this study, two types of data were collected, namely; primary and secondary data. The source of the secondary data includes Ministry of Agriculture and Forests National Corporation (FNC) documents, files, articles, and annual reports. The primary data were principally collected to investigate the level and awareness of the local people towards the agroforestry. The data was covered qualitative and quantitative information including the main objectives of the study.

The study was conducted in three villages namely (ELtemada, Boli, Umghoha) the reason for selection those villages is that the natural resources in the selected villages show a general trend of deterioration. In particular, the tree cover is declining in density and diversity. The most sever is the expansion of crop production in marginal areas using practices incompatible with resources maintenance. For this research the required data was collected from the surveyed population using the semi structured questionnaire as a tool for interviews. A total of 80 respondents representing farmers were interviewed.

The construction of the questionnaire was prepared according to the guidelines of (FAO, 1992). The statistical analysis was commenced through descriptive and exploratory manipulations of the data obtained from the study. The main tools were the construction of simple tables and charts and selected cross-tabulation which allowed tentative answers for many of the questions being asked in the survey. Micro software program Statistical Package for Social Sciences (SPSS) was used for the Statistical analysis.

Results and discussion

Planting trees around croplands to protect crops has a long history. It was reported that trees were planted around crops in china to prevent wind erosion in as early as 550 B.C. Today, establishment of windbreaks has become a common approach in the areas where wind is a problem for agricultural production (Li and Lai, 1994).The results of the presence of trees on farm land are shown in (Table 1). The table shows that (99 %) of the respondents have trees in their farm land while, only (1%) of them they don't have trees. The most important trees in farm land in the study area are, Hashab "*Acacia senegal*" which was indicated by (32%) followed by Sidir "*Ziziphus spina- christia*" (28%), Heglig "*Balanites aegyptiaca*" 26%, Humeid "*Sclerocarya birrea*" 11% and Gubeish"*Guiera senegalenses*" which was indicated by 3% of the respondents. This result is in line with the finding of Bunderson *et al* (1990) who reported that in South Kordofan *Acacia senegal*, *Balanites aegyptiaca*, and *Zizphus spina christi* are deliberately retained on the cultivated land.

Table1. Important trees in farm land in the study area

Scientific name	Local name	Respondents %
Acacia senegal	Hashab	32
Zizphusspina- christi	Sidir	28
Balanites aegyptiaca	Heglig	26
Sclerocary birrea	Humaid	11
Guiera senegalenses	Gubeish	3
Total		100

The types of trees arrangement can be described as follow: Scatter trees on farm land (58%), wind breaks (13%), boundary planting (26%) and alley cropping (3%) figure (1).The higher percentage of scatter trees on farm land reveals the appreciation of respondents for the importance of trees in their farm land. The lowest percentage of alley cropping can be explained by the lack of community awareness about the agroforestry systems or due to the fact that alley cropping requires careful technique in planting and management. This result are in line with the finding of Moshapir, (2013) who reported that most important agroforestry systems in Kordofan region include parkland system, wind breaks and boundary planting. The same author reported that the most important trees in Kordofan region include *Acacia senegal*, followed by *Fadherbia albida*, *Ziziphus spina- christia* and

Balanites aegyptiaca while, the lowest presence of trees was recorded for *Delbergia melonoxylon*.

From the surveyed samples (71 %) of the respondents prefer to cultivate crops with trees vice versa (29%) prefer to cultivate crops alone. The cultivation methods in the study area include shifting cultivation which was indicated by (52%) of the respondents, followed by mono-cropping (36%) and intercropping (trees and field crops) which was indicated by (12%) of the respondents (Figure2). Since shifting cultivation is a farming system where farmers cleared the land for cultivation of the field crops for few years when the land becomes exhausted they left the land for the regeneration of the gum Arabic trees. The implication is that the *Acacia senegal* trees has the ability to fix the atmospheric nitrogen which restore the soil fertility in the cultivated area.

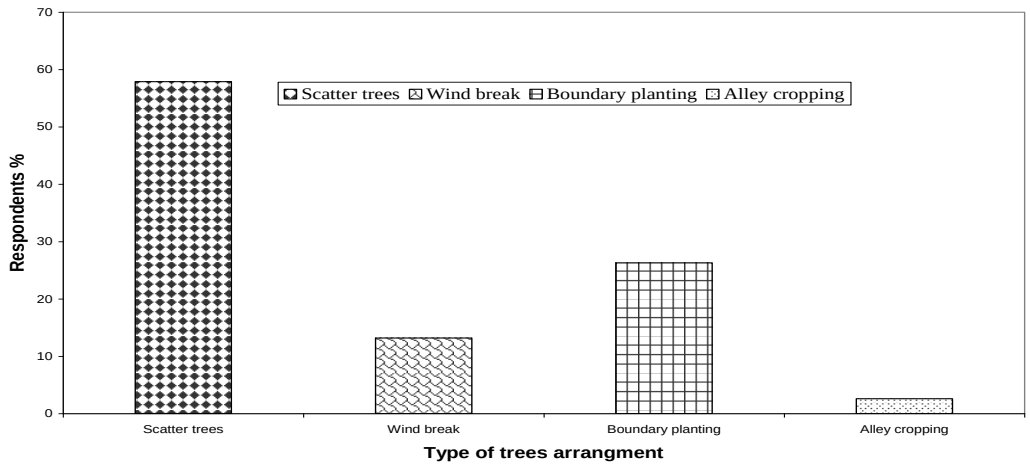

Figure1. Type of trees arrangement on farm land in the study area

These results are in line with the finding of Moshapir, (2013) who reported that the main methods used in cultivation of the field crops in greater Kordofan region are shifting cultivation followed by the mono-cropping system. Similarly, (FAO, 1978; DANIDA, 1989 and Barbier, 1990) reported that the bush fallow system is practiced as a means of restoring soil fertility and promoting gum Arabic production; the system is a version of the old shifting cultivation and has been acknowledged internationally as an ideal system for dry lands. Under this system the farmers can obtain reasonable yields from agriculture and gum Arabic.

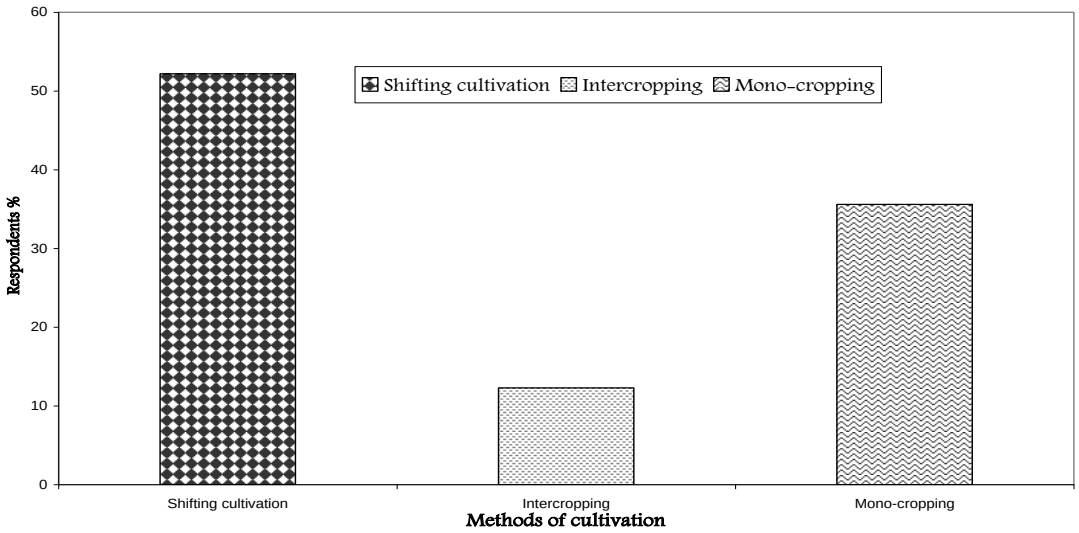

Figure2. Methods of cultivation in the study area

From the surveyed samples (94%) of the respondents mentioned that trees has a positive effect on soil fertility while only (6 %) of the respondents mentioned that trees doesn't affect soil fertility. The implication is that trees add organic matter to the soil through letter mineralization and improve soil physical and chemical properties and protect the soil from wind erosion. Furthermore, the leguminous tree has the ability to fix the atmospheric nitrogen in symbiosis with rhizobium in root nodules and these add nitrogen to the soil. This result agrees with the fundamental assumption in agroforestry, that the integration of trees into farming systems and landscapes can increase soil fertility and productivity and sustainability (Nair, 1984). Similarly, Shukla, (2009) reported that tree has a positive changes in micro-climatic, floral, faunal and other components of the eco-system through bio-recycling of mineral elements.

Trees can improve the nutrient balance of soil by reducing unproductive nutrient losses from erosion and leaching and by increasing nutrient inputs through nitrogen fixation and increase biological activities by providing biomass and suitable micro-climate (Schroth and Sinclair, 2003).

The main trees that have a positive effect on soil fertility as mentioned by the respondents include Hashab "*Acacia senegal*" which was reported by (56%) of respondents, followed by Humaid "*Sclerocarya birrea*" (30%) and Haraz "*Fiedherbia albida*" which was indicated by (14%) of the respondents (Figure 3).

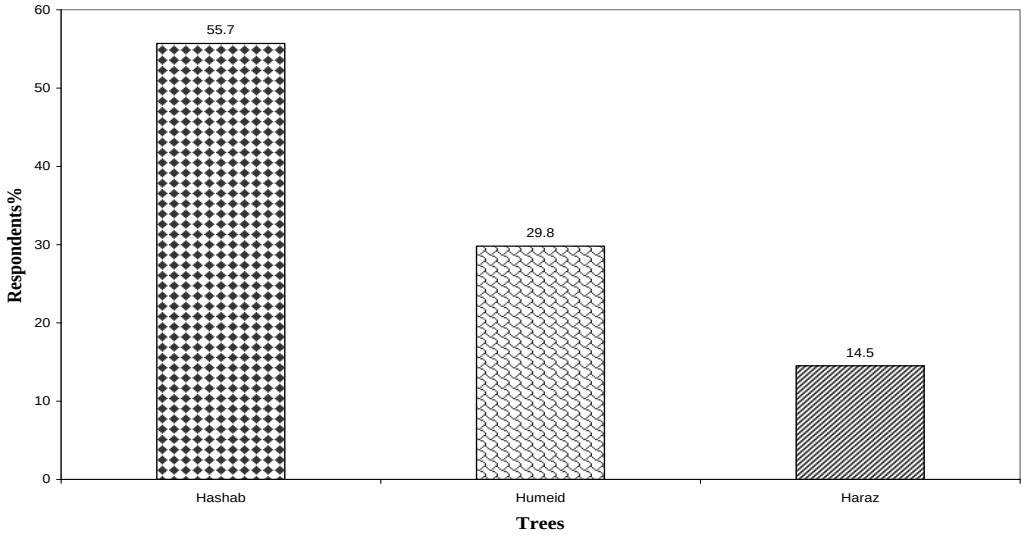

Figure3. Main trees that have positive effect on soil properties

The implication is that those trees are leguminous tree and they have ability to fix the atmospheric nitrogen through the rhizobium bacteria and this nitrogen improves soil fertility. These results are in agreement with the finding of Huseein (1983) who reported that the sandy soils under *Acacia senegal* had more nitrogen than the soils away from *Acacia senegal*. Similarly, Hussien and El Tohami, (1998) investigated the ameliorative effect of *A. senegal* natural stands and plantations on some properties of a vertisol " clay soil" in the central clay plain of the Sudan at El Dali Mechanized rainfed schemes, compared to continuously cultivated schemes. They found that the ameliorative effect was most pronounced on carbon and nitrogen contents and soil bulk density. The total nitrogen and organic carbon were higher under *A. senegal* natural stands than in cultivated fields.

The advantages of the presence of trees in farm land are shown in (Table 2). The table shows that (36%) of respondents mentioned that trees increase soil fertility, (28%) showed that trees protect the farm against soil erosion, (24%) showed that trees improve the micro-climate and (12%) mentioned to source of income. This was attributed to the fact that in dry land area trees especially the leguminous trees improve the soil fertility through nitrogen fixation and letter mineralization, protect the farm from wind erosion and improve the microclimate.

Table 2.The advantages of the presence of trees on farm land

Advantages	Respondents%
Protection against soil erosion	28
Increasing soil fertility	36
Improving micro climate	24
Source of income	12
Total	100

The disadvantages of the presence of trees on farm land are shown in (Table 3). The table shows that (47%) of the respondent's mentioned that the trees in their farm land act as a host for birds, (27%) showed that trees compete with the field crops for water while, (26%) showed that trees compete with the field crops for light. These was attributed to the below ground completion between the trees and their associated crops especially for water and soil nutrient. These results are in line with the finding of Fadl and Elsheikh, (2010) who reported that the reduction in groundnut, sesame and roselle yield in Edamokey forest reserve could be attributed to the below ground competition between the *A. senegal* tree and the field crops for water and nutrient.

Table3. The disadvantages of the presence of trees on farm land

Disadvantages	**Respondents %**
Competition for water	27
Competition for light	26
Host for bird	47
Total	100

From the surveyed samples the respondents mentioned that there are three main field crops which are grown with trees in the study area. Those crops are groundnut (44%), sorghum (35%) and roselle (21%) figure (4).

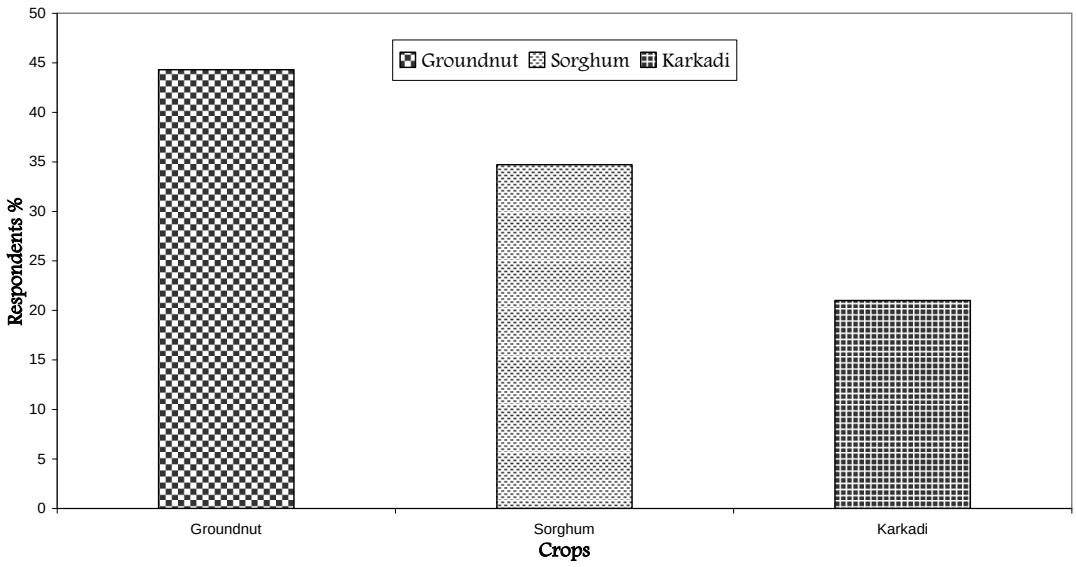

Figure 4. Main field that cultivated on farm land

The implication is that groundnut and roselle are the main cash crops while; sorghum is a food crop. These results are in line with the finding of Moshapir, (2013) who reported that the main field crops that cultivated with trees in greater Kordofan region include groundnut, sesame, sorghum, roselle, cowpea and watermelon.

The results showed that the average yield of groundnut and sorghum in agroforestry systems are (373.5 kg and 210 kg) higher than that obtained from the mono cropping (Table 4).

In contrast, roselle has the highest average yield in mono-cropping system compared with the

Table 4. Average yields of the field crops (kg/feddan) under different agroforestry

crop	Cropping system	Minimum	Maximum	Mean ± Std.
Groundnut	Agroforestry	360 kg	405kg	8.3 ± 0.58
	Mono cropping	135	675	8.2 ± 3.4
Sorghum	Agroforestry	100	350	4.2 ± 1.5
	Mono cropping	100	250	3.4 ± 1.1
Roselle	Agroforestry	30	150	4.9 ± 1.8
	Mono cropping	180	180	12 ± 0

agroforestry systems. The higher crop yield could be attributed to the higher concentration of organic matter and nutrients and the better growth environment provided by the trees beside the significant increase in soil fertility and better improvement in the micro-climate. These results are in line with the finding of Fadl, (2012) who reported a higher yield in sesame and sorghum crops when intercropped with *A. senegal* in North Kordofan State.

Conclusion

In this study, it was found that farming is the dominant production activity in the study area. *Ziziphus spina- christi, Balanites aegyptiaca, and Sclerocarya birrea* are the dominant multipurpose trees in the study area .The most important agroforestry systems in the study area are scatter trees on farm land followed by windbreak, boundary planting and alley cropping. The field crops that cultivated with trees are groundnut, sorghum and roselle. The majority of respondents prefer to cultivate the field crops in agroforestry systems. The study concluded that *Acacia senegal*, *Sclerocarya birrea* and *Fedherbia albida which* had significant effect on improving soil properties. The advantage of the presence of trees in farm land includes improvement of soil fertility, protection the farm from soil erosion; improve the microclimate in addition to source of income.

Recommendation

The study recommended that**, i**ncreasing the public awareness for adoption of modern agroforestry systems should be encouraged, participation in forests plantation, protection and establishment should be given a higher priority, further study for determination the yield trend under the different agroforestry system is needed and activation and enforcement of forest legislations to reorganize the agroforestry systems should be given a high priority.

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