Agriculture and Forestry Journal
Vol. 3, Issue 2, pp. 81-88, December, 2019
E-ISSN 2602-5795
Published by university of Tlemcen - ALGERIA

Available online at:
http://ojs.univ-tlemcen.dz/index.php/AFJ/

Open Access

The Importance of Farm Trees in Rural Livelihoods in Eastern Galabat Locality, Sudan

Mohamed Abdelmoneim Ali HEMIDA & Yahia Omar ADAM (*)
University of Khartoum, Faculty of Forestry, Dept. of Forest Management, Code 13314, Shambat-Khartoum Bahri, Sudan
Corresponding author, email: gumaa1973@hotmail.com

ARTICLE INFO

Article history:

Received: 16 June 2019
Accepted after corrections 04 December 2019

Keywords:

Trees outside forests, Farm trees, Determinants of tree planting, Environmental awareness

ABSTRACT

The objectives of this study were to: (i) assess the share of farm trees in farmers' total income; (ii) determine and analyze the factors influence the farmers' decision on farm trees planting; and (iii) identify the attitudes and perceptions of farmers towards planting farm trees. A sample of 60 farmers was purposively selected from Galabat locality in 2015 and interviewed using a structured questionnaire. The data were analyzed using descriptive statistics and linear regression analysis. Farm tree products were found contribute 31% of farmer's total annual income. Farmer's land holding in feddan (*P= 0.009*), farmer's family size (*P=0.000*), farmer's income (*P=0.042*) and extension services from Forests National Corporation (EXT from FNC) (*P = 0.001*) were found to positively and significantly associated with farmers' decisions to plant trees on farmlands. The study results also indicate that the farmers have awareness of the benefits associated with trees, and their attitudes towards trees planting are mostly positive. It is concluded that farmer's decisions to plant farm trees are driven by their socioeconomic circumstances. Thus, it is recommended that the farmers' socioeconomic characteristics should not be overlooked when designing future tree planting programs in the region.

1. Introduction

Sudan covers an area of 1.9 million km² with a total population of more than 36 million, with rapid growth rate of 2.3% per annum. Most of the population (70.5%) live in rural areas and many are considered forest dependent (e.g. Glover and Elsiddig, 2012). However, the forest resource is threatened by deforestation, driven predominantly by energy needs and clearing for agriculture (Badri, 2012). According to FAO (2013), the ongoing process of land degradation is a critical issue that affects the livelihoods of large sector of the rural population. Removal of tree cover for crop production, felling trees for fuelwood and building poles, in addition to overgrazing, are factors that together with drought conditions resulted in desertification and consequently shortage in food crops, as well as loss of soil fertility (El Tahir et al., 2009). Another cause of land degradation in Sudan is the clearing of rangelands for mechanized rain-fed agriculture and shifting cultivation (FAO, 2008). According to Glover and Elsiddig (2012) and Biro et al. (2013), many areas in central and eastern Sudan covered by natural forests have been converted to mechanized rain-fed agricultural schemes for cultivating cash and subsistence crops.

To safeguard against the problems of deforestation and land degradation, the Sudanese government introduced the *Investment Act of 1990* and the Ministerial Order 345/95 which obliged all land proprietors to conform to the allocation of 10% of their farmland for forestry (shelterbelts or forest cover), and to allow 20% of the holdings for forestry (that is by not clearing that margin in the first place) in case of new licenses (FNC, 2003). This legislation supported by the Comprehensive National Strategy (CNS) for socioeconomic development (1999 - 2002) which formulated and enacted by the Federal Government (FNC, 2003). Nevertheless, no research has been undertaken to evaluate the importance of farm trees in rural livelihoods in Sudan. Moreover, widely differing and often contradictory claims about the livelihood impacts of farm trees have been widely reported in the literature, some authors (e.g. Luedeling and Neufeldt, 2012; Bayala, 2013; Bayala et al., 2014; Mbow et al., 2014; Dessie et al., 2019) mentioning that there is an increasing scientific interest in understanding the contribution of trees on farms to farmers' livelihood.

The fundamental appeal of farm trees is that, in addition to addressing environmental concerns such as deforestation and climate change (Kiyingi et al., 2016), farm forestry realized as a tool for improving livelihoods of the rural communities through supplying wood products market (FAO, 2001), which could encourage the rural poor households to participate in establishment of farm trees and could improve their livelihoods and alleviate their poverty (Oksanen et al., 2003). However, studies evaluating the impact of farm trees on household livelihoods have largely focused on commercial plantation forests and their role on rural livelihoods is

ambiguous (Kiyingi et al., 2016). On the one hand, some authors (including Barlow and Cocklin, 2003; Oksanen et al., 2003; FAO, 2011; Kiyingi et al., 2016) have argued that the share of plantation investment correlates with potential benefits, through increasing farm income, diversification of income, job creation and access to credit services. On the other hand, a number of authors (including McElwee, 2008; Naburs et al., 2014; Szuleka et al., 2014) reported that poverty levels are higher than average in areas where plantations have been established by farmers. However, there are few studies (e.g. Nsiah, 2010) evaluated the contribution of farm plantation to the livelihoods of farmers in Africa (Kiyingi et al., 2016; Gizachew, 2017; Dessie, 2019) and there is still a large gap in the literature (Chirwa and Mala, 2016). Such information is important and necessary for providing the policy-makers with feedback for policy adjustment and thus helps informing the design and development of future forestry and/or agricultural projects which target farmers for improving their rural livelihoods. Thus, the objectives of this study were to: (i) assess the share of farm trees in farmers' total annual income; (ii) determine and analyze the factors influence the farmers' decision to plant trees in their farms; and (iii) identify the attitudes and perception of farmers towards trees planting on farms.

2. Methodology

2.1. The Study Area

The study was conducted in Eastern Galabat locality in Gedaref state in Sudan. This locality lies between longitudes 35° 31’ and 36° 09’ E; and latitudes 12° 59’ and 13° 33’ N. The total population of Eastern Galabat locality is 160,623 (Sudan Central Bureau of Statistics, 2012). The study area is characterized by its highly fertile clay soil for sesame and sorghum production. The annual rainfall concentrates in a single relatively short summer season during June to September, and amounts to about 670 mm. Temperature ranges from a mean minimum of 21° C in January to a mean maximum of 36.4° C in April and May. The type and distribution of trees across the study area is largely dependent on rainfall amount and soil type. The main dominant trees include: *Acacia seyal var. seyal*, *A. Senegal*, *A. millifera*, *A. nubica*, and *Balanites aegyptiaca*. Tree products (wood and non-wood) have a large and expanding market for charcoal and fuelwood because almost all households use biomass as the main source of energy. Agriculture is the main livelihood activity, followed by livestock rising in the traditional seasonal transhumance pattern (the practice of moving livestock from one grazing ground to another in a seasonal cycle). Gum Arabic production and trading forests products and charcoal production and sale are other traditional income sources. Thus people derive their income from various combinations of the three main forms of land use, viz. cropping, grazing and forest exploitation (Glover, 2005).

2.2. Data collection

This research employed a case study approach. A sample size of 60 farmers was selected purposively from Eastern Galabat locality, Gedaref state in April-May of 2015. Galabat locality was selected due to the implementation of the ministerial decision with regard to 10% tree planting on the agricultural farm. The unit of analysis is a farmer who has trees on his farm. To fulfil the objectives of this study, the selection of farmer was based on: i) ownership of trees on farms, and ii) farm tree products selling for at least one season in one year. The secondary data were collected from available literature (e.g. articles, reports, books, policy briefs and documents) from relevant institutions which provided baseline information for the study. Then a reconnaissance survey was conducted in the study area to enable the researchers to get a better insight of the study communities, to establish contacts with some key personalities within the farmers’ community, and to select field assistants and enumerators.

The criteria used for selecting the assistants and enumerators were based on their knowledge on the study area and their social connection with the farmers’ community. After testing the questionnaire with 10 farmers in the study area, the questionnaire was modified by omission of irrelevant questions and addition of new relevant ones. The questionnaire consisted of questions on farmer characteristics (e.g. age, educational levels, and number of households), farm information (e.g. agricultural land size, type of planted tree species, type of tree products produced, amount of agriculture production, incomes from agricultural production and farm tree) and other source of livelihoods and income from each source.

Before the interview of the farmer, each interviewee was informed about the purpose of the study and his full right to response to our interview or to refuse it. This ethical issue was important to build confidence between enumerators and the participants as well as to be voluntary process. Focus group discussion was also applied with a total of 5-7 farmers. To cross-check, validate the data, and reveal any ambiguities for the information generated from group discussion, key informants interviews were also employed with forestry officials, heads of community (*Omda*s), and farmers’ union committee in Gedaref state on the same issues.

2.3. Data analysis

The study employed a combination of qualitative and quantitative methods to analyze the data by using the Statistical Package for Social Survey (SPSS) Version 20 with the aid of Microsoft Excel Version 2010. Descriptive statistical methods were applied to analyze the data on socioeconomic characteristics, income

generation, perceptions and attitudes of farmer households towards establish trees on farms in the form of frequency and percentage distributions. The cash income from different livelihood activities were averaged and converted to US$ using the conversion rate for Sudanese Pound at the time of the survey (2015). The annual cash income from trees products was obtained by multiplying the amount of the products sold annually by mean price obtained from the local markets. Cash income from commercial farming was computed by multiplying the crop yields with their farm gate prices. Cash income from land renting was computed by multiplying the area of land rented with its price. The cash income from livestock was obtained by asking the respondents to estimate their income from livestock if any. Linear regression analysis was applied to determine a number of factors and their influence on farmer's decision to plant trees on their farms. Table 1 below explains the description of explanatory variables used in linear regression analysis.

Table 1. Description of explanatory variables used in linear analysis

Factor	*Description*
FAGE	Farmer age
FEDU	Farmer education
FHSIZ	Farmer household size
FLND	Farmer land holding
FTINC	Farmers total household annual income
EXT from FNC	Extension services received from Forests National Corporation

For this study, a number of contextual variables were regressed against the dependent variable (Y) to estimate the parameters ($ß_i$). Equation 1 was used to estimate the explanatory variables:

$$Yi = \beta 0 \pm \beta 1(FAGE) \pm \beta 2(FEDU) \pm \beta 3(FHSIZ) \pm \beta 4(FLND) \pm \beta 5(FTINC) \pm \beta 6(EXT\,from\,FNC) \pm \varepsilon \quad (1)$$

Where: Y_i = the dependent variable; β_0 = the intercept term; β_1, β_2, β_3… β_x = regression coefficients associated with each explanatory variables; and ε = the error term. The dependent variable is area of planted trees on farm. The independent variable (FAGE) is the farmer age and it was expected that a young farmers has a greater opportunity of adopting new activities (tree planting) than an older one, because he is more willing to or capable of taking risks as suggested by Sidible (2005). Farmer education (FEDU) measures the level of education. It takes the value 1, if illiterate; 2, if the respondent has *Khalwa*[1] education; 3, if completed primary education; 4, if completed secondary education; 5, if a university graduate; 6, if have a postgraduate education. Education is thus expected to have a positive effect on the decision to plant trees on farms. Household size (FHSIZ), measures the number of people living in the household. It was expected that the largest number of household are more likely to plant trees on farms. Thus household with many members and with educated head, has higher probability of adopting tree planting (Buyinza 2008). This similar situation occurs for farmers with a large land holding (FLND) and within a higher income (FINC). It's expected that farmers owing big portions of land may face less pressure to plant trees on their farms and this may positively affect planting trees on farm. Extension services from FNC (EXT from FNC), measure the contact of farmers with FNC and their recipients of any kind of extension from FNC. It was hypothesized that (EXT) positively influenced farmer's decision to plant trees on their farms.

3. Results

3.1. Socioeconomic characteristics of the farmers

The average age of the farmer is 53.25±1.8. The majority of respondents (58.3%) are at age above 50 years (50-87 years), while only 11.7% and 30% at age range of 18-38 and 39-50 years, respectively. The average of household size is 8±0.16 members. The education profile illustrates that 3%, 42%, 10% and 4% of the respondents have *Khalwa*, primary, secondary and university education, respectively, while 41% is illiterate. The study findings also reveal that the majority of respondents (61.7%) own farm land size with average of (139.65±23.9) Feddan[2] (fa), 1.7% with an average of (100±34.7) fa, 33.3% with an average of (300 ± 23.4) fa, and 3.3% with average of more than (500±101) fa. Regarding the farm land ownership, the study results explain that the majority of the respondents (61.7%) are the landlords, 3.3% are renters, 28.3% are inherited for their elders, and 6.7% are sharing land with relatives.

[1] A *Khalwa* is a religious school in which Muslims learns the Holy Goran and Goran studies
[2] One Feddan is equal to 0.42 ha.

3.2. Share of farm trees in farmer total annual income

The study results in table 2 indicate that the average annual cash income is US$ 1467±45.6, US$ 2481±22.9, US$ 171±123.8 and US$ 893±12.6 from farm trees (wood and non-wood forest products), agriculture, livestock and land renting, respectively. The same table illustrates that farmer's total annual average cash income is US$ 5012. The study findings shows that agriculture is the first most important contributor to farmer's annual total cash income (52%) followed by farm trees (31%), land renting (13%) and livestock (4%).

Table 2. Distribution of farmer's total cash income (US$) from different economic activities (*n*= 60)

Economic activity	*Annual average income (US$ ± Std. Error)*	*Share of total annual farmers income (%)*
Agriculture	2481 ± 22.9	52
Farm trees (wood & non wood products)	1467 ± 45.6	31
Land renting	893 ± 12.6	13
Livestock	171 ± 123.8	4
Total	5012	100

n = number of respondents; 1US$ = 7.5 SP (Sudanese pound) in 2015

3.3. Factors influencing farmers' decisions to plant trees on farms

The results of the linear regression analysis in Table 3 show that the farmer land size (FLND) (*P = .000*), farmer total income (FINC) (*P = 0.042*), farmer household size (FHSIZ) (*P = 0.009*) and extension services from FNC (EXT from FNC) (*P = 0.001*) are significantly and positively correlated with farmers' decision to plant trees on farm at 5% level of significance (*P<0.05*). However, farmer age (FAGE) and farmer educational level (FEDU) are not significantly associated with farmer decision to plant the trees on farms. The adjusted R^2 was found to be 0.557, which indicates that 55.7% of the variation in dependent variable is explained by the incorporated independent variables.

Table 3. Factors influencing farmers'decision to plant tree on their farmlands

Variable	Partial regression coefficient	Std. Error	Beta	*t-value*	Significance level
Constant	112.027	165.304		0.678	0.501
FAGE	-2.471	1.608	-0.185	-1.536	0.130
FHSIZ	13.183	4.828	0.336	2.731	**0.009**
FEDU	20.452	26.930	0.080	0.759	0.451
FLND	0.245	0.035	0.708	7.050	**0.000**
FINC	-0.001	0.000	-0.213	-2.089	**0.042**
EXT from FNC	-56.859	41.477	-0.131	-1.371	0.176

Note: Bold values contribute significantly at P<0.05; R^2 = 0.557

3.4. Farmers' attitudes and perceptions towards trees planting on farms

Table 4 reveal that the benefits of farm trees as indicated by the farmers, which include: increased income (95%), increase in productivity of agricultural crops (90%), increased availability of firewood (88%) and reduced damage of trees on crops (80%). These high percentages of tree benefits indicated by farmers obviously explain the fact that they are aware of tree environmental services other than income generation. However, the findings in the same table 4 also illustrate that the farmers have negative/risk perceptions towards farm trees. These risk perceptions are coming from the idea that trees on farms increase pest outbreaks (78.3%) and lead to water scarcity on farms (100%).

Table 4. Farmers perceptions and attitudes on farm tree planting (*n* =60)

Perceptions and attitudes towards trees planting on farms	*Frequency and percentage*			
	Yes	%	No	%
Planting trees on my farm will increase my cash income	57	95	3	5
Planting trees on my farm will reduce the crops damage	48	80	12	20
Planting trees on my Farm increase pest outbreaks	47	78.3	13	21.7
Planting trees on my farm increase the productivity of agricultural crops	54	90	6	10
Planting trees on my farm leads to water scarcity on my farm	0	0	60	100
Planting trees on my farm will increase the availability of firewood	53	88.3	7	11.7
Awareness of forest policy and law regarding tree planting on farmlands	44	73.3	16	26.7
Forest policies and laws towards trees planting on farms are effective	26	43.3	34	56.7
Awareness of silvicultural operations for farm trees	17	28.3	43	71.7
I am aware with the importance of trees on farm	54	90	6	10
I have a will to plant trees on my farm	55	91.7	5	8.3

The study findings also show that the majority of farmers (71.3%) have no idea on tree silvicultural operations, while only 28.3% familiar with some of silvicultural practices (e.g. pruning and thinning) which is based on their own experience. The study results also illustrate that, the majority of respondents (90%) aware about the importance of trees on farms in the face climate change. 91.7% of the respondents state that they have a will to plant trees on their farms if they have been supported with financial and technical assistance (Table 4).

4. Discussion

4.1. Share of farm trees in farmer total income

Farm tree planting is a relatively recent phenomenon for some of the study population. Nevertheless, it has become an important income diversification activity for the farmers. This section highlights the financial contribution of farm tress to the income streams of the farmers and the importance of this income component to the farmers' livelihoods. One of the benefits of integrating trees into existing farms is the opportunity to improve farm incomes and thus livelihoods (Tonts et al., 2001; Dessie et al., 2019).

The income from the sale of various farm tree products contributed as much as US$ 1467 of total farmer's income that own farm tree (Table 2). This amount accounts for 31% of total farmer income and also represents the second most important income generating activity after agriculture for these farmers. Income from farm trees seeks to broaden the income spectrum of the farmer and therefore allows them some level of flexibility and greater income security in the face of declining returns from traditional food and cash crop (e.g. grain and sesame) production as a result of fluctuating commodity prices. This finding mirrors the results of Nsiah (2010) who argued that, the income gained from tree planting can contribute to farmers' daily income and consumption in many developing countries. However, Angelsen and Wunder (2003) have raised doubts on the potential of forest regarding livelihood improvement, arguing that this potential is currently small. In contrast, Lopez-Gomez et al. (2008); Tesfaye et al. (2010); Adam et al. (2013); Gizachew (2017) indicated that forest income could raise the income levels of poor households closer to the level of the wider community, and sometimes improve their livelihoods and lift people out of poverty.

4.2. Factors influencing the farmers' decisions to plant trees

The results of linear regression analysis show that farmer household size (FHSIZ) is positively and significantly associated with farmer decision to plant trees on farm. This may be due to the fact that a large family offers better availability of labor in areas where household depends on family labor for farming activities. Large families in traditional farming areas are found to be important for increasing income generation options (Fahmi et al., 2015; Dessie et al., 2019). In addition to that, there are more mouths to feed, and thus, more family members are involving in livelihoods diversification within the available strategies (Yirga, 2007; Deressa et al., 2009). This result is also consistent with Munner (2008) who found that the family size ($\geq$ 11) members in North Kordofan, Sudan were more innovative in practicing agroforestry system than family with small size. However, this study result contradicts with Jenbere et al. (2012) who stated that family size is negatively and significantly correlated with decision on tree planting. Similarly, Kulindwa (2016) in Ghana found that when the family size increases, usually through additional children, parents redivide a piece of farm land among their children after they grow up, in an effort to help them get a good start in life.

Farmer land size (FLND) is significantly and positively correlated with farmer decision to plant tree on farm. This suggests that once the decision to plant trees on farm is taken, land right becomes crucial to the farmer in the study area. Similarly, Kulindwa (2016) in Tanzania, Danquah (2015) in Ghana and Asharf et al. (2015) in India reveal a positive association between the landholdings size and farmer decision on planting trees on farm. Another determinant of farmer decision to plant trees on farm is total farmer income (FINC). The total farmer income is positively and significantly associated with his decision to plant trees on farm. This finding is quite expected giving the fact that when a farmer has high income he will has a greater chance to adopt new livelihood strategy for making a better life including tree planting, because his economic situation will make him possible to take risk for adopting new ideas. This finding mirrors the results of Kakuru et al. (2014) who stated that farmer total income is the main driver for adoption of on-farm tree planting in Kibaale district, Uganda.

Extension services provided by Forest National Corporation (EXT from FNC) were positively and significantly correlated with farmer decisions on planting farm trees. This may be due to the fact that extension services may increase the awareness of farmers to plant trees. This result is in line with Fahmi et al. (2015) who reported that farmers who didn't receive extension services and limited support from agricultural organization were unlikely to plant *Acacia senegal* trees in their farm.

Some farmer characteristics, including age (FAGE) and education level (FEDU), did not have significant effect on their decision on trees planting in the farms. In contrast, Nsiah (2010) reported that the age of the household head farmer was highly significant in explaining the farm household decision to establish farm forest plantation in Ghana, where he found that relatively older farmers tend to plant trees as they engage in an economic activities that have long term asset accumulation potential.

4.3. Farmers' attitudes and perceptions towards trees planting on farms

The attitudes towards tree planting on farm were mostly positive, meaning that farmers associated more positive than negative out-comes with farm tree planting. This confirms the results of Meijer et al. (2015) who reported that farmers in Malawi highly value trees on their farms. However, the results of this study also indicate that there are negative/risk perceptions connected to farm trees planting such as water scarcity. This may be due to the fact that the study area suffers from the scarcity of rainfall over the last decade. Gaafar (2005) concluded that *A. senegal* agroforestry systems in Sudan result in competition for water resources between the crops and trees, which is contradictory to the general aims of agroforestry practice.

To facilitate farm trees planting in such situations, the extension services offer by Sudan's Forest National Corporation (FNC), should include more technical and research oriented issues of tree-crop interaction and eco-physiological adaptation, as well as climatic and edaphic factors (Fahmi et al., 2015) as the majority of the farmers in the sample are willing to plant trees and aware with the environmental importance of trees. The majority (71.7%) of the farmers have no knowledge on silvicultural operations for *A. Senegal* and *A. seyal* which have been planted on the farm. This means that the most common management activity is often limited to harvesting of trees products. Therefore extension services should include training on how to run the tree management practices in order to secure the intermediate products for farmer income generation an reduce tree competition with farm crops for water and nutrients.

4.4. Policy Implications

The study illustrates that farm trees make significant contribution to total income and is ranked as the second important source of income after agriculture. Many farmers have adopted farm trees as a key livelihood strategy to increase and diversify their income sources, and strengthen their capacity and ability to improve their livelihoods. However, some factors induce farmer's decision to plant trees on their farms. The results show that farmer's decision to plant trees on farm is positively and significantly influenced by an increase in farmer's landholding, size of the household, amount of total income, and extension services received from the FNC.

The study indicates that the respondents are aware with the benefits farm trees planting, and thus their attitudes towards farm trees are mostly positive. This means that farmers associated more positive than negative outcomes from farm tree planting regardless of their socioeconomic characteristics. However, there are risk perceptions associated with planting trees on farm identified by the farmers. These include insects out break and water scarcity.

Further studies should include the analysis of current forest policy and forest products market and their impact on farm trees livelihoods aspects- income generation. Additionally, Forest National Corporation (FNC) should not overlook the socio-economic characteristics of the farmers when farm trees planting program is initiated in the rest of region.

Acknowledgements

The authors gratefully acknowledge the Technical University of Dresden, the Institute of International Forestry and Forest Products, Germany for hosting the first author for three months (October, 2015 to December, 2015) and the DAAD for financing the first author stay and fieldwork. Thanks and appreciations are also extended to the farmers and key informants in Gedaref State for their exerted time and valuable information.

References

1. Adam YO, Pretzsch J, Pettenella D., 2013. Contribution of Non-Timber Forest Products livelihood strategies to rural development in drylands of Sudan: Potentials and failures. *Agricultural Systems*, 117: 90-97.
2. Angelsen A., Wunder S., 2003. Exploring the forest–poverty link: key concepts, issues and research implications (No. CIFOR Occasional Paper no. 40, pp. viii-58p). CIFOR, Bogor, Indonesia.
3. Ashraf J., Pandey R., de Jong W., Nagar B., 2015. Factors Influencing Farmers' Decisions to Plant Trees on Their Farms in Uttar Pradesh, India. *Small-scale Forestry*, 14(3): 301-313.
4. Badri, S., 2012. Sudan Environmental Threats and Opportunities Assessment with Special Focus on Biological Diversity and Tropical Forest. Management Systems International, USAID/Sudan Integrated Strategic Plan (ISP).
5. Barlow K., Cocklin C., 2003. Reconstructing rurality and community: Plantation forestry in Victoria, Australia. *Journal of Rural Studies*, 19(4): 503-519.
6. Bayala J., Sanou J., Teklehaimanot Z., Kalinganire, A., Ouédraogo, S. J., 2014. Parklands for buffering climate risk and sustaining agricultural production in the Sahel of West Africa. *Current Opinion of Environmental Sustainability*, 6: 28-34
7. Biro K., Pradhan B., Buchroithne M., Makeschin F., 2013. Land use/land cover change analysis and its impact on soil properties in the northern part of Gadarif region, Sudan. *Land Degradation and Development*, 24(1): 90-102.

8. Buyinza M., Wambede N., 2008. Extension for agroforestry technology adoption: mixed intercropping of crotolaria (*Crotolaria grahamiana*) and maize (Zea mays L.) in Kabale district, Uganda. *Environmental Resources Journal*, 2(3): 131-137.
9. Bwalya S.M., 2013. Household dependence on forest income in rural Zambia. Zambia *Social Science Journal*, 2(1): 67-86.
10. Chirwa P. W., Mala, W., 2016. Trees in the landscape: towards the promotion and development of traditional and farm forest management in tropical and subtropical regions. *Agroforestry Systems*, 9: 555-561.
11. Danquah J. A., 2015. Analysis of factors influencing farmers' voluntary participation in reforestation programme in Ghana. *Forests, Trees and Livelihoods*, 24(3): 176–189.
12: Deressa T.T., Hassan R. M., Ringler C., Alemu T., Yesuf M., 2009. Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change*, 19(2): 248-255.
11. Derbe T., Yehuala S., Agitew G., 2018. Factors influencing smallholder farmers adoption of eculayptus wood in Wogera District, North Gondar Zone, Amhara region state of Ethiopia. *International Research Management*, 6(07): 566-574.
12. Dessie A. B., Abtew A.A., Koye A.D., 2019. Determinants of the production and commercial values of eucalyptus woodlot products in Wogera District, northern Ethiopia. *Environmental Systems Research*, 8(4): 1-10.
13. Gizachew K., 2017. Expansion of eucalyptus woodlot and its factors in Cheha District, Southern Ethiopia. *World Science News*, 66: 600-608.
14. El Tahir B. A., Ahmed D.M., Ardö J., Gaafar A.M., Salih A. A., 2009. Changes in soil properties following conversion of Acacia senegal plantation to other land management systems in North Kordofan State, Sudan. *Journal of Arid Environment*, 73(4&5): 499–505.
15. Fahmi M.K.M., Mohamed E.S., Kanninen M., Luukkanen O., Kalame F.B., Eltayeb A. M., 2015. Determinants and constraints of integrating natural acacias into mechanised rain-fed agricultural schemes Sennar State, Sudan. *GeoJournal*, 80(4): 555-567.
16. FAO., 2001. Global Forest Resources Assessment 2000: main report. Food and agriculture organization of the United Nations (FAO).
17. FAO., 2011. Forests for improved food security and nutrition report. Rome: FAO. Available at: http://www.fao.org/docrep/014/ i2011e/i2011e00.pdf. [Accessed on 27 January 2015].
18. FAO, 2008. Agricultural mechanization in Africa. Time for action. Rome, Food and Agriculture Organization. Pp. 23. Available at: http://www.fao.org/3/a-k2584e.pdf . [Accessed on 20 March 2015].
19. FAO, 2013. Climate Change Guidelines for Forest Managers. FAO forestry Paper 172, Rome. Food and Agriculture Organization of the United Nations. Pp. 104. Available at: http://www.fao.org/3/i3383e.pdf [Accessed on 23 June 2015].
20. FNC, 2003. The annual afforestation and programme- present and future, FNC Khartoum. Pp.50
21. Gaafar A.M., 2005. Improvement of traditional *Acacia Senegal* agroforestry: Ecophysiological characteristic as indicators for tree–crop interaction on sandy soil in western Sudan. Ph.D. thesis, University of Helsinki. Tropical Forestry Report, No. 26, pp. 100.
22. Glover E.K., Elsiddig E.A., 2012. The causes and consequences of environmental changes in Gedaref, Sudan. *Land Degradation and Development*, 23(4): 339-349.
23. Glover E.K., 2005. Tropical dryland rehabilitation: Case study on participatory forest management in Gedaref, Sudan. Academic dissertation fort the Dr. Sc. Agric. & For. Degree, Helsinki, 183.
24. Jenbere D., Lemenih M., Kassa H., 2012. Expansion of eucalypt farm forestry and its determinants in Arsi Negelle District, South Central Ethiopia. *Small-Scale Forestry*, 11(3): 389–405.
25. Kakuru O.V., Doreen M., Wilson M., 2014. Adoption of On-Farm Tree Planting in Kibaale District, Western Uganda. *Journal of Sustainable Forestry*, 33(1): 87-98.
26. Kiyingi I., Edriss A., Phiri M., Buyinza M., Agaba H., 2016. The Impact of farm forestry on poverty alleviation and food security in Uganda. *Journal of Sustainable Development*, 9(1): 150-163.
27. Kulindwa Y.J., 2016. Key factors that influence households' tree planting behavior. *Natural Resources Forum*, 40: 37-50.
28. Lopez-Gomez A.M., Williams-Linera G., Manson, R.H., 2008. Tree species diversity and vegetation structure in shade coffee farms in Veracruz, Mexico. *Agriculture Ecosystem and Environment*, 124: 160-172.
29. Luedeling E., Neufeldt H., 2012. Carbon sequestration potential of parkland agroforestry in the Sahel. *Climate Change*, 115(3-4): 443-461.
30. Mbow C., Smith P., Skole D., Duguma L., Bustamante M., 2014. Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. *Current Opinion of Environmental Sustainability*, 6: 8-14.
31. McElwee P.D., 2008. Forest environmental income in Vietnam: Household socioeconomic factors influencing forest use. *Environnemental Conservation*, 35: 147-159.

32. Meijer S.S., Catacutan D., Sileshi G.W., Nieuwenhuis M., 2015. Tree planting by smallholder farmers in Malawi: Using the theory of planned behaviour to examine the relationship between attitudes and behaviour. *Journal of Environmental Psychology*, 43(1): 1–12.
33. Muneer S.E.T., 2008. Factors affecting adoption of agroforestry farming system as a mean for sustainable agricultural development and environment conservation in arid areas of Northern Kordofan state, Sudan. Saudi *Journal of Biological Sciences*, 15(1): 137-145.
34. Nabuurs G. J., Schelhaas M.J., Orazio C., Hengeveld G., Tome M., Farrell E.P., 2014. European perspective on the development of planted forests, including projections to 2065. *New Zealand Journal of Forestry Sciences*, 44(1): 1-7.
35. Nsiah B., 2010. Contribution of farm forest plantation management to the livelihood strategies of farm households in the high forest zone of Ghana (Doctoral dissertation, Technische Universitat Dresden).
36. Oksanen T., Pajari B., Tuomasjukka K., 2003. Forests in poverty reduction strategies: capturing the potential. European Forest Institute proceedings No. 47, 2003.
37. Sidibé A., 2005. Farm-level adoption of soil and water conservation techniques in northern Burkina Faso. *Agricultural water management*, 71(3): 211-224.
38. Sudan Central Bureau of Statistics., 2012. Fifth Population and Housing Census. Government of Sudan. http://www.cbs.gov.sd/RESULT/Piority% 20 English.xls (accessed 23 July 2012).
39. Sulieman H.M., 2008. Mapping and modelling of vegetation changes in the Southern Gadarif Region, Sudan, using remote sensing: land-use impacts on biophysical processes. Doctoral dissertation, Technical University of Dresden. Germany.
41. Szulecka J., Pretszch J., Secco L., 2014. Paradigms in tropical tree plantations: a critical reflection on historical shifts in plantation approaches. *International Forestry Review*, 16: 128-143.
41. Tesfaye Y., Roos A., Campbell B., Bohlin F., 2010. Forest income and poverty alleviation under participatory forest management in the Bale Highlands, South Ethiopia. *International Forestry Review*, 12: 558–577.
42. Tonts M., Campbell C., Black A., 2001. Socio-economic impacts of farm forestry. A report for the RIRDC/LWRRDC/FWPRDC. Joint Venture Agroforestry Program. Publication No. 01/45. Project No. ECU-8A.
43. Yirga C.T., 2007. The dynamics of soil degradation and incentives for optimal management in Central Highlands of Ethiopia. A Ph.D. thesis. Department of Agricultural Economics, Extension, and Rural Development, University of Pretoria. South Africa.

Please cite this Article as:

Hemida M.A.A. and Adam Y.O., 2019. The Importance of Farm Trees in Rural Livelihoods in Eastern Galabat Locality, Sudan. *Agric. For. J.*, 3(2): 81-88.
DOI: https://doi.org/10.5281/zenodo.3568242