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Influences of Shifting Cultivation on Soil Degradation and Deforestation at El Salaam Locality in South Darfur State – Sudan

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Abstract

The study was conducted at El Salaam Locality which is laid between (24º 30' and 24º 50' Northern latitudes, and 11º 20' and 11º 40' Eastern longitudes) South Darfur State during the years 2017– 2018. The aim of this study was to conduct a socioeconomic survey to detect peoples' perceptions toward soil degradation and deforestation from shifting cultivation. A primary data was collected by questionnaire from farmers were practices shifting cultivation. Secondary data were obtained from the documents related to the study aims. In addition to that, field observations and general survey were used to obtain primary data. The statistical package for Social Science (SPSS) program was applied to analyze data obtained from farmers. The respondents showed significant differences at $p<0.0001$ in age grouping, sex, life system and family size, also the results showed that the illiteracy was increased within farmers. The shifting cultivation was the main sources of income for the local farmers, and there was high demand of land resources to practicing shifting cultivation due the increased family size and immigration from conflict areas, The reasons behind soil and land deterioration were shifting cultivation, the reasons behind soil and land deterioration where the practice of shifting cultivation, cutting trees and fires, which often used by the local farmers to clean forest land to cultivate their crops. Inefficiency products and poor production system and land degradation are the most phenomenon in the study area. The study also concluded that, the degradation of land and forest cover was resulted from deforestation and expansion of crop land, and these are the most serious problem that facing forestland and ecology.

Keyword: shifting cultivation, deforestation, soil, land, farmers, deterioration

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1. Introduction:

Shifting cultivation is one of the earliest forms of agricultural systems and dates back to about 7,000 B.C., when man began to change its mode of life from food gathers and hunters to cultivators. It is a very primitive form of agriculture Pareta, (2013). Traditional shifting cultivation, practiced by indigenous farmers, has been found to be a well-balanced and ecologically sound system. In this system, the fallow period had been sufficiently long to restore soil fertility and to prevent weed infestation. However, at present, intensive land use associated with the current socioeconomic condition results in various types of environmental deterioration such as land degradation, declining crop yield, and deforestation Kendawang, *et al,* (2004). The practice of shifting cultivation occurs every year, the destruction of thousands of hectares of forests and bushes; this activity introduces changes on natural ecosystems through the destruction of soil and vegetation cover Ranjan and Upadhyay, (2001). Declining soil productivity and increasing weed problems lead farmers to abandon fields after a few years Arifin and Hudoyo, (1998).

The increase in human population density, after drought and Darfur conflict, has put tremendous pressures on land use systems. Currently, rain fed cultivation and irrigated farming are only practiced in small pockets close to settlements due to insecurity and displacement, some people go camping during the rainy season and return to IDPs camps after harvest a process that is locally called agricultural returns or seasonal returns Ahmed, (2016). As in El Salaam locality -study area- some people have come down from Nyala city and IDPs camps around it to find agricultural land by certain settings from land owners set local agreements with others who have the means of staying in the country side to cultivate their lands and share harvest at agreed percentages, It has been the main source of livelihood for both sedentary and agro-pastoralists in rural areas in Darfur region locally refer to as traditional rain-fed agriculture. This resulted in agricultural land expansion into forest cover by cutting down trees and shrubs which made deforestation and land degradation. Intensification of shifting cultivation practices by those newcomers living in the forest edge those practiced small-scale slash-and-burn agriculture without incorporating long fallow periods that resulted in a decrease in soil productivity and deforestation. These people represent different ethnic groups which have a unique culture, traditions and techniques for managing land for shifting cultivation and these groups live in small isolated rural communities. The land under shifting cultivation loses its nutrients and top soil. With a reduction in crop yield these groups start moving to new other virgin areas of unproductive lowland to productive upland. Frequent shifting cultivation from one land to the other has affected the ecology of these regions. The impact of shifting cultivation practices on vegetation cover and soil productivity has been widely studied by many research groups and limit research is conducted in South Darfur State these studies try to detect peoples perceptions toward soil degradation and deforestation resulted from shifting cultivation.

2. Material and methods

2.1.1. Study area:

The study was conducted at El Salaam Locality which is located at (24º 30' and 24º 50' northern latitudes, and 11º 20' and 11º 40' eastern longitudes) Latitude-longitude.net, (2015). It's bordered by Nyala locality from North, Beliel locality from East, Kass and Idd el Fursan localities from West and Gerieda and Tullus localities from the South. It's covered about 450,000 Km^2. It consisted of five administrative units, namely Abu Adjura, Sania Delieba, Bulbul Timbisco, Bulbul Abu Gazo and Abu Selala.

2.1.2. Secondary data were obtained from the documents of institutions related to the study. These documents included reports, scientific papers, textbooks and handbooks.

2.1.3.Primary data: based on the following: General survey: It was done in October and September the primary objectives were to give a general background of the physical features of the study area, such as forest tree cover, types of farms and crops, tools used in crop land preparation and farm size

2.1.4. Field observations: This was made possible by covering large distance covered during the field survey. Observations covered various aspects of the area, e.g.: vegetation cover, topography, signs of environmental degradation types of crops information about follow period, and crop land preparation processing, in addition to shifting cultivation activities.

2.1.5.The questionnaires were designed to obtain primary data information from the study area and targeted to farmers whose practices shifting cultivation, these distributed randomly for selecting villages located within the study area, 145 of the respondents were selected randomly from targeted groups whose practice shifting cultivation, these included village leaders and farmers (resident and seasonal) at the study area. The data were analyzed by using statistical package for Social Science (SPSS) computer program. The results were revealed in the form of frequency tables and figure

3. Result and discussion

Table 1) the age within respondents in the study area

Age	Frequency	Percent
18 – 25	19	13.1
26 – 35	31	21.4
36 – 50	69	47.6
50 - above	26	17.9
Total	145	100
Sign	*******	

NS = insignificant (p>0.5). *= significant (<0.01). **= highly significant (p<0.001). ***= very highly significant (p<0.0001).

Table (1) showed that there is a high significant difference at p<0.0001 among the respondents according to their age groups. (47.6%) of respondents were above middle age (36 – 50) followed by middle age (26 – 35) while (17%) were above (50) according to statistical year book (2002). These may be due to the cultivation of land needs manpower because they cultivate manually, in addition to that may be agricultural land were far from their villages

Table (2) the sex within the respondent in the study area

Sex type	**Frequency**	**Percent**
Male	120	82.8
Female	25	17.2
Total	145	100
Sign	***	

The results in table (2) showed there is a highly significant difference at p<0.0001 among the respondents according to their sex types that (82.8%) were male and (17%) were female, these may be due to that man in the rural communities have ability to move and work in long distances between their farm and villages. These may also attribute to the fact that men in rural communities prefer that women are only working in their homes to prepare food, look after children and provide water and fuel wood, as well as opportunities to build houses. In addition to insecurity conditions in study area, moreover the traditional tenure system women could not be able to own a land for farm, women allowed to cultivate a land round their villages (Gabratica)

Table (3) life system according respondents in the study area

Life system	**Frequency**	**Percent**
Resident	120	82.8
Nomads	3	2.1
Seasonal immigrants	22	15.2
Total	145	100
Sign	***	

The results in table (3) showed a highly significant difference at (p<0.0001). The majority of respondents

(82.8) were resident and (15.2%) of them were seasonal immigrants, which they move with their animals using the natural rangeland in rainy season and practice land cultivation at the same time.The same result was reported by (Ibrahim, et al, 2015) in study in Elbaja area immigrants practice agriculture beside animal raring, in the form of shifting cultivation, and they grow different type of crops such as sesame, millet and sorghum, in addition to vegetables. There high number of residents are attributed to a targeted group for study (farmers)

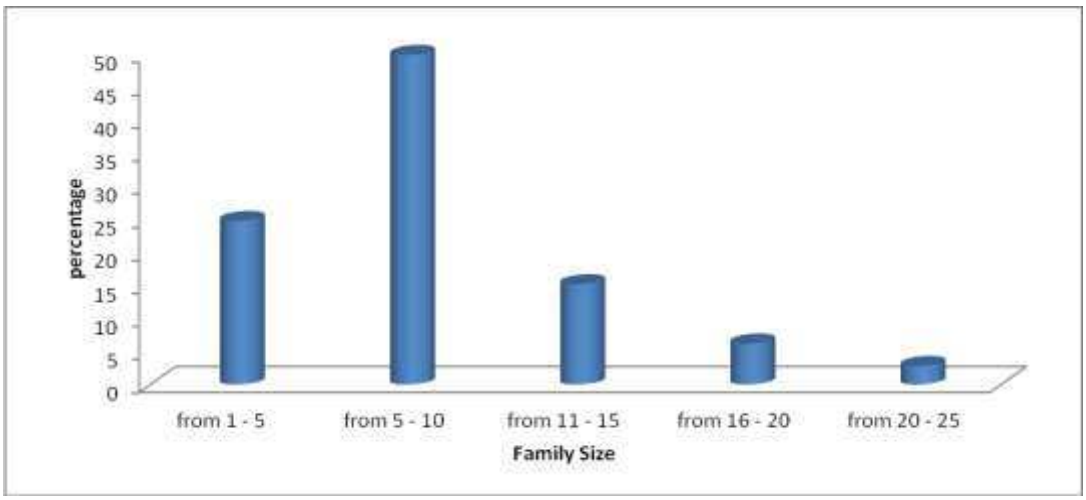

Figure (1) the family size per individual according the respondents

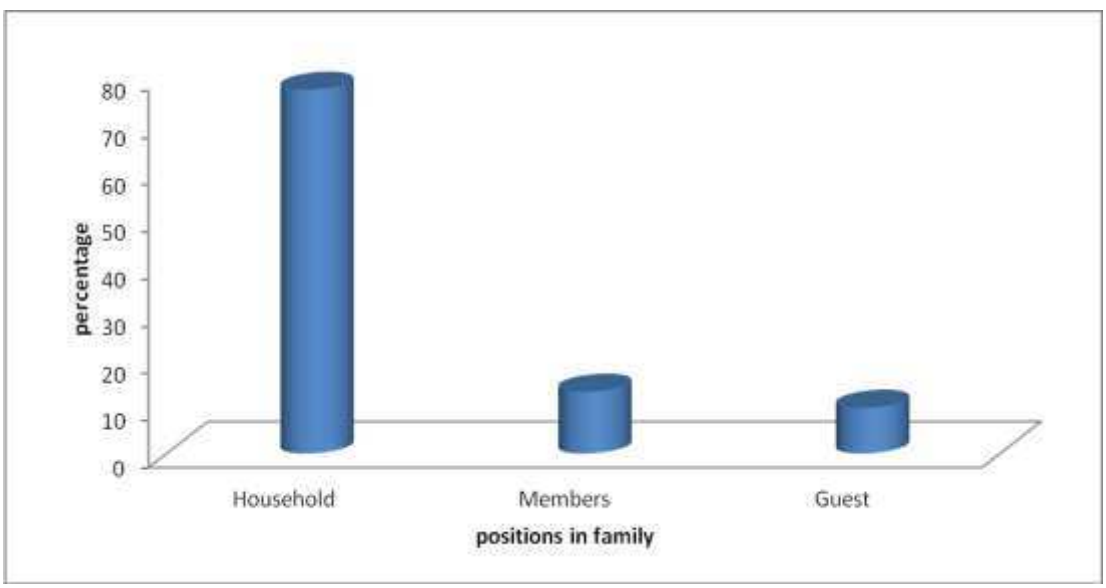

Fig. (2) Respondent's position in the family

Figure (1) revealed that there were high significant differences in family size among respondents families at $p < 0.0001$, most of them (50%) have family size ranging between (6 – 10) members, followed by (1 – 5) members, while (15%) of them have family size ranging between (11 – 15) and fewer of respondents (9%)

said that they have more than (15) member in their families. These may attributed to the culture dictated that a woman's place was in the home, and her succeed was found there, where she served her husband and raised her children, in addition to that they get married in early ages. The increasing of family size within respondents may increase the demand of crop land, to practice shifting cultivation to meet their needs for food that will increase the effects on the environment in the future (fashir *et al*, 2015) reported that, the expansion of agricultural land were led to range land degradation in the Tendalti Locality at White Nile State.

According to Figure (2) Most of the respondents (77.2%) mentioned that their position in the family is Household followed by Members (13.1%), while (9.7%), said they were guests. In rural societies, men is the head of the family this may be due to reason that men have a right to access cropland, to be a leader and have all responsibility for their family, but the role of women was neglected by tradition, also some members were guest these may be to extended families and they look for their relatives in case of security situations in their village.

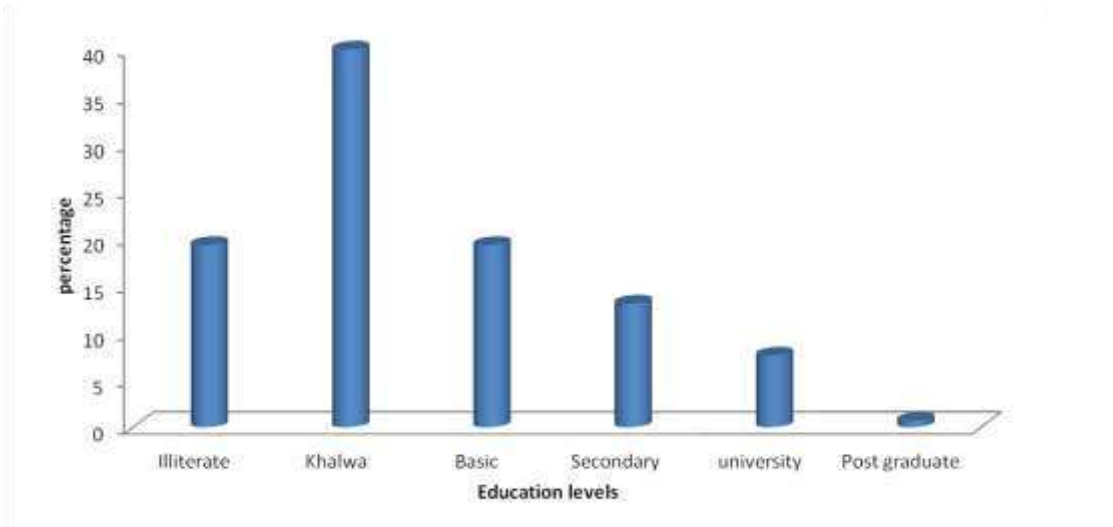

Fig. (3) Education level within respondents in study area

There was the high significant difference between the respondents according to the education levels at $p < 0.0001$. Figure (3) indicates that the majority of respondents (40.0%) were on Khlawa level followed by illiterate (19.3 %), basic level (19.3%), secondary levels (13.1%), and the university at (7.6%).The reason that education level is very low may be due to civil war in the Darfur region in the study area in particular. Also the people in Darfur region preferred Khlawa others education methods.

Table (4) Respondents occupation in the study area

Occupation	Frequency	Percent
Farmers	124	85.5
Formal employment	13	9
Informal employment	8	5.5
Total	145	100
Sign	***	

According to table (4) showed that there is highly significant difference at $p<0.0001$ between the respondents according to their occupations, most of the respondents mentioned that they are farmers (85.5%) and they

used traditional shifting rain-fed agriculture, (14.5%) said they are formal and informal employment. The reason that the majority of the respondents were farmers may be due to the education level that can limit their opportunity for other jobs or due to the fact that there are no other alternatives for farming, also may be attributed to vast areas that are suitable for agricultural uses and in addition to governmental agricultural policies.

Farmland owned

Table (5) number of the farm that owned by respondents in the study area

Number of farms	Frequency	Percent
1 – 3	130	89.7
4 – 6	13	9.0
Missing	2	1.2
Total	145	100
Sign	***	

Table (6) cropland sizes per Fadden according respondents

Cropland size	Frequency	Percent
1 – 10	48	33.1
11 – 20	29	20.0
21 – 30	23	15.9
31 – 40	12	8.3
41 - 50	5	3.4
51 – above	16	11.0
missing	12	8.3
Total	145	100
sign	***	

Table (5) shows the number of the farmland owned by farmers (89.7) of respondents owned more than one farm land (1 – 3). With sizes ranged between (1 – 10) Fadden as indicated in table (6) that represent (33.1%), followed (20%) said they owned between (11 – 20) Fadden, while (15.9%) said their farm size is between (21 – 30) Fadden and (11%) they owned more than (51) Fadden. The high significant differences in both number of the farm land and size per Fadden may be attributed to family size, with increased of family members the demand of farmland for cultivation was increased. Moreover, the traditional pattern of shifting cultivation is needed more than one land to practice crop rotation, which increased the crop yield as they indicate in the table (5-9).

Table (7) the types of cropland tenure, according respondents in study area

Cropland access	Frequency	Percent
Heritage	65	44.8
Rented	34	23.4
Borrowed	22	15.2
Gift	7	4.8
Bought	5	3.4
Missing data	12	8.3
Total	145	100
Sign	***	

The types of cropland tenure in the study area were variations between the farmers, the majority of respondents (44.8%) access cropland by heritage from their relatives, (23.4%) of farmers was rented land for cultivation, (15.2%) were access their cropland by borrowing and (8.3%) of the access cropland by gift and bought as indicated in table (7). The highly significant differences in cropland access may attributed to different ethnic groups that reside in the study area and by customary rights the land is for local peoples, but the newcomer can access land by rent, borrow or gift even they bought because they have not right for the indigenous Khakura tenure system. These methods of land access based on custom as in many parts in Africa that customary rights to land in indigenous societies are usually followed their traditions and through the ways in which community leaders assign land use rights to the community members. These rights of access may have their origin in the use of the land over a long period.

Table (8) shifting cultivation practices at same cropland per years, according to respondents in the study area

Years of shifting cropland	**Frequency**	**Percent**
1 - 3	131	90.3
4 - 6	7	4.8
Miissing	7	4.8
Total	145	100
Sign	***	

There was the high significant difference between the respondents according to shifting cultivation practices at same cropland per years at $p < 0.0001$. The results table (8) revealed that the majority of respondents (90.3%) mentioned that took between (1 – 3) years cultivated the same land, while (4.8%) said they took more than three years in the same land. The reason of shifting to other lands may be due to declined of land fertility by cultivation one crop.

Table (9) vegetation cover on respondent's farm land.

Answer	**Frequency**	**Percent**
Yes	135	93.1
On	10	6.9
Total	145	100
Sign	***	

Table (9) showed highly significant differences within respondents according to having vegetation cover in their land before starting cropping, and (93.1%) of them indicate that there was vegetation cover in their land.

Table (10) conditions of vegetation cover before start crops cultivation

Vegetation cover conditions	**Frequency**	**Percent**
Very dense	84	57.9
Dense	20	13.8
Moderately dense	7	4.8
Slightly dense	34	23.4
Total	145	100
Sign	***	

The results in table (10) showed very high significant differences at $p<0.0001$, that the most of respondents

(57.9%) said that the trees cover condition was very dense when they started cropping land preparation, (13.8%) said it was dense, (23.4%) said it was slightly dense, these may be shifting cultivation needs to move from land to others looking of fertile land. These types of practice of shifting cultivation occur every year, they destruction of thousands of hectares of forests and bushes. This activity introduces changes on natural ecosystems through the destruction of soil and vegetation cover Ranjan and Upadhyay, (2001). Declining soil productivity and increasing weed problems lead farmers to abandon fields after a few years Arifin and Hudoyo, (1998).

Table (11) Benefit comes out from tree cutting according to respondents

Benefit from tree cutting	Frequency	Percent
Firewood	71	49.0
Building materials	24	16.6
Farm fencing	12	8.3
Charcoal making	11	7.6
Green manure	14	9.7
Fodders	9	6.2
Burn	4	2.8
Total	145	100
Sign	***	

The results in table (11) revealed that there was high significant differences among respondents according to needs come out from cutting vegetation (49.0%) said they benefit firewood when we cutting trees to prepare crops land, (16%) mentioned that they benefit building materials, (7.6%) said they benefit charcoal, others (8.3%) indicate that they used trees for farm fencing and in addition to (9.7%) said the benefits green manure from trees cutting. As indicated in results above many benefits comes from vegetations cleanness, they can encourage people to move quickly from land to other land. Moreover, these practices can decrease forest and natural regeneration. Mohamedain (2009) stated that, removal of tree cover for crop production felling trees for fuel wood and building poles were practiced in Darfure region.

Land fallow

Table (12) fallow length per years according to respondents

Numbers years	Frequency	Percent
1 - 2 years	116	80.0
3 – 8 years	29	20.0
Total	145	100
Sign	***	

Table (13) land leaves to go fallow and satisfied with fallow length according to respondents in the study area

Answer	Land Leave for go fallow		Satisfied with fallow length	
	Frequency	Percent	Frequency	Percent
Yes	127	87.6	55	37.9
No	18	12.4	90	62.1
Total	145	100	145	100

Sign	***	***

The results in table (12) and (13) showed that, there were very high significant differences at p< 0.0001 among the farmer according to land fallow, (87.6%) of respondents said they leave their land to got fallow, about ((87.0%) mentioned that the fallow length per years were between (1 - 2 years), and (62.1%) said they not satisfied with fallow length, these result indicate that fallow period were not enough for re-establishing soil fertility because they leave crops land to short period and return to cultivate again, according to Filho *et al.,* (2013) the cultivation period must be shorter than the fallow period, in areas where the fallow period has been reduced to one year in extreme cases to 5 or 6 years in moderate cases fertility is insufficiently restored as to sustain a high crop yield for two to three continuous cropping, and under these conditions that the farmers realize that their land is 'dead' and shift to new areas where fertility is much higher, also the reported that the fallow period must be managed and allows recovery from the soil degradation resulting from conversion and cultivation , and (62.1%) said they not satisfied with fallow length

Table (14) the main power used in shifting cultivation practices

Types of power	**Frequency**	**Percent**
Man power	28	19.3
Animal power	117	80.7
Total	145	100
Sign	***	

The results in table (14) indicated that (80.7%) of respondents using animal power for cultivating their cropland and (19.3%) said they cultivate their land manually. The high significant differences between respondents answer may be attributed to farm sizes that they own, or may be due to traditional methods and tools that used in shifting cultivation, in addition to that the purpose of agricultural practices for their usage only note of traded or selling (FAO,2017) reported that agricultural operation in small scale rain-fed crops production are handled mostly by family members and depend on the use of locally tools . From observation, fire was used in land preparation, the reason may be due to that they used forest land and converted to cropsland these needs trees cutting and burning it to clean land for agricultural practices.

Table (15) the indicators used by respondents for identifying soil degradation

Indicators	**Frequency**	**Percent**
Degreased productivity	92	63.4
Loss of top soil	21	14.5
Increased pest/ diseases	22	15.2
Bad growth	5	3.4
Invaders plant species	5	3.4
Total	145	100
Sign	***	

The results in table (15) shows significant difference between the respondents according to the indicators used for identifying soil degradation at p < 0.0001, about (63.4%) of the respondents said there is a clear indicator of soil deterioration, and these resulted in the form of decreased productivity, Followed by (14.5%) considered loss of topsoil is indicator while (15.2) said increased pest/ diseases is indicated for soil degradation. The reasons behind soil deterioration may be due to shifting cultivation, cutting trees or fires which often used by farmers cultivate the crops. Moreover, the reason may attribute to the fluctuation rainfall and frequency drought also causes an additional factor of soil deterioration in the study area.

Crops yields condition

Table (16) Crop yield in stable condition according to respondents in study area

Crop yield in stable condition	Frequency	percent
Yes	55	37.9
no	90	62.1
Total	145	100
sign	***	

Table (17) Crops yield condition in study area

Crops yield condition	Frequency	percent
Increased	60	41.3
Decreased	4	2.8
Fixed	5	3.4
Fluctuated	68	46.9
Missing	8	5.5
Total	145	100
sign	***	

Table (18) the main causes of Crops yield Fluctuation in the study area

Causes of crops yield fluctuated	Frequency	percent
Decline of soil fertility	84	57.9
Insufficient rainfall	45	31.0
Poor techniques	6	4.1
Vegetation cover	3	2.1
Missing	7	4.8
Total	145	100
Sign	***	

The results in table (16) and table (17) revealed that the crop yields condition in the study area. The results show significant differences between the respondents according to crop yields condition at $p < 0.0001$, as in table (18) most of the farmers (62.1%) said that crop condition were not in stable condition, these may be due to shortage of rainfall between a different seasons. Also the results in a table (17) revealed that the majority of respondents (46.9%) mentioned the crops yield were fluctuated followed by (%41.3) said the crop yield were increased. The crop yields may be fluctuated due to climatic condition such as rainfall, drought, and other factors like bad seeds uses. And increased of cops yield may attributed to soil fertility when they cultivated a new land.

Also the results in a table (18) showed the main causes of Crops yield Fluctuation, the majority of respondents (57.9%) mentioned that the main causes of crops yield fluctuation were declined of soil fertility, while (31.0%) of them said crop yields fluctuated by insufficient rainfall, the reason of crops yield fluctuation may be due to traditional cultivation methods that used within farmers in the study area. Moreover, pests, natural disasters, soil fertility, and other factors can have an impact on crop yield fluctuation, also crop yield fluctuations may attributed to temperature which were much more vulnerable in area to others.

Table (19) traditional land rehabilitation methods used for mitigating soil fertility

Land rehabilitation methods	Frequency	Percent
Added soil organic meter	12	8.3
Crops rotation	111	81.6
Ploughing once	4	2.9
Agro forestry	4	2.9
Plant residues	5	3.7
Missing	9	6.2
Total	145	100
Sign	***	

The results in table (19) shows significant difference between the respondents according to traditional land rehabilitation methods used for mitigate soil fertility at $p < 0.0001$, most of them (81.6%) said that they used crops rotation to increased soil fertility, these may attributed to their knowledge that given by practice land cultivation for long time or maybe they practice growing different types of crops in the same area in sequential seasons, these can give various nutrients to the soil. In addition to that a traditional element of crop rotation can use of green manure in sequence with cereals and other crops also it helps in reducing soil erosion and increases soil fertility and crop yields at the same time.

4. Conclusion

The study concluded that the illiteracy increased within the farmers, group. The cultivation was considered the main source of income within local communities. The shifting cultivation was considered the main sources of income within local people, and there was high demand of land resources to cultivate due to increased family size and immigration from conflict areas. The main reasons of the land deterioration were shifting cultivations and deforestation. The results showed that crop's condition were not in stable condition, the main causes of crops yield fluctuation were declined of soil fertility, pests, natural disasters, and other factors. Influences of shifting cultivation on soil degradation and deforestation were the main reason on ecological problems.

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