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Assessment of Selected Environmental Impacts and Current Situation of Rangeland in Wad Omer Agricultural Scheme West Omdurman- Sudan

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Abstract

The study was conducted in Wad Omer agricultural scheme at Omdurman locality which was located between 16º 19′ 37″ -16º 27′ N and 31º 43′- 31º 47′ E, in Khartoum state, during the years 2017and 2018. The aim of the study was to investigate environmental impact of drought and desertification in Wad Omer agricultural scheme. For vegetation measurements the parker loop method were used to measure relative plants cover, of the rangeland using transect 100 meter tape and a ¾ loop placed at ground level at one meter intervals. In addition to, weight and harvest method was used to determine biomass in specific area, ($1m^2$). Also in the same quadrate was used to determine plant frequency%, and plant density. The questionnaire were designed for three villages (Wad Omer village, Souge village, and Umharoot village) of the total villages round wad Omer agriculture scheme that represent 10%, a total of 105

respondents was taken. A questionnaire was designed to collect data and information required. The target groups were farmers, traders, herders, Focused group discussion was conducted using checklist to investigate some aspects concerning with the study. The standard equations of vegetation measurement were used for plant attribute data analyzes and the statistical package for social sciences (SPSS) was used to analyze socio-economic data. The results showed the average percentage of plant cover in the sandy soil was higher than the rocky soil site also the result showed that the plant density in sand soil was 45/plant/m^2 and 35/plant/m^2 in rock soil. The productivity of the biomass had not affected by the soil types in grazing sites, while the sandy soil grazing site recorded the same production of biomass compared to rocky soil grazing sites.

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Key Words: Rangeland, Plant density**,** Rocky soil, biomass, overgrazing.

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1. Introduction:

The Sudan is one of the most seriously affected counties in south of Sahara by desertification and recurrent droughts (Goda, 2007). In the Sudan drought is the main reason causing the breakdown of the primary production system, in addition to pest, fires and other hazards, the breakdown of primary production system (especially farming or livestock systems), result in major loss of output. Wad Omer agricultural scheme is partnership between FAO and Ministry of Agriculture, Livestock and irrigation. The State of Khartoum, where work begins in 2004 and is still continuing. The area is open desert areas that influence the desert crawl and intense storms and sand movement in the form of buttoning reputing .The region suffers from the deterioration of rangeland, forest and the proportion of fire wood collection and use of trees in fuel and the lack of rainfall, (Sumya, 2008). The environmental assessment is activities

designed identify and predict the impact of project on biogeophysico-chemical environmental and on human health so as to recommend appropriate legislative measures, programs, and operational procedures to minimize the impact (Y. Anjaneyulu, et, al, 2017). Desertification is a major environmental problem with adverse socio-economic impact, particularly in the arid and dry sub-humid land of developing countries (Hamza, 2009). Desertification and drought endangered rain-fed agricultural production, grazing land, led to decrease in the animals numbers, and made the pastoralist migrate away to search for drinking water and pasture in dry seasons(Mustafa ,2007). The Rangeland of the Sudan is a land that is dominated by grasses, forbs, managed as a natural ecosystem. Rangelands do, not only for low- input and renewable forage for grazing, but also serve as watersheds, recreational areas, and natural environments for native plant and wildlife (Mohammed, 2011).Rangeland supports different vegetation types including shrub lands such as deserts, steppes, temporarily treeless areas in forests, and whatever grows on land today, sandy, rocky, saline, or wet soils, and steep topography for commercial farm and timber crops (Grice et al., 2008).

2. Study Site:

The study area located in Khartoum state and Occurs on the northern part of Omdurman (at Elkilo 84, Khartoum – Dongla highway), which was located between 16º 19′ 37″ - 16º 27′ N and 31º 43′- 31º 47′ E, (Ministry of Agriculture, Khartoum State, 2012). The total area of the Wad Omer Agricultural Scheme is about (840 hectares), just 25% covered by Scheme activities (210 hectare). Wad Omer village surrounding with a sough village at North (Farah, 2008).

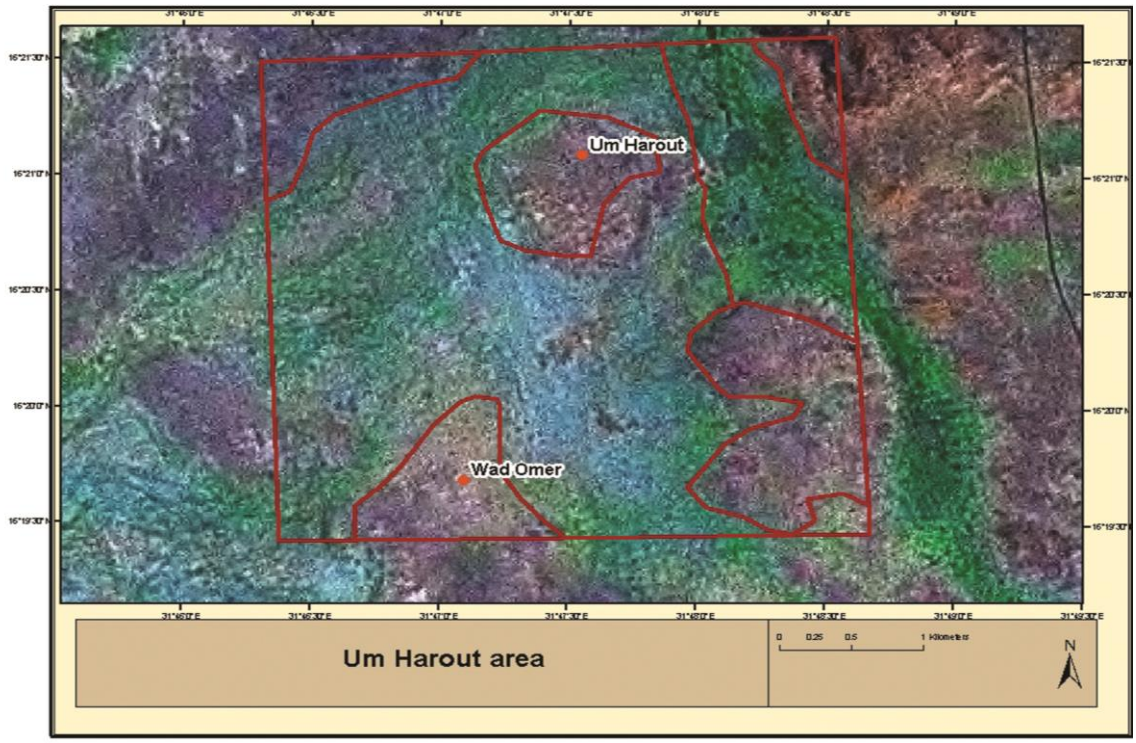

Fig (1) Wad Omer area, Ministry of Agricultural, 2012

Research objective:

The General objective of the study was to evaluate the environmental impacts of natural rangeland management interventions in Khartoum state at Wad Omer agricultural scheme. While the Specific objectives of the study were to investigate the environmental impacts on vegetation attributes, and to evaluate the socio –economic aspect of wad Omer agricultural scheme.

3. Methodology:

Data collection:

The primary data was collected through questionnaire and vegetation attributes measurement.

Plant measurements sampling:

Measurements taken for the herbaceous cover included plant cover, plant frequency,

trees density and Bio mass. While the measurements taken for the browse assessments were tree density and available browse. A Loop, 1 m^2 quadrate, a 100 m tape, and ranging rods were the major equipments used. The following measurements were taken within the sample plots and along transect.

Plant Cover:

Readings were taken using quadrats every 20 meters interval, the most prevalent types of plants within quadrates were identified. Twenty Five readings were taken for plants in the two sites. The ground cover estimated as follows:

$$\text{Plant Cover} = \frac{\text{Total hits of plant species}}{\text{Total number of hits}} \times 100$$

Plant Frequency:

Frequency is the number of times, a plant species is present in a given number of quadrats of a particular size or at a given number of sample points. Frequency is usually expressed as a percentage and sometimes called a Frequency Index. It is calculated as follows:

$$\text{Species frequency} = \frac{\text{Number of Samples containing species}}{\text{Total number of Samples taken}} \times 100$$

Trees Density:

The nearest individual method was used in each site. Density for trees was determined in each site. A total of 30 points were selected randomly for each site at each point distance to nearest tree spp measured and the type of tree reported. Tree density was calculated as follow:

$$\text{Mean Distance} = \frac{\text{Sum of Distances measured}}{\text{Number of Samples Taken}}$$

Density per hectare was obtained as follow:

$$\text{Density} = \frac{10000\ m^2}{2\ (\text{Mean Distance})^2}$$

$$\text{Relative trees density} = \frac{\text{No of species encountered}}{\text{Number of all trees}} \times \text{density of trees}$$

Biomass productivity:

To determine the dry matter production (DM) a 1×1 meter (quadrat) was placed along each transects at 20 meter intervals (eight quadrat/transect). The plant species in each quadrat were clipped at (3) cm above the ground level, as this represent grazing level using scissors. The harvested plant materials were placed in paper bags, partially dried under sun light to reduce the moisture contents of plants and to proted them from decaying, because when the samples were taken the moisture was high. The plant materials were oven dried at 75◦c for 48 hours , the oven dried materials were weighed .the dry matter per quadrate was obtained by divining the total weighed of all quadrate by their number (35 quadrate per site) to obtain one average of weight (gm/m2).Then the dry matter (Ton/h) was obtained. Total forage production in ton/h was calculated after divinding the total biomass production by two (50% available forage), a proper use factor (PUF) as stated by (Drage, 1986).

$$\text{Range productivi ty (Ton/ha/yr)} = \frac{\text{Average biomass (g/m}^2\text{)} \times 10000 \times 0.5}{1000000}$$

0.5= Proper used factor, 10000=hectare, 1000000=convert to tone

Socio –economic aspects:

Direct interviews, a questionnaire and observation were conducted in Wad Omer agricultural scheme area. The most important indicators for the environmental impacts of desertification and drought . A questionnaire was prefered to collect the data and selected environmental aspects in the area. Farmers and herders, where random samples were selecting three village(Wad Omer village, Suog village and Um Harout village) located within study area,805 of respondents were selected randomly that included from the target group. (30) group farmer and herders ,(20) farmers and shepherds were selected from a village and (15) from Umm Harut village to study the environmental impact of sand creeping on agriculture and animal resources and knowledge of the extent of desertification in the region and villages most affected by desertification. On

rainfed agriculture and less affected villages that depend mainly on irrigated agriculture.

Data analysis:

The vegetation attributes data were analyzed by using the standard equations of range vegetation measurement, SAS used to analyze the biomass productivity and statistical package for social sciences (SPSS) used to analyze socio-economic aspects.

4. Results and Discussion:

Vegetation measurements

Plant Cover

Result in table (1) showed the average percentage of plant coverage at the sandy soil site was 51% and the average at the other site rocky soil was 47.9%. This result indicated that the average percentage of plant cover in the sandy soil is higher than the site rocky soil. Difference in cover could be attributed to different vegetation density at different sites, in addition to relative variation in vegetation composition.

Table (1) Average of plant Cover at the two sites (Sandy and Rocky soil) in Wad Omer agricultural scheme:

Sites	Rock	Litter	B.S	SP	Plant Cover percent %
Sandy	2	9	14	73	51
Rocky	5	11	18	53	47.9

Although cover percentage is an important variable in range assessment but it may not reflect the quality of range in relation to plants characteristics, but in all cases cover percentage was higher than critical values stated by (Reid, and Love, 1951), which may indicate that project interventions contributed positively to area conservation and protection from soil erosion. Variation in cover percent could also be attributed to growth performance as indicated by the growth condition. (babeker,2012) stated that rangeland management plans should include grazing management with the purpose of increasing the vegetation cover and decreasing the grazing pressure on the natural

vegetation and controlling kinds and numbers of animals (Proper stocking).Also Abdalla et al (2013) stated that the plant cover in sandy soil was a higher at the other sites. When utilizing the rangeland it is absolutely essential to regulate the effects of grazing on vegetation cover. This is found to be realistic as the interview with villagers confirmed, since according to their views that before the project the cover was poor in the area for many years compared with recent years.

Plant Frequency:

Table (2) and table (3) showed that the frequency into two sites of *Corchorus spp* was 87.5% in the sandy soil site and 100% in the rocky soil site with activities .Species with high frequency in the site sand soil with activities were *Corchorus spp* 87.5% *Eragrostis tenella* 75% *Aristida adscensionis* 75 %, *Dactyloctenium aegyptium* 62.5% *Panicum turgidum 50% Trianthema portulacastrum* 37.5% and *Amaranthus spp* 37.5%.In addition to species with high frequency in rocky soil site with activities were *Corchorus spp* 100%, *Trinthema spp* 87.5%, *Aristida adscensionis* 75%, *Crotalaria senegalensis*75%, *Dactyloctenium aegyptium* 62.5%, *Panicum turgidum* 62.5%, *Senna occidentalis* 50%, and *Tribulus terrestris* 37.5%. The result showed that the plant density in sandy soil was 54/plant/m^2 and 35/plant/m^2 in rocky soil. This result is higher in sandy site soil than other site. The results indicated that the frequency percentage of a plant in the area varies depending on plant palatability. It is found that the frequency of *Eragrostis tenella* and *Trianthema portulacastrum* in the sandy soil site with activities (75% and 37.5%) relectivey higher than the other site.

Table (2) Plant Frequency % and Density at the site (Sandy Soil) in Wad Omer Agricultural scheme:

Species name	**Local name**	**percentage%**	**Density/plant/m^2**
Tribulus terrestris	Diraisa	7.5	8
Dactyloctenium aegyptium	Abuasabee	62.5	5
Eragrostis tenella	Banw	75	8
Forsskaolea tenactssima	Leseeig	12.5	2
Trianthema portulacastrum	Tarba	37.5	5
Aristida adscensionis	Gaw	75	8
Amaranthus spp	Lesan alter	37.5	2
Corchorus spp	Khudra Baria	87.5	12
Panicum turgidum	Tumam	50	1
Stylosanthes flaricans	Sharaiya	12.5	1
Ipomoea cordofana	Tabar	12.5	1
Trinthema spp	Rabaa	12.5	1
Crotalaria senegalensis	Sefera	12.5	-
Total			**54/plant/m^2**

Table (3) Plant Frequency % and Density at the site (Rocky Soil) in Wad Omer agricultural scheme:

Species name	**Local name**	**percentage%**	**Density/plant/ m^2**
Trinthema spp	Rabaa	87.5	6
Aristida adscensionis	Gaw	75	7
Tribulus terrestris	Diraisa	37.5	3
Senna occidentalis	Sanamaka	50	3
Corchorus spp	Khudra Baria	100	6
Crotalaria senegalensis	Sefera	75	2
Dactyloctenium aegyptium	Abuasabee	62.5	5
Eragrostis tenella	Banw	25	1
Panicum turgidum	Tumam	62.5	1
Trianthema portulacastrum	Tarba	25	1
Schoenfeldia gracilis	Danab alnaga	12.5	-
Amaranthus spp	Lesan alteer	12.5	-
Total			**35/plant/m^2**

Trees Density:

According to the study results in table (4) the total of trees density in the site sand soil with activities was (112 trees) while in the site rocky soil only (23 trees) reflected high difference in trees density values and indicated that *Ziziphus Spina-christi (*Sidir) was 47 trees / hectare in the sandy soil site with the activities and none in the rocky site. The other trees at the site sandy soil with activities were *Salvadora persica* (Arrack) *Grewia tenax* and *Acacia radiana* (Seyal), while in site rocky soil were *Capparis decidua* (Tundub), *Boscia senegalensis* (Mokhate), *Maerua crassifolia* (Sareh). Very few numbers of trees was observed at the site rocky soil compared with other site. Existence of trees and shrubs in the site sandy soil with activities and not in the other site was attributed to the management interventions adopted by the project, including seed broadcasting, fencing and improvement in the nearby irrigation system. The highest tree density was 47 Trees/ha in the site sandy soil, while on the other site no trees were observed. The site with trees will provide a browsing resource during the summer.

Table (4) Relative Density of trees T/h at the two sites (sandy and Rocky soil in Wad Omer agricultural scheme):

Species	**Trees density/ha**	
	Sandy soil	**Rocky soil**
Salvadora persica	25	3
Ziziphus spina-christi	47	-
Maerua crassifolia	16	4
Boscia senegalensis	-	7
Capparis deciduas	3	8
Grewia tenax	7	1
Acacia radiana	14	-
Total	**112**	**23**

Biomass production in different range sites:

From the results represent in table (5), illustrated there were no significant differences among the range sites in the biomass production (Pr >f 0.97). Also transect and quadrate had not affected of the biomass in the study area. On the one hand the productivity of the biomass had not affected by the soil types in grazing sites, which the sandy soil grazing site recorded the same production of biomass compared to rocky soil grazing sites such as 4.16 and 4.13 respectively, see table (6). Generally the biomass production in the two sites was poor, subjected to effect of desertification and sand dunes in this area. Abdelsalam et al (2012 and 2017) stated that lowest biomass found in sandy soil range sites, and less fertile. These rangelands need especial management to improve their capability and biomass productivity, and also need more protection against the soil loss from the wind and water erosion.

Table (5) Effect of sites in Biomass of different sites

Source	DF	Mean Square	F Value	Pr > F
Site	1	0.004	0.00	0.97 NS
Transect	1	3.96	0.78	0.39 NS
Quadrate	3	4.73	0.93	0.46 NS

Table (6) Effect of Sites in Biomass in Wad Omer Area

Site	Mean g/m^2
Sandy soil	4.16 a
Rocky soil	4.13a

Means with the same letter are not significantly different.

Socio –economic aspects:

The results in table (7) show that, there were high significant differences at P< 0.0001 within respondents' age in three villages. That the majority of respondents age were between (20 – 40), in Wad Omer village (40%), Soug village (50%) and Umharoot

village (60%), the second category of respond age (41 – 60) that wad Omer 40% Soug 35% and Umharoot 6.7, while the above 60 were gradually low. These results may be due to that the ages between 20 – 40 were active and very important in agricultural practices in the study area specially in Umharoot village, in addition to the same results were reported by(Babeker, 2012).On the other hand, this results indicates that the high percentage of youth found in the study area, that considered so important when we need to implements any activity to improve and rehabilitate the degraded rangeland, they have contributes in these activities strongly.

Table (7) Age categories of responds in study area

Categories	In Wad Omer village		In Soug village		In Umharoot village	
	Freq	%	Freq	%	Freq	%
20-40	12	40	10	50	9	60
40-60	12	40	7	35	1	6.7
Above 60	6	20	3	15	5	33.3
Total	30	100	20	100	15	100
Sign	***					

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

Occupation of respondent in wad Omer agricultural scheme:

fig (1) indicated that most of respondents were farmers in three villages, about (70%) 0f them in wad Omer village were famers, followed by Soug village (65%) and Umharoot village (60%), but a few of respondents in three villages were herders and traders. The high significant differences within respondent's occupations may attributed to agricultural land availability and the do to encourages com from ministry of agriculture in Khartoum state food security project in (2004), in addition to disasters through last decade such as frequents drought and famine the converted many herders to formers due to loss their animals. this agreed with (S.R.Vero´n, et al 2006) he found that rural population relies on the effective use of natural resources These lands are therefore more vulnerable to desertification and drought. The most widely accepted definition to

date is that desertification is land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climate change and human activities.

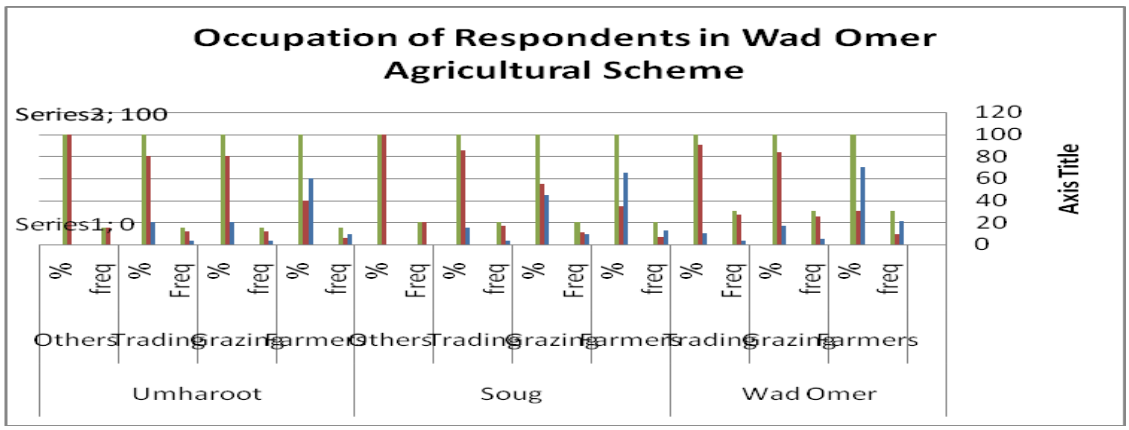

Fig (1) Occupation of respondents in wad Omer agricultural scheme:

Environmental impact of the disappearance of some plant on livestock in study area:

Table (8) indicated that most of respondents were stated that the environmental impact of disappearance of plant cover livestock within three village were very high significant such as Wad Omer village 53.3%, Souge village 55%, and Umharoot village 40%. This result may be due to deficiency of livestock, deficiency of forge, desertification, and sand dunes and over grazing. this result agreed with (S.R.Vero´n, et al 2006) found that desertification is a serious threat to arid and semiarid environments.

Table (8) Environmental impact of the disappearance of some plant on livestock in study area:

	Village					
Respondents answer	**Wad Omer**		**Soug**		**Umharoot**	
	Freq	%	Freq	%	Freq	%
Yes	16	53.3	11	55	6	40
No	14	46.7	9	45	9	60
Total	30	100	20	100	15	100
Sign ***						

Selected environmental impact of Wad Omer agricultural scheme in the study area:

According to results in fig (2) the majority of respondents (40%) in two villages (Soug and Umharoot) said there was pollution in farm soil, while the respondents at Wad Omer village said there was no soil pollution. Also the results showed that about (65%) of respondents at Soug village said there was air pollution. followed by Umharoot (46.7%), while (96.7%) at Wad Omer village said there no air pollution, The results showed no water pollution in Suog and Umharoot village all of the respondents stated there were no water pollution, while (43.3%) in Wad Omer village said that there were water pollution, moreover, the results showed (16%, 6%, 5%) respectively that new disease were found in three villages (53.3%, 30%, 33.3%) respectively, these results may attributed to environmental deterioration by human activities and climatic factors

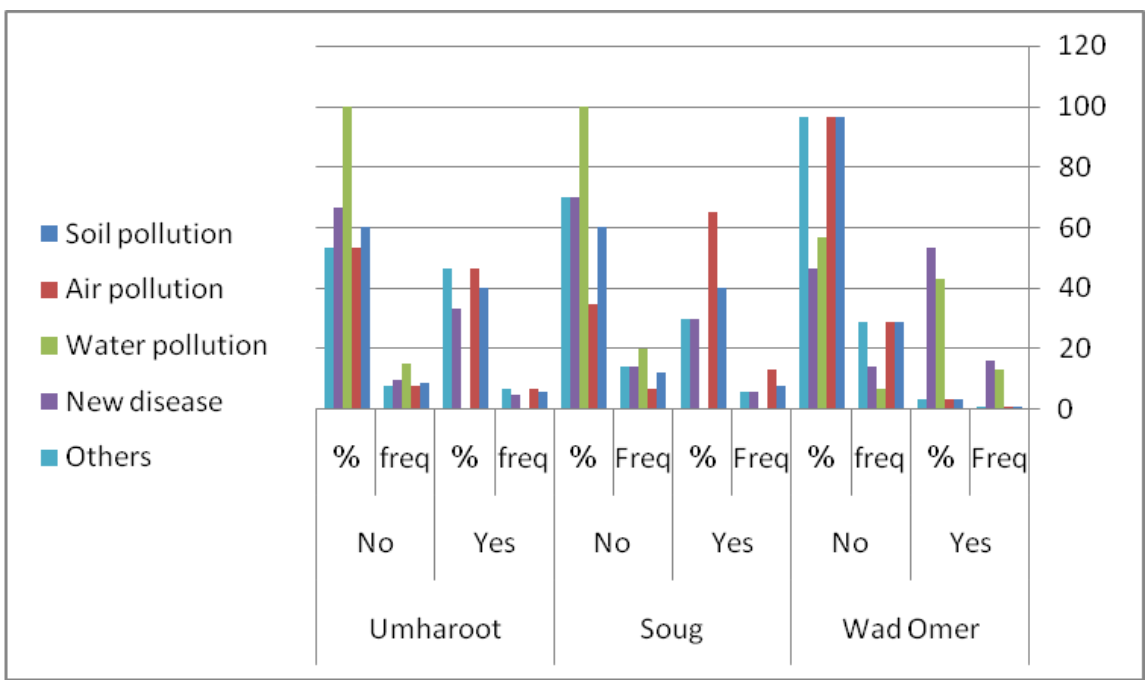

Fig (2) Selected environmental impact assessment in study area

The role of shelter belt in Wad Omer agricultural scheme

The result in fig (3) show that the shelter belt in Wad Omer agricultural scheme have a very high significant differences within three sites according to respondents investigation, that the trees shelter belts prevent soil erosion, soil protection and decreased sand dunce, that Wad Omer recording 40%, Soug village 30% and Umharoot village 60%. For the role of shelter belts in crop protection, the results revealed that 66.7% of respondents stated the shelter belts protect their crops in Umharoot, followed by Wad Omer village 63.3%, while 35% in Soug said the shelter belts protect their crops, this result may be due to good managements of trees shelters belts program and farmers awareness in shelters belts role or environmental benefits of shelter belts to the study area.

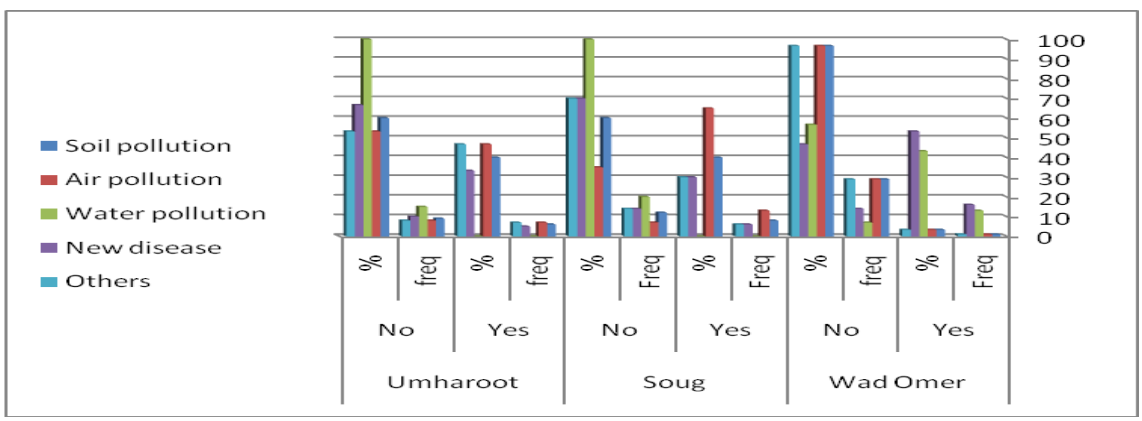

Fig (3) The role of shelter belt in Wad Omer agricultural scheme

5. Consolation:

The study found that the average percentage of plant cover in the sandy soil site was higher that than the rocky soil site, so the plant density in the sandy soil were 45/plant /m^3, while in the rocky soil was 35/plant/m^3. The biomass productivity was the same in the two sites (Rocky and Sandy).The environmental impact of disappearance of some plants in the study area were very high significant, this may be due to deficiency of livestock, forage, desertification, sand dunes moving and overgrazing.

6. Recommendation:

Improve environmental impact assessment and treatment through laboratory measurements and analysis, conservation of natural rangeland in Wad Omer agricultural scheme and development of natural rangeland and conservation of environmental effects and improvement of the current situation in the study area.

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