



Evaluation of the Current Situation of Shelterbelts in Gadambaliya Area, Gadarif State, Sudan

Moatesum Babiker Mohammed¹, Yasir Yousif Abdalla² and Mutasim Ali Mohamed Elagab³

1. Faculty of Forest Sciences and Technology – University of Gezira

2- College of Forestry and Range Science – Sudan University of Science and Technology

3- Faculty of Agricultural Sciences – University of Gezira

Corresponding author Moatesum Babiker Mohammed Moatesum1985@gmail.com Mobile Number 0129208776

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ABSTRACT

This study was carried in Gedarif State in Gadambaliya area. during (2020-2021). The study was aimed to evaluate of current situation of shelterbelts in the study area. Population of the study was 360 respondents from agricultural schemes owners, forests and range employees. Sample of this study was 103 respondents represents 28.6% from the population. Data were collected through questionnaire, group discussion, field survey and formal and informal meetings as a primary data. On the other hand secondary data was used from different sources as references and papers. Data analysis was using Statistical Package for the Social Sciences (SPSS), through using descriptive statistics and chi square test in addition to the content analysis. The findings of the study were; the types of trees in shelterbelts was *Acacia seyal* and *Acacia senegal* and the more effected by illegal cutting, over grazing and bests was *Acacia seyal* . the study shows that schemes owners perceived that the shelterbelts as valuable resource, socially, economically and environmentally. While chi square test found that; There was no significant differences between the two categories of the respondents (scheme owners and employees) in determination of the shelterbelts direction, in effects type of the shelterbelts and in presence of training program about shelterbelts. The study recommended farmers to adopt the act of 2002 which reveals that “10% of their scheme should be planted as a shelterbelt”. Efforts have to be exerted towards stopping illegal cutting and initiation of artificial rehabilitation in order to avoid deterioration of the shelterbelts. Shelterbelts protection and training programs should be directed to the rural communities.

KEYWORDS:

Current situation, Deterioration, Evaluation, Gedambalyia, Shelterbelts

INTRODUCTION

Gedarif State is one of the important mechanized rain-fed agricultural areas in Sudan and produce more than one third of the total production of sorghum, which represent the main food stuff in the country dry land, (Gedarif State, 2012). In the last thirty years the decrease of crop productivity is due to clearance of trees and continuous rain fed mono cropping in Gedambaliya (Elmoula, 1985). Trees planting is accepted by mechanized scheme farmers as stated in the lease contract. According to forest and renewable natural resources act 2002, the shelterbelts should constitute about 10% of total mechanized farm area. Inclusion of shelterbelts in the mechanized farming system started in 1994 in Gedambaliya area with *Acacia seyal* and *Acacia senegal* (FNC, Gedarif State, 2020). The idea is convince farmers in this area to adopt this trial, particularly in other similar area. Shelterbelts are strips of trees, shrubs and grasses planted in rows raised at right angles to the wind direction to reduce wind velocity and give general protection of roads, canals, agricultural fields, the woody stem ,branches and thick foliage help to reduce wind hazard. (Osman, 2010; Nair, 1989). A shelterbelt is a protective screen of trees (with or without shrubs) of more than two rows planted at right angles to the direction of harmful winds in order to decrease their speed and strength , thus protecting large agriculture field, irrigation canal and roads from strong winds , Furthermore, Alamin (2014) defined shelterbelts as rows of trees planted across the wind direction to reduce wind speed. Osman, (2010) mentioned that when the wind direction is at a right angle to the log axis of the barrier , wind speed to lee-ward side is significantly reduced for a distance up to twenty times the average height of the windbreak , small reduction in wind velocity is extended to 30 times. According to Abdalla and Fungamam, (2015), in Sudan usually the shelter belts extends north west and south east in front of north-eastern wind to counteract dry and cold current in winter and the south-western winds loaded with dust in summer and autumn. According to Abdelmagid and Eiman, (2010). Saleem (1986) proposed a shelterbelt design in the rain fed schemes consisting of 6 rows, with equal space at 4m×4m and the distance between shelter belts being 210m. The history of systematic planting of shelterbelt to protect agricultural fields goes back to1789 when a group of German farmers who immigrated to Russia steppes established linear tree plantations (Hussien, 2006). Most studies on the effect of shelter belts on crop yield have been made in the temperate zones where conditions of climate, soil, crop and cropping practices are sufficiently uniform over extensive areas to allow for generalization. Shelter belts effects on crop yields are the integrated result of the complex interaction between site, shelter belts and crop factors, many of which display considerable variety of time and space. As a result of the effects which shelter belts exert on the physical factors, reduced wind velocity, evaporation and transpiration and increased humidity, soil moisture and temperature, yields of crops grown in sheltered areas are higher than in the open thus shelter belts increase the quantity and quality of the crop and increase financial returns (Saleem, 1985). The beneficial effects of shelterbelts on agricultural crops can generally be described as follows: firstly; Interception of solar energy and reduction of the dispersal of Co₂ emitted from the soil. Secondly: Stabilization and improvement of the soil. Thirdly: Provision of additional income from wood sale. And fourthly: Improvement of the landscape. Shelterbelts are very important for agriculture and livestock production and provide essential trees products. They are able to sustain agriculture production capacity via improving the microclimate and protecting and ameliorating the soil. Forests are one of the most vital renewable resources, they have four vital functions: they contribute in soil and water conservation, they

provide rural people with sustainable needs, they are important source of industrial products, hence foreign exchange and they harbor vast genetic resources (Elamin and Elmadina, 2014). In the mechanized rain fed sector in Sudan, yield of sorghum, groundnuts and millet have declined due to poor input supply and lack of rainfall. Tree planting and forest have a role to play in this endeavor by building greater resilience into traditional farming systems through improved soil and water conservation and by improving income generation from the sale of tree plantations (Elamin and Elmadina, 2014)

Objectives of the study:

The general objective: To evaluate the current situation of shelterbelts in the study area.

The specific objectives:

- 1- To investigate the reasons of shelterbelts deterioration.
- 2- To assess the effects of shelterbelts on the crop productivity.
- 3- To Detect the relationship between scheme owners and employees in determination of the shelterbelts direction.
- 4- To explore the relationship between scheme owners and employees in effects type of the shelterbelts.
- 5- To know the relationship between scheme owners and employees in presence of training program about shelterbelts

Variables of the study:

Variables of the study were; area of agricultural scheme, Shelterbelts: (presence, direction, area, objectives, types of trees, benefits, presence of grasses, animals grazing, effects of shelterbelts, rehabilitation), deterioration of the shelterbelt (past status, current status, reasons of deterioration, deteriorated types of trees, usage of deteriorated trees, impact of deterioration on the area, trees affected by pests, trees affected by over grazing), protection of shelterbelts, training programs about shelterbelts and satisfaction of establishing shelterbelts.

Hypotheses of the study:

Ho= there is no significant differences between scheme owners and employees in determination of the shelterbelts direction.

Ha= there is a significant differences between scheme owners and employees in determination of the shelterbelts directions

Ho= there is no significant differences between scheme owners and employees in effects type of the shelterbelts.

Ha= there is a significant differences between scheme owners and employees in effects type of the shelterbelts.

Ho= there is no significant different between scheme owners and employees in Presence of training program about shelterbelts

Ha= there is a significant different between scheme owners and employees in Presence of training program about shelterbelts.

Materials and Methods:

The study was carried in Gadambalyia schemes, which is lies forty six Kilometers to the west of Gedarif town on both sides of Khartoum – Port Sudan Highway centered around Gadambaliaya village. It is subtended by latitudes 13°45' and 14 ° 15' N and longitudes 34° 45' and 35° 15' E,. These are the oldest rain-fed mechanized schemes in the region and it is farming history goes back to the late 1940s, which were cultivated by sorghum as a main crop (Ali, 2009). Forest National Corporation in coordination with Ministry of Agriculture has implemented shelterbelts in the study area to stop the degradation of soil and vegetation cover. Observed that this shelterbelts deteriorated according to many factors, may be; to increased illegal cutting and over grazing. So this study comes to evaluate the current situation of the shelterbelts in the study area. Added to that, the previous studies did not cover this issue. Population of the study was composed of agricultural schemes owners, forests and range employees and forests experts those were 360 divided as follows; 320 of them were schemes owners and 40 of them were forests and range employees. Sample of the study was involved the two mentioned types of the respondents which was selected randomly composed of 103 respondents based on 28.6% of the population, as follows; 83 of the were schemes owners and 20 of them were forests and range employees. Data were collected by using questionnaire forms through field interviews and survey, group discussions, formal and informal meetings with the experts and administrators as a primary data. On the other hand secondary data was used from different sources as references and scientific published papers. Data analysis was done by using different statistical measurements; the first measurement was descriptive statistics analysis through frequency distribution and percentages by using Statistical Package for the Social Sciences (SSPS). The second measurement was chi square test analysis by using 2×2 contingency table to detect the relationship for certain variables and the third measurement was the content analysis.

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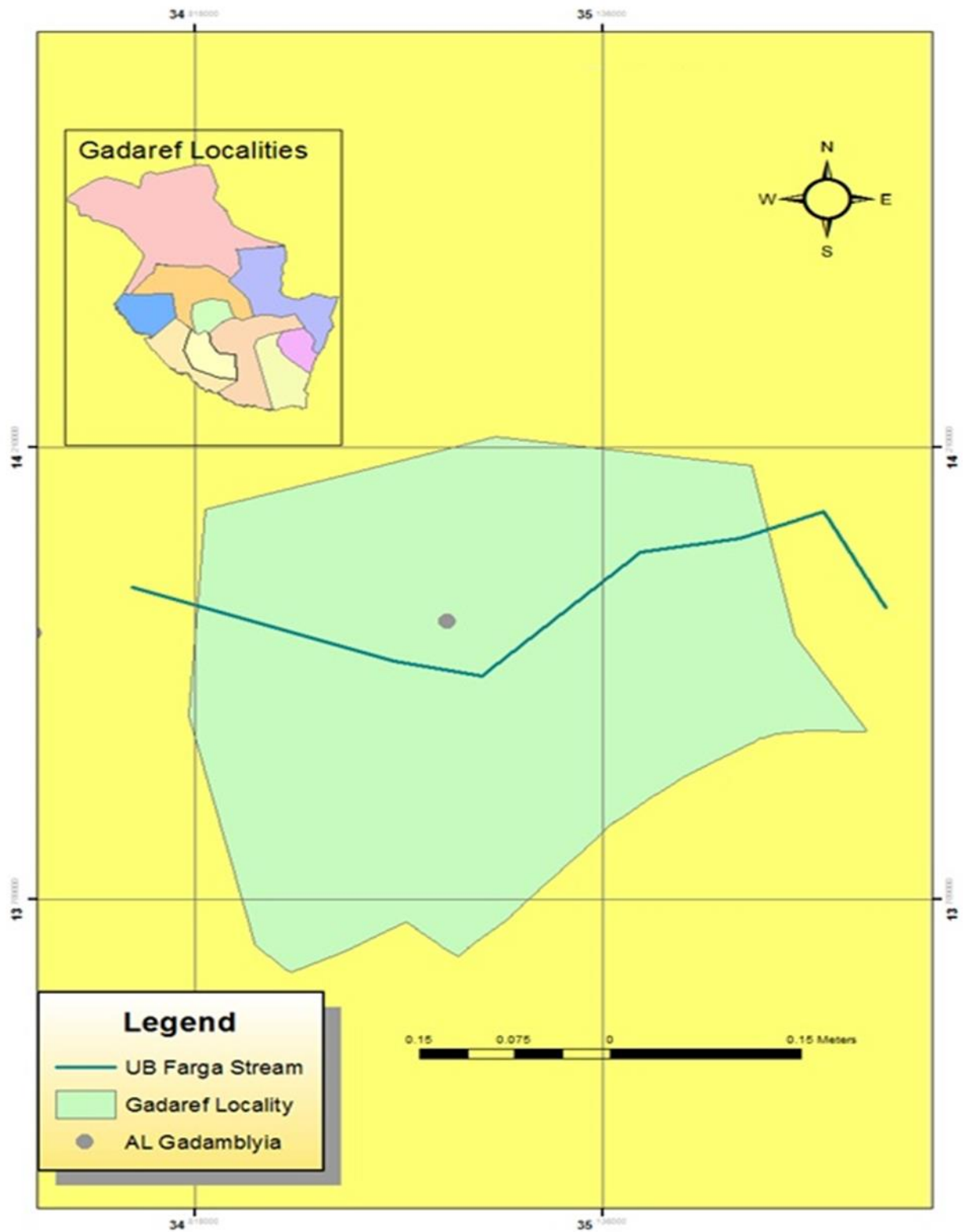


Figure 1: Location of Gedaref State and Gadambalyia area (Department of Irrigation, Ministry of Production and Economical Resources, Gedaref State, 2022)

Result and discussion:

This part of the study is devoted for data analysis and discussion in three parts as follows:

Part one: Descriptive Statistics Analysis:

1- Area of shelterbelts:

Figure (2) shows that, 78.3% of owner schemes respondents reported that their shelterbelts area was 100 feddans and more, These result indicated that the respondents are well aware about the role of the shelterbelts for their schemes. Also these results reported that the owner scheme adopt of forest and renewable natural resources act 2002, which reveals that; 10% of their scheme should be planted as a shelterbelt.

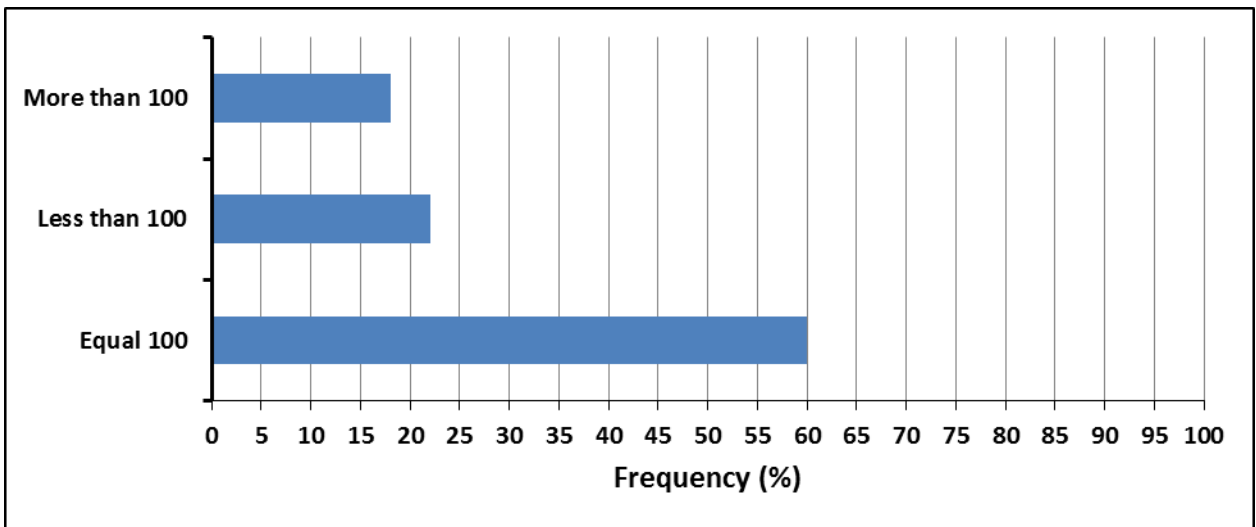


Figure 2: Area of shelterbelts.

2- Direction of shelterbelts:

Figure (3) reflects that 92.2% of the respondents reported that the direction of shelterbelts was West - East. So according to this result most of the respondents from the two categories were agree to the recommended direction, which is "shelterbelt have to be established on West - East". It was clear that this result agreed with the findings of Abdelmagid (1995)

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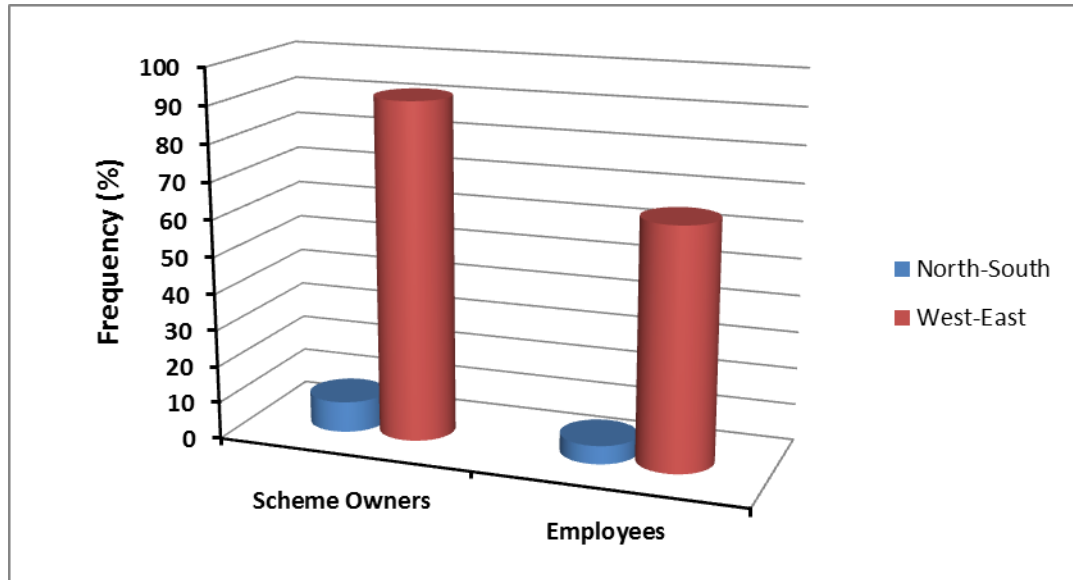


Figure 3: Direction of Shelterbelts

3- Effects of shelterbelts

Figure (4) reflects that 70.9;% of the respondents reported that the positive effects of shelterbelts such as fuel wood, shelter and shade , compared by 29.1% of them who were stated negative effects such as attract insects, bring birds, thieves & animals. It was clear that this result agreed with the findings of Mohammed Nour (2022).

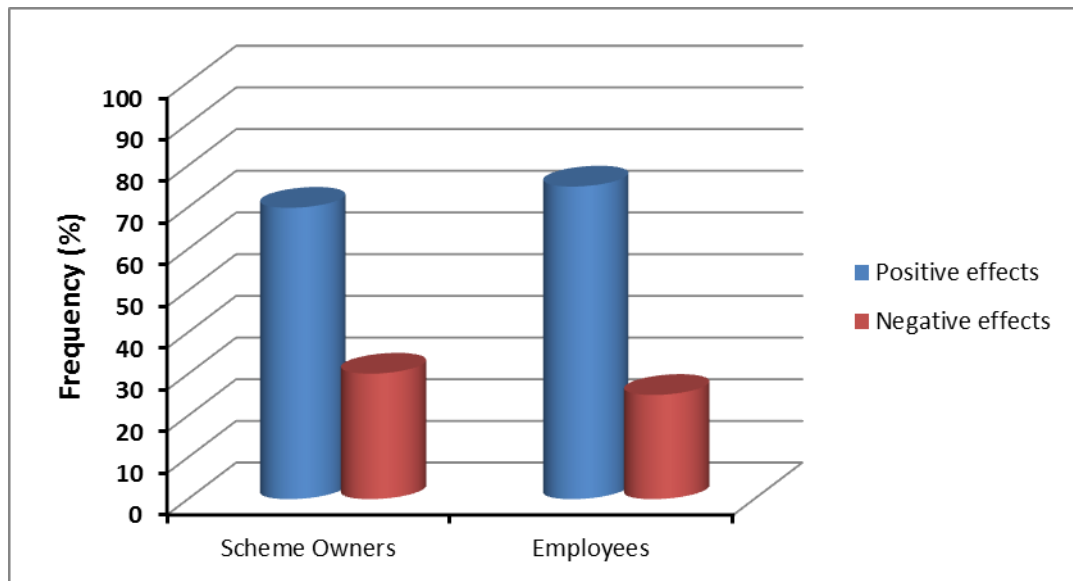


Figure 4: Type of shelterbelt effects

4- The effects of shelterbelts on crop yield:

Figure (5) shows that 79.6% of the respondents said that the shelterbelts increased crop yield, followed by 2.9 % and 17.5 % and of them were reported that the shelterbelts decreased crop yield and the shelterbelts had no effect in crop yield subsequently. These results indicated that, the respondents in the study area are well aware about the role of the shelter belts in increasing the production of agricultural crops. This result is consistent with Charreau *et al.*, (1965) in Senegal and Dancette *et al.*, (1969) in Burkina Faso who mentioned that yield of Millet under Acacia Canopy produced 1688 kg/ha compared with 660 kg/ha on plots outside the canopy, and yield of Millet under Acacia albida canopy reported to 1250 kg/ha compared with 820 kg/ha in control plots outside canopy respectively. Also it is consistent with the study of Gezira Scheme shelterbelts (case of Abu Gota block) (Muneer, 2006) which mentioned that, farmers whose farms are located closed to the shelterbelts got high productivity of crops, while farmers whose farms located away from shelterbelts obtained low productivity. However, according to group discussions and observations the variation in crop productivity is mainly due to: cultivated area, financial ability, rainfall and other climatic conditions, insects and rodents, and cost of tending and agricultural operations.

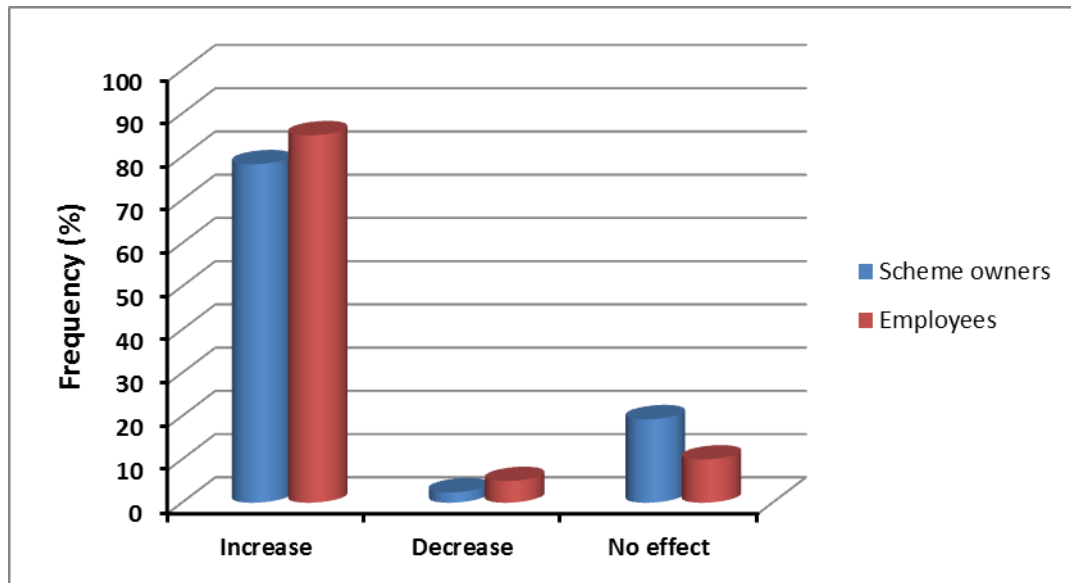


Figure 5: The effect of shelterbelt on crop yield

5- Past status of shelterbelts:

Figure (6) indicates that 85.4;% of the respondents reported that the past status of the shelterbelts was extensive, followed by 10.7% and 3.9 % of them who reported that the status was moderate and deteriorate successively. This result is consistent with El Lazim and Desougi (2015) This means that the status of the shelterbelts in the past was extensive.

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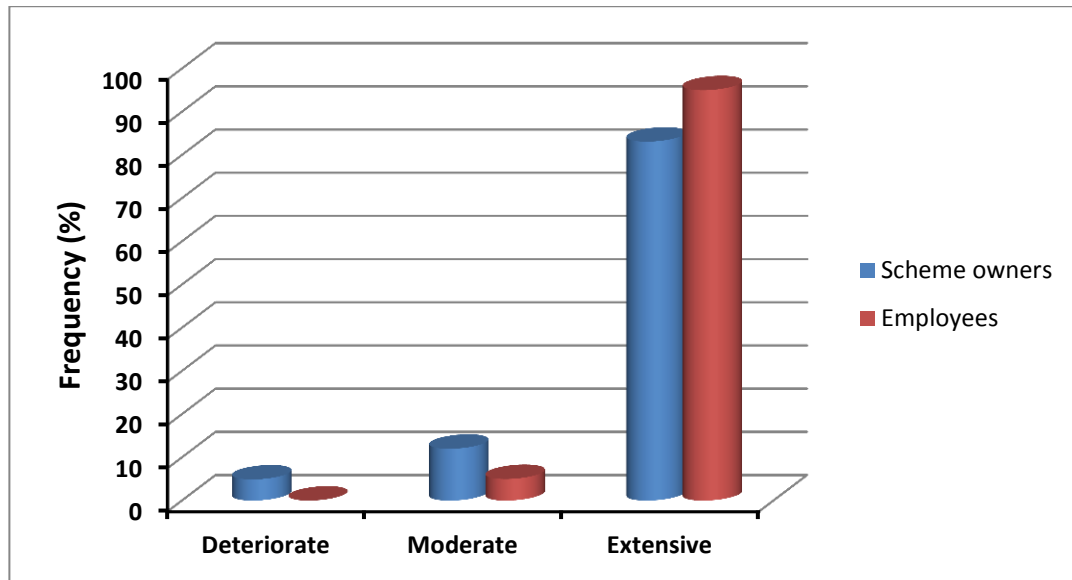


Figure 6: Status of Shelterbelts

6- Current status of shelterbelts:

Table (1) reflects that 70.9% of the respondents reported that the current status of the shelterbelt is deteriorating compared to 29.1% of them who were reported that it is an extensive. This result is consistent with El Lazim and Desougi (2015) This means that the current status of the shelterbelts was deteriorated.

Table (1): Current status of shelterbelts:

Current status	Scheme Owners		Employees		Total	
	No	%	No	%	No	%
Deteriorate	55	66.3	18	90	73	70.9
Moderate	0	0	0	0	0	0
extensive	28	33.7	2	10	30	29.1
Total	83	100	20	100	103	100

7- Reasons of shelterbelts deterioration:

Table (2) table indicates that 56.3% of the respondents reported that the illegal cutting was the main reason of shelterbelts deterioration followed by 24.3% and 19.4% of them who were reported the over grazing and agricultural expansion. This result is consistent with El Lazim and Desougi (2015). The result of this table indicates that the main reason of the shelterbelts deterioration was the illegal cutting.

Table (2): Reasons of shelterbelts deterioration

Reasons of deterioration	Scheme Owners		Employees		Total	
	No	%	No	%	No	%
Agricultural expansion	17	20.5	3	15	20	19.4
Illegal cutting	46	55.4	12	60	58	56.3
over grazing	20	24.1	5	25	25	24.3
Total	83	100	20	100	103	100

8- Most deteriorated trees:

Table (3) shows that 75.7% of the respondents said that the types of most deteriorated trees in their shelterbelt were *Acacia seyal*, followed by 17.5% and 6.8% of them were reported that the most deteriorated trees were *Acacia mellifera* and *Acacia senegal* successively. The result of this table indicates that the types of most deteriorated trees in their shelterbelt were *Acacia seyal*. Because *Acacia seyal* has many uses for local communities (fuel wood, charcoal and building poles)

Table (3): Most deteriorated trees

Most deteriorated trees	Scheme Owners		Employees		Total	
	No	%	No	%	No	%
A. Seyal	61	73.5	17	85	78	75.7
A. Senegal	17	20.4	1	5	18	17.5
A. Melifera	5	6.1	2	10	7	6.8
Total	83	100	20	100	103	100

9- Usage of most deteriorated trees:

Table (4) reflects that 69.9 of the reported that the usage of most deteriorated trees was fuel wood, followed by 23.3% and 6.8% of them were reported that the usage was building poles and charcoal. The result of this table indicates that the most usage of deteriorated trees was for fuel wood.

Table (4): Usage of most deteriorated trees:

Usage of trees	Scheme Owners		Employees		Total	
	No	%	No	%	No	%
Fuel wood	60	72.2	12	60	72	69.9
Charcoal	0	0	7	35	7	6.8
Building poles	23	27.8	1	5	24	23.3
Total	83	100	20	100	103	100

10 - Training program about shelterbelts:

Table (5) reflects that 96.1% of the respondents reported the absence of training program about shelterbelts compared to 3.9% of them who reported presence of it. This result revealed absence of training program about shelterbelts. This result is consistent with Elamin, and Elmadina, (2014).

Table (5): Presence of training program about shelterbelts

Presence of training	Scheme Owners		Employees		Total	
	No	%	No	%	No	%
Present	4	4.8	0	0	4	3.9
Not present	79	95.2	20	100	99	96.1
Total	83	100	20	100	103	100

Part two: Chi square Test Analysis:

Table (6) indicates that; there was no significant difference between scheme owners and employees in determination of the shelterbelts direction. This means there was a relationship between the two categories of the respondents (scheme owners and employees) in determination of the shelterbelts direction. This result may be due to the fact that; the employees were responsible of the determination of the shelterbelts direction.

Table (6): Chi square test for the respondents by determination of the shelterbelts directions.

Variable2	Scheme Owners	Employees	Total	significant
Variable1				
North- South	7	1	8	* 0.27
East - West	76	19	95	
Total	83	20	103	

Tabulated $X^2 = 3.841$ Alfa level = 0.05 df = 1 Source: Field survey (2021) * No sig. dif.

Table (7) indicates that; there is no significant different between scheme owners and employees in effects type of the shelterbelts. This means there was a relationship between the two categories of the respondents in effects type of shelterbelts.

Table (7) :Chi square test for the respondents in effects type of shelterbelts

Variable2	Scheme Owners	Employees	Total	significant
Variable1				
Positive effect	58	15	73	* 0.094
Negative effect	25	5	30	
Total	83	20	103	

Tabulated $X^2 = 3.841$ Alfa level = 0.05 df = 1 Source: Field survey (2021) * No sig. dif.

Table (8) indicates that; there are no significant differences between scheme owners and employees in presence of training program about shelterbelts. This means there was a relationship between the two categories of the respondents in the presence of training program about shelterbelts.

Table (8): Chi square test for presence of training program about shelterbelts

Variable2	Scheme Owners	Employees	Total	significant
Variable1				
Present	4	0	4	* 0.1
Not present	79	20	99	

Total	83	20	103	
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Tabulated $X^2 = 3.841$ Alfa level = 0.05 df = 1 Source: Field survey (2021) * No sig. dif.

Part three: Content Analysis:

1- Interview form questions:

This part is devoted to the questions of the interview which run with three administrators in the Ministry of Production and Economical Resources, Gedaref State, Sudan.

Q 1: What are the objectives of establishing shelterbelts in the Qudunbilyah area?

To stop desert encroachment, stabilize and improves soil quality and conservation of biodiversity.

Q2: What are the benefits of shelterbelt?

Providing fodder, water, and shade for livestock, creating job opportunities, providing firewood and building poles, furthermore it reduces the conflicts between farmers and pastoralists.

Q3: What is the type of trees species in the shelterbelt?

Acacia seyal followed by *Acacia senegal*, and *Acacia mellifera*.

Q4: What is the importance of livestock to the shelterbelt?

It enhances the biodiversity status by distributing tree seeds throughout the grazed/browsed area.

Q5: Are there any negatives or side effects due to the shelterbelt establishing?

There was no any side effect from establishing the shelterbelt.

Q6: What about the current status of the shelterbelt?

It was deteriorated.

Q7: what are the reasons of the shelterbelt deterioration?

Illegal cutting, overgrazing and shortage of irrigation water.

Q8: What are the proposed solutions to stop the deterioration of shelterbelt?

Awareness raising, protection of the shelterbelt, provision of water sources, energy alternatives and natural range lands.

Q9: What is the suitable direction of shelterbelt?

The recommended direction is (East-west).

2- Researcher's notes:

Through the researcher's visits to the study area, he noticed the following:

- 1- Tree belts have deteriorated, especially those near to villages.
- 2- *Acacia seyal* are the most deteriorated trees by illegal cutting.
- 3- The direction of the belts is east-west.
- 4- *Acacia seyal* (Talh) and *Acacia senegal* (Hashab) were found in the shelterbelt.
- 5- There is acceptance of the idea of establishing and maintaining tree belts
- 6- The lack of a sufficient number of permanent guards.

- 7- The belts provide job opportunities for citizens from the villages adjacent to the belt, especially in the establishment stage.
- 8- The area of shelterbelts vary from one to another
- 9- The presence of coppices in the stump of cut acacia seyal.

Conclusion and recommendations:

This study was concluded to the following: Most of the owners' respondents were reported that they have 1000 feddans and more, they were committed to the recommended area of the shelterbelt which was 10% of the total area of the scheme and they were agreed to the recommended direction of the shelterbelt which is " West – East side. The dominant type of trees in the shelterbelts was *Acacia seyal*. Most of the respondents were mentioned positive effects of shelterbelts such as fuel wood, shade, and shelter on the other hand, some of them were mentioned negative effects such as crop competition, attract insects and bring birds and thieves. Most of the respondents reported that the rehabilitation of the shelterbelt is natural, a thing reflects that the types of trees which composed the establishing shelterbelts were adapted to the climatic conditions and capable to recover themselves when they exposed to any hard conditions, such as cutting processes and desertification. Current status of the shelterbelts is deteriorating. According to illegal cutting of *Acacia seyal* for fuel wood. Most affected type of trees by pests and over grazing in the shelterbelts was *Acacia seyal*. The study also concluded to absence of training programs about shelterbelts. Shelterbelts increases the crop productivity and the respondents were satisfied of establishing shelterbelts due to benefits gained from these shelterbelts for them and their communities. On the other hand the findings of chi square test indicates that; There was a relationship between the two categories of the respondents (scheme owners and employees) in determination of the shelterbelts direction, in effects type of shelterbelts and in the presence of training program about shelterbelts. The study recommends the following: Farmers have to commit to the act of 2002 which reveals that; 10% of their scheme should be planted as a shelterbelt. Formal and informal institutions have to exert more efforts towards illegal cutting and artificial rehabilitation in order to avoid deterioration shelterbelts. Government and the local community have to offer alternatives in order to minimize consumption of fuel wood such as improved stoves and cooking gas. Government and the local community have to offer range lands for grazing and to increase fodder production. Government and the local community have to offer protection for the shelterbelts. Forests National Corporation have to introduce training programs for the local community.

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