

***Dedication***

***To my family, Friends  
& to all people in my homeland***

## ***Acknowledgement***

***As the say goes that, if two people tell you that your head is not in place you listen to their advice, so I would like to give my gratitude to those cooperated with me, helping me and sometimes advising me during my research period. And I give credit to all who have contributed to my research topic conceiving the issue of impacts assessment of open grazing system on some rangeland environmental components.***

***I would like to express my deep gratitude and sincere appreciation to my supervisor Prof.Dr. Abdel Hafeez Ali Mohammed for his helpful supervision, valuable advice, and continuous supports throughout this work. And my thanks extend to my co-supervisor Dr. Elkheir Mugadom Salih for his encouragement and continuous supports during the study period.***

***My appreciation extends to Dr: Mohammed Ibrahim, Hesseen Abdullah and to staff of forest and range Department in Dilling locality for their great help in data collection during two seasons.***

***Finally I want to express my sincere and profound gratitude to Prof: Nawal Khder, Ustaz : Mona Hassan, Ustaz Mahil Mohammed Ustaz Kuwther Mohammed for their perceptive comment, advice and suggestion and for this I thank them and ask God to keep and protect them continues in that spirit by helping others.***

## Abstract

The study was conducted at EL Dilling locality rangeland at South Kordofan state which lies about 165km Southwest EL Obied town during the years 2010 – 2011. The aim of this study was to assess the impacts of open grazing system on some rangeland environmental components. The rangeland was divided into three sites according to utilization degree. Three water points were selected randomly from 24 permanents water points. Three grazed sites were also selected randomly, while the un-grazed site was selected in middle of two sites. For vegetation measurements the Parker loop method (Parker and Hiris, 1959) have been used to measure relative plants composition and ground cover of the rangeland. almost 48 transects were delineated using 100 meter tape and a  $\frac{3}{4}$  loop placed at ground level at one meter intervals. In addition to the quadrat method (Wilm *et al*, 1944) double sample procedure was used to determine relative plants density, plant frequency and biomass productivity. For seed bank analysis, 72 soil samples were taken from the three sites to assess seed bank. Almost 12 soil samples of 10×10 cm with a two different depths (0 – 10 cm) and (10 – 20 cm) were taken from each site (four from each transect). The point's center quarter method (Cottam and Acurtis, 1956) had been used to measure trees density. To analyze and assess the socio- economic and social dimensions of open grazing system and its impacts, descriptive statistical analysis had been used. Questionnaire was designed to collect information from the animal owners at the seasonal grazing land users. A total of 120 randomly selected respondents represented 6% of total number on herders that used seasonal grazing land at the study area. The SAS statistical package and manual calculated formula were used for analysis of data obtained from vegetation measurements. And the socio- economic aspects data were analyzed using the SPSS computer programme.

The results showed very high significant differences in ground cover and significant variation in plant relative composition over the three sites. The study showed that the very sensitive forbs that considered to be sensitive for grazing procedure was found in un-grazed site. Also the results showed that plant density and plant frequency showed high variation between the three sites, in addition to very high significant differences in biomass productivity between the three sites. Also the results showed that, native tall grass species like *Sorghum purpureosercim*, , *Andropogon gayanyus*, and *Pennisetum pedicellatum*, and forbs such as *Blepharis linariifolia*, *Asteraceae hyperhernia ofrun*, *Demodium dichotomum*, and *Impomea cordofana* had disappeared around water points and grazing sites, while those plants represented high frequency at un-grazed site. The study conclude that the open grazing system has affected plants growth, decreased soil stability, changing plant types, seed bank and decreased rangeland productivity. Also the study showed that, many populations were affected by open grazing system, as results of degradation of rangeland, and the high demand of rangeland resources. And these led to conflicts among stakeholders.

The study recommended that, new methods of animal production system should be tried. Hence to protect rangeland environmental components deterioration, such as farm for beef production can be established in large areas at Dilling locality.

Rangeland conservation through introduction of native forbs such as *Blepharis linariifolia*, *Asteraceae hyperhernia ofrun*, *Demodium dichotomum*, and *Impomea cordofana* and native grasses like *Chloris gyana*, *Sorghum purpureosercim* *Andropogon gayanyus* should be introduced in rangeland.

## المستخلص:

أجريت الدراسة في ولاية جنوب كردفان بمحلية الدنج التي تقع على بعد 165 كيلو متر جنوب غرب مدينة الأبيض في الفترة من 2010 - 2013. هدفت الدراسة إلى لتقويم أثار نظام الرعي المفتوح على بعض مكونات بيئة المراعي وإتجاهاتها وحالة النمو لنباتات المراعي وتأثيرها على إنتاجيتها من العلف. قسم المرعى في محلية الدنج إلى ثلاثة أقسام على حسب درجة الإستغلال. أختيرت ثلاثة من نقاط المياه بطريفة عشوائية من جملة 25 نقطة مياه بمحلية الدنج, وأيضا أختيرت ثلاثة مناطق رعويدة بطريفة عشوائية و اما المنطقة المحمية فأختيرت في موقع وسط بين المنطقتين.

تم إستخدام طريفة اللوب (باركار وهيري, 1959) لقياس الموشرات النباتية في المرعى. وأيضا تم إستخدام طريفة الكواردارات (وليم واخرون 1944) لقياس التغطية الارضية و تردد النباتات والنسبة المؤيدة للنباتات بالإضافة إلى تقدير الإنتاجية العلفية للمرعى. ولتحليل المحزون البذري تم اخذ 72 عينة من ثلاثة مناطق مختلفة تحت الدراسة، بحجم 10 X10 سنتمتر من عمقين مختلفتين (0-10) و (10-20) سنتمتر. اعتمدت طرق جمع المعلومات على المسح الاولي والاستبيان لجمع المعلومات عن البعد الاجتماعي لعملية الرعي المفتوح واثارها على المجتمع السكاني.

أظهرت النتائج فروقات معنوية عالية جدا في التغطية الارضية بين الثلاثة مناطق المختلفة. كما أظهرت الدراسة فروقات معنوية في التركيبة النباتية, وجد أن النباتات غير المرغوبة تنتشر بصورة كبيرة في مناطق حول نقاط المياه والمناطق المرعية, بينما تقل في المنطقة المقفولة. وجدت أيضا فروقات معنوية كبيرة جدا في الكثافة

النسبية وتردد النباتات بالمقارنة مع المناطق الثلاث، كما وجدت فروقات كبيرة جدا في الانتاجية العلفية للمرعي بين المناطق الثلاث تحت الدراسة.

خلصت الدراسة إلى أن نظام الرعي المفتوح له أثر واضح على نمو النباتات الرعوية وتدهورها. كما أنه يؤثر على التركيبة النباتية ويقلل الإنتاجية العلفية للمرعي بالإضافة إلى تقليل المحزون البذري للنباتات. وكذلك خلصت الدراسة إلى أن بعض الأعشاب مثل التبر و ابو مروة والبقيل و ابو عريضة والتي تعتبر حساسة لعملية الرعي قد احتفت من حول نقاط المياه والمنطقة المرعية. وكذلك خلصت الدراسة إلى أن النباتات غير المرغوبة مثل الكول و حراب هوسا والصبغ وجدت بكثافة عالية حول نقاط المياه والمناطق المرعية. كما أن الدراسة وجدت أن عملية الرعي المفتوح والمكثف حول نقاط المياه تؤثر تأثيرا سلبيا على البيئة الرعوية.

وكذلك خلصت الدراسة إلى أن زيادة المنافسة على الموارد الرعوية يؤدي إلى النزاعات بين المستخدمين لأراضي المراعي الطبيعية، وأيضا تفعيل النزاعات يرجع إلى تدهور الأراضي الرعوية في المخرف نتيجة لاستخدام غير المرشد والتوسع الزراعي على حساب الأراضي الرعوية، وأيضا وجدت الدراسة إلى أن الكثير من السكان بمنطقة الدنج تأثروا بعملية الرعي المفتوح.

أوصت الدراسة بإدخال نظم جديدة في استخدام المراعي الطبيعية لاجل حماية بيئة المراعي من التدهور. وأيضا أوصت الدراسة بإجراء عملية صيانة المراعي بمنطقة الدنج عن طريق نثر بذور النباتات الرعوية المحلية مثل التبر و ابو مروة و ابو عريضة و البقيل و عفن الخديم و ابو رحيص وذلك بالتنسيق مع الجهات ذات الصلة بالمراعي، وأيضا أوصت الدراسة بالتوزيع الأمثل لنقاط المياه في المراعي.

كما اوصت الدراسة بتنفيذ دور الارشاد الرعوي في محلية الدلنج والتي تشمل مفاهيم تدهور بيئة المراعي وسوء استخدام الموارد الطبيعية وخطر النزاعات بين المستخدمين الاراضي المراعي.

## Table of Contents

Dediction .....	I
Acknowledgement .....	II
Abstract .....	III
Arabic abstract .....	V
Table of Contents .....	VII
List of Tables .....	XIII
List of plate .....	XV
List of Figure.....	XVI
List of histogram.....	XVII
1.1. General.....	1
1.2. Research problem and justification .....	3
1.3. Objectives.....	4
1.3.1. General objectives.....	4

1.3.2. Specific objectives .....	4
1.4. Study hypotheses .....	5
1.5. Expected outcome.....	5

## **CHAPTER TWO: LITERATURE REVIEW**

2.1. General .....	6
2.2. Grazing resources .....	7
2.3. Animal grazing systems .....	9
2.3.1. Nomadic .....	9
2.3.2. Transhumant .....	9
2.3.3. Sedentary .....	9
2.3.4. Solely livestock production systems.....	9
2.3.5. Grassland-based systems.....	10
2.3.6. Other systems.....	10
2.4. Livestock grazing System in south Kordoan .....	10
2.5. The impacts of grazing on rangeland vegetation .....	12
2.6. Factors of rangeland plants degradation .....	13
2.7. Overgrazing .....	14
2.8. Change in plant cover .....	16
2.9. Change in species composition and abundance .....	16
2.10. Grazing impacts on biomass production .....	18
2.11. Vegetation indicators in rangeland degradation.....	19
2.12. Degradation around water points .....	20

2.13. Impacts of water points on rangeland condition .....	21
2.14. Impact of grazing on soil seed bank .....	22
2.15. Signs of soil degradation .....	23
2.15.1. Rangeland Soil .....	23
2.15.2. Soil quality .....	24
2.15.3. The important of rangelands soil .....	24
2.15.4. The impacts of soil quality on rangeland health .....	24
2.15.5. Soil quality as indicators in rangelands assessments and monitoring .....	25
2.15.5.1. Assessment .....	25
2.15.5.2. Monitoring.....	26
2.15.6. The impacts of Soil degradation .....	26
2.16. Land tenure in South Kordofan .....	26
2.17. Land use change and their impacts on the rangeland .....	27
2.18. The impacts of open grazing on ecological systems .....	29
2.19. The social -dimensions of open grazing system .....	31
2.19.1. Economic and cultural roles of livestock in south Kordofan.....	31
2.19.2. Conflicts for natural resources .....	32

### **CHAPTER THREE: STUDY AREA**

3.1. General .....	35
3.2. Location .....	37
3.3. Climate .....	41
3.3.1. Temperatures .....	41

3.3.2. Rainfall .....	41
3.3.3. Geology .....	43
3.3.4. Soil .....	43
3.3.4.1. Vertisols or heavy cracking clay soils .....	43
3.3.4.2. <i>Gardoud</i> soils .....	43
3.3.4.3. Qoz or sandy soils .....	43
3.4. Vegetation .....	44
3.5. Water .....	45
3.6. Population .....	45
3.7. Households .....	46
3.8. Social relations .....	46

## **CHAPTER FOUR: MATERIALS AND METHODS**

4.1. ....	General
.....48	
4.2. The study concept .....	48
4.3. Sampling .....	49
4.4. Plants composition and plants relative composition .....	49
4.5. Biomass productivity .....	50
4.6. Frequency .....	50
4.7. Plants density and plants relative density .....	51

4.8. Ground cover .....	51
4.9. Carrying capacity .....	51
4.10. Seed bank assessments .....	52
4.11. Seed classification .....	52
4.12. Tree density .....	53
4.13. Impacts assessment of open grazing system on socio – economic aspects...	53
4.14. Statistical analysis .....	53

## **CHAPTER FIVE: RESULTS & DISCUSSION**

5.1. General .....	55
5.2. Vegetation measurement .....	56
5.2.1. Bare soil .....	56
5.2.2. Litter .....	57
5.2.3. Plants composition and relative composition .....	58
5.2.4. Plants density and relative density .....	62
5.2.5. Ground cover .....	66
5.2.6. Unpalatable plants .....	67
5.2.7. Botanical composition .....	71
5.2.8. Frequency .....	74
5.2.9. Biomass .....	77
5.3. The impacts assessment of open grazing on soil seeds bank .....	78

5.4. Trees and shrubs density .....	83
5.5. The social dimension of open grazing system .....	85
5.5.1. Conflicts for rangeland resources .....	86
5.5.2. Water resources at the study area .....	89
5.5.3. The impacts of open grazing system on local population .....	90
5.5.4. The deterioration of range land .....	92

## **CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS**

6.1. Conclusion .....	94
6.2. Recommendations .....	96
References .....	97

## List of Tables

Table (3.1) rain-fall variability at South Kordofan .....	42
Table (5.1) the variation in plants composition, bare soil and litter around water points, grazing site and un-grazing sites in two seasons .....	56
Table (5.1.2) the variation of average plants composition, bare soil and litter within three sites using parker loop method .....	56
Table (5.2) the variation in relatives' botanical (plants) composition at the three sites using loop parker method .....	60
Table (5.3) shows the variation in plants density, ground cover and unpalatable plants (%)around water points, grazed sites and un-grazed sites in two seasons using quadrat method .....	62
Table (5.3.2) the variation in average Plant density p/m <sup>2</sup> , Ground cover (%) and Unpalatable plants (%) within the three sites .....	62
Table (5.4) the variation between average plants density per /m <sup>2</sup> at three sites within two seasons .....	68

Table (5.5) the variation between average individual botanical compositions (%) at three sites within two seasons .....	72
Table (5.6): Plant frequency % at different range sites over two seasons .....	75
Table (5.7) the dry matter production ton/ hectare in the three sites of the study sites when double sample methods used .....	77
Table (5.8) variation of live and dead seeds bank densities in depth (0 -10) within the three sites .....	80
Table (5.9) variation of live and dead seeds bank densities in depth (10 -20) within the three sites .....	81
Table (5.10) total number of trees and shrubs plants /hectare in the three study sites .....	83
Table (5.11) shows the conflicts for getting water .....	86
Table (5.12) shows conflicts for rangeland resources .....	87
Table (5.13) shows how pastoralist solved their conflicts.....	87
Table (5.14) shows the source of water in Dilling locality.....	89
Table (5.15) shows the distances of water points .....	89
Table (5.16) shows the impacts of open grazing system on local population.....	90
Table (5.17) shows the impacts of open grazing system on families .....	90
Table (5.18) shows the fluctuation in animal production .....	91
Table (5.19) shows the reason production fluctuation in Dilling locality .....	91
Table (5.20) shows the deterioration of range land.....	92
Table (5.21) shows the types of deterioration on rangeland .....	92

## **List of plates**

Plate (5.1) the invaded plants round water point of the study area .....	67
Plate (5.2) the poor plants density round water point of the study area .....	70
Plate (5.3) the plants density at grazing site of the study area .....	70
Plate 5.4) the plants density un-grazed of the study area .....	71
Plate (5.5) shows domination of tall grass at un-grazed site .....	85

### **List of maps**

Fig: No (3.1) shows the Sudan map .....	38
Figure: No (3.2) shows the south Kordofan map .....	39
Figure: No (3.3) shows the study area map.....	40

### **List of histograms**

Figure (3.1): El Dilling locality average temperature / C (2000 – 2011) .....	41
Figure (3.2): El Dilling locality annual rain-fall (2000 – 2011) .....	43
Figure (5.1) plants species that disappeared from rangeland according to pastoralist interview .....	65
Figure (5.2) unpalatable plants species that invades rangeland according to pastoralist interview .....	65
Figure (5.3) the variation in live and dead seeds density within different depth at the three sites .....	83

## **Appendix**

Appendix (1) Botanical lateen name, Botanical types and Local name

Appendix (2) shows sacrifices area round water points at study area

Appendix (3) the effect of open grazing system on vegetation attributes

Appendix (4) the effect of open grazing system on vegetation attributes

Appendix (5) the plants diversity in grazing sites

Appendix (6) range inventory form (loop form)

Appendix (7) range inventory form (Quadrante form)

Appendix (8) biomass production forms (weight/g)

Appendix (9) Questionnaire