

Dedication

To the soul of my mother.

To My Father, My wife and my daughter...

Hadeel and My sons Omer and Ahmed...

Brother and sister.

To My colleagues and friends

*For all those
I dedicate this humble work.*

ACKNOWLEDGMENT

I would like to express my deep and sincere appreciation to my main supervisor prof. Babo Fadlalla for his keen interest, and unlimited consultation.

My deep appreciation and much gratitude to my Co-Supervisors Associate prof.Dr. Abdelaziz Karamalla and Assistante prof. Abdelrahman Alteib for unfailing help rendered during this work, and their valuable advice and encouragement.

Sincere thanks and gratitude to prof. Faisal Mohammed Ahmed Elhag for his vital and fruitful help in my research and thanks also are due to the staff of the laboratory of animal nutrition, Faculty of Animal Production, University of Khartoum for laboratory analysis.

My great thanks to the staff of El Obeid Research Station, Maki Eid, Abdel Lateif Ahmed, Baballh ElFaki, Tag ElSir Ahamed, Abdel Rahman Khater, Khalel ElNour and Abdel Moniem Mohammed to their assistance. Also my thanks extend to my student Yassen Abobaker.

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ABSTRACT

This study was conducted in El Demokeya forest, a protected rangeland, in Sheikan Locality, North Kordofan State. The forest lies about 31 km east of the city of El Obeid. Another rangeland in northeast of El Demokeya Forest was also selected for use as a control open rangeland. The main objective of this study was to examine the interactions between plants and animals (sheep and goats) and implications for the management of natural rangelands in North Kordofan.

Plant measurements were taken in an area of one km² inside and outside the forest (along eight radiating transects of 500 meter each). Measurements of plant species composition, biomass production, plant density and frequency, the amount of forage available from shrubs and density of trees in the protected and open rangeland were conducted.

The nutritional value of rangeland was evaluated by determination of the chemical composition of range plants in the protected and open rangeland and also by assessing voluntary feed intake by sheep and goats using the product of the quantity of faeces collected over a specific period of time and in vitro digestion coefficient of forage plants selected by sheep and goats. The selection of plants by sheep and goats was determined using the bite count technique.

The investigation of the social and economic aspects of livestock management in North Kordofan and their impact on the use of rangelands was done through the collection of data from the livestock raisers using a questionnaire.

The results of measurements of the plant species composition in the range showed that there were differences between the protected and open rangelands (81.9% and 87.5% respectively). It was found that the plants *Echinochloa colonum* (Difra) and *Zaleya pentandra* (Rabaa) have formed the highest relative composition in protected site 27.9% and 21.8% respectively, while in the open site *Fimbristyls dichotoma* (Um fisiysiat) and *Cenchrus biflorus* (Haskaneet) showed the highest relative composition, 37.1% and 16.8% respectively. The vegetation cover percentage was 54.7% in the protected site and 40.7% in the open site. The results showed significant differences for plant density between the protected and open rangeland (260.9 and 181.9 plants / m²), respectively. *Zaleya pentandra* (Rabaa) had highest frequency in the protected rangeland (85%), while in the open rangeland *Fimbristyls dichotoma* (Um fisiysiat) formed highest frequency (85.2%).

There were very highly significant differences in productivity between the protected and open rangeland at flowering and seed setting seasons. The productivity of rangeland at flowering season on protected site was 4.5 ton / ha, while it was 2.3 ton/ ha in the open rangeland. In the season of seed setting productivity was 1.4 ton / ha, in the protected site, but only 1.0 ton / ha in the open site.

The dominant plants in the protected site were *Aristida mutabilis* (Gaw), *Echinochloa colonum* (Difra), *Fimbristyls dichotoma* (Um fisiysiat), *Zaleya pentandra* (Rabaa) and *Geigeria alata* (Gdgad), while the dominant plants in the open site were *Eragrostis tremula* (Bano), *Cenchrus biflorus* (Haskaneet), *Echinochloa colonum* (Difra) and *Aristida mutabilis* (Gaw).

The results of chemical analysis of some herbaceous plants and trees in the study area showed, that *Ipomoea blepharosepala* (Hantoot) and

Echinochloa colonum (Difra) had the highest crude protein content of 18.7 and 18% respectively, among the former group while *Acacia senegal* (Hashab) had the highest level of crude protein in the latter, 20.9%. It was found that there were significant differences in the nutritional value of rangeland biomass (protected and open) between the seasons of flowering and seed set in the crude protein content. The percentage of crude protein in the protected site at the season of flowering was 6.8% while in the season of seed setting it was 5.7%. In the open site at the flowering season, the percentage of crude protein was 3.5% while in the season of seed setting it was 3.2%. There were highly significant differences in crude protein content of rangeland between the protected and open site in both seasons (flowering, seed set).

The chemical analysis of the plants selected by sheep and goats showed highly significant differences in the crude protein content between the seasons of flowering and seed setting in the protected site and also in the open site. The plants selected by sheep in the flowering season at the protected site were *Ipomoea blepharosepala* (Hantoot) 19.2% and *Cenchrus biflorus* (Haskaneet) 14.1%, which accounted for the highest proportion of plants selected, while in the open site the plants selected, were *Cenchrus biflorus* (Haskaneet) 42% and *Echinochloa colonum* (Difra) 12.8%. The most important plants selected by sheep during grazing in the seed set season in the protected site were *Aristida mutabilis* (Gaw) 22.3% and *Tephrosia spp.* (Fresha) 12.8% which accounted for the highest percentage of the plants chosen, while in the open site the plants selected were *Eragrostis tremula* (Bano) 68% and *Aristida mutabilis* (Gaw) 21.9 %.

The selection by goats during the flowering season in the protected site was highest for *Acacia senegal* (Hashab) 26.6% and *Echinochloa*

colonom (Difra) 11.3%, while in the open site the highest selection was for *Acacia senegal* (Hashab) 22.6% and *Eragrostis tremula* (Bano) 13.8%. In the season of seed setting the selection of goats in the protected site was high for *Justica kotschyi* (Na'na) 18.4% and for *Acacia senegal* (Hashab) 15%, while in the open site goats showed preference to *Eragrostis tremula* (Bano) 52.9% and *Acacia senegal* (Hashab) 25.6%.

The data on feed intake by Sheep and goats showed that, there were no significant differences between the protected and open rangeland in the flowering season. The amount of food eaten in the protected rangeland by sheep and goats was 1199.5 and 1259.3 g of dry matter/day, respectively, while in the open rangeland it was 1339.3 g of dry matter/day for the sheep and 1232.9 g/DM/day for goats.

The distance walked by the animals during grazing showed highly significant differences between the type of animal (sheep or goats) and between the seasons of flowering and seed setting. It was found that in the protected site at the flowering season sheep and goats walked a distance of 4.9 km / day, while during the seed setting season the sheep, walked 8.3 km / day and the goats, 4.4 km / day. In the open site at the flowering season the sheep walked a distance of 12.4 km / day, while goats walked 5.3 km / day. In the season of seed setting the sheep, walked a distance of 13.9 km/day and the goats 7.3 km/day.

The results of metabolizable energy concentration (Mcal /kg DM) in the feed intake (selected plants) by sheep and goats showed that there were no significant differences between the seasons of flowering and seed setting and also between protected and open sites. Moreover there were no significant differences in the amount of metabolizable energy intake (MEI Mcal / day) by the sheep and goats in the protected and open sites. The

metabolizable energy in the feed selected by the sheep and goats in the protected site at the flowering season was 1.9 and 2.3 (Mcal / Kg DM), respectively. The value of the metabolizable energy intake by sheep was 2.4 (Mcal / day) and that by goats was 2.9 (Mcal / day).

Crude protein intake by sheep and goats showed highly significant differences between the season of flowering and seed setting and also between protected and open sites. The average crude protein intake by sheep and goats in the protected site in the flowering season was 105.6 and 137.6 g / animal / day, respectively. The average crude protein intake for sheep and goats in the open site in the flowering season was 63.1 and 157.5 g / animal / day, respectively.

The study concluded that these findings should be taken into consideration in the process of range pasture management. The preferred plants for both sheep and goats must be made use of in the rehabilitation of the rangelands of North Kordofan. From the findings of this research the most preferred plants by sheep were *Ipomoea blepharosepala* (Hantoot), *Cenchrus biflorus* (Haskaneet) and *Tephrosia spp.* (Fresha), The most preferred plants by goats were *Acacia senegal* (Hashab), *Gyndropsis gynandra graecizans* (Tamaleika), *Corchorus olitorius* (Molokhya).

The study found that sheep walked longer distance than goats during grazing specially at seed setting stage, Therefore, the quality of range must be improved. Seeds of plants of high nutritive value should be sprinkled to meet the energy requirements of animals for maintenance and production. Also the conservation and storage of the range plants to provide energy for production should be encouraged. A well vegetated rangeland with good cover comprising preferred species should be a major objective of range development. This, coupled with good distribution of water sources, should

result in a reduction in the energy cost for walking and thereby availing more metabolizable energy for production. Rangelands are found to be intensively grazed all over the year with sheep and goats which constitute the main livestock raised. The percentage of illiteracy among the respondents was found to be high (55.8%).

ملخص الأطروحة

أجريت هذه الدراسة فى محلية شيكان بولاية شمال كردفان وأخذت القراءات لنماذج رعوية شملت مرعى غابة الديموكية كمرعى محمى تبعد حوالى 31 كيلومتر شرق مدينة الابيض. ومرعى آخر شمال شرق غابة الديموكية كمرعى مفتوح. كان الهدف الرئيسى من هذه الدراسة هو دراسة التفاعل بين النبات واستخدام الحيوان (الضأن والماعز) وعلاقته بإدارة المرعى الطبيعية فى شمال كردفان.

تم اخذ قياسات النباتات فى مساحة واحد كيلومتر مربع داخل مرعى الغابة وخارج الغابة (ثمانية قطاعات طول الواحد 500 متر). تضمنت قياسات النباتات كل من التركيبة النباتية، الإنتاجية، كثافة وتردد النباتات، كمية العلف المتاح من الشجيرات وكثافة الاشجار بالمرعى المحمى والمفتوح.

تم تحديد القيمة الغذائية للمرعى بواسطة التحليل الكيمائى لنباتات المرعى المحمى والمفتوح وايضاً تم تحديد كمية العلف (النباتات المختارة) المتناول من جانب الضأن والماعز بأستخدام العلاقة بين كمية الروث المنتج ومعامل الهضم المعملى للنباتات المختارة من الضأن والماعز. لقد تم تحديد إختيار الحيوان (الضأن والماعز) لنباتات المرعى عن طريق حساب عدد القضمات بالملاحظة المباشرة.

تم التحقيق من الجوانب الإجتماعية والإقتصادية للرعاى فى شمال كردفان وتأثيرها على إستخدام المرعى عن طريق جمع البيانات بإستخدام الإستبيان.

أظهرت نتائج قياسات النبات ان هنالك إختلاف فى تركيبة النباتات بين المرعى المحمى والمفتوح وكانت 81.9 و 87.5% على التوالى. ووجد أن نبات الدفرة *Echinochloa colonum* والربعة *Zaleya pentandra* قد شكلت أعلى نسبه تركيب نسبى فى المرعى المحمى 27.9 و 21.8% على التوالى، بينما فى المرعى المفتوح أظهرت نباتات أم فسيسيات *Fimbristyls dichotoma*

والحسكيت الخشن *Cenchrus biflorus* أعلى نسبة نباتات 37.1 و 16.8% على التوالي. وكانت نسبة الغطاء النباتى فى المرعى المحمى 54.7% و فى الرعى المفتوح 41.1%. وأظهرت نتائج الكثافة النباتية فروق معنوية ($P<0.05$) بين الرعى المحمى والمفتوح 260.9 و 181.9 نبات/متر² على التوالي. قد شكلت الربعة *Zaleya pentandra* أعلى تردد للنباتات فى الرعى المحمى 85% بينما فى المرعى المفتوح شكلت أم فسيسيات *Fimbristyls dichotoma* أعلى تردد للنباتات 85.2%. أظهرت نتائج إنتاجية المرعى فروق معنوية عالية جداً ($P<0.001$) بين المرعى المحمى والمفتوح فى موسم الإزهار وموسم إنتاج البذور. فى موسم الإزهار كانت إنتاجية المرعى المحمى 4.4 طن/هكتار, بينما كانت 2.2 طن/هكتار فى المرعى المفتوح. فى موسم إنتاج البذور كانت الإنتاجية فى المرعى المحمى 1.4 طن/هكتار, بينما كانت 1.0 طن/هكتار فى المرعى المفتوح. النباتات الرعوية السائدة فى المرعى المحمى كانت القو *Aristida mutabilis*, الدفرة *Echinochloa colonum*, أم فسيسيات *Fimbristyls dichotoma*, الربعة *Zaleya pentandra* والقد قاد *Geigeria alata*, بينما النباتات السائدة فى المرعى المفتوح كانت البنو *Eragrostis tremula*, الحسكيت الخشن *Cenchrus biflorus*, الدفرة *Echinochloa colonum* والقوقو *Aristida mutabilis*.

أوضحت نتائج التحليل الكيمياءى لبعض نباتات المراعى والأشجار فى منطقة الدراسة بأن الحنثوت *Ipomoea blepharosepala* والدفرة *Echinochloa colonum* شكلت أعلى محتوى من البروتين الخام 18.7 و 18% على التوالي, بينما شكلت شجرة الهشاب *Acacia Senegal* أعلى مستوى من البروتين الخام 20.9%. وجد أن هناك فروق معنوية ($P<0.05$) فى القيمة الغذائية للمرعى (المحمى, المفتوح) بين مرحلة الإزهار وإنتاج البذور فى محتوى البروتين الخام. كانت نسبة البروتين الخام فى فى المرعى المحمى فى مرحلة الإزهار 6.8% اما فى مرحلة إنتاج البذور 5.7%. فى المرعى المفتوح فى موسم الإزهار كانت نسبة البروتين الخام 3.5% وفى مرحلة إنتاج البذور 3.2%. بينما وجد أن هناك فروق معنوية عالية جداً ($P<0.001$) فى القيمة الغذائية للمرعى بين

المرعى المحمى والمفتوح فى محتوى البروتين الخام فى الموسم المعين (الإزهار, إنتاج البذور).

أظهر التحليل الكيمياءى للنباتات المختارة من جانب الضأن والماعز فروق معنوية عالية ($P < 0.01$) فى محتوى البروتين الخام بين موسم الإزهار وإنتاج البذور فى المرعى المحمى وايضا فى المرعى المفتوح. وكانت أفضل النباتات المختارة من جانب الضأن فى موسم الإزهار فى المرعى المحمى هى الحنوت *Ipomoea blepharosepala* 19.2% والحسكيت الخشن *Cenchrus biflorus* 14.1% وشكلت أعلى نسبة من النباتات المختارة, بينما فى المرعى المفتوح كانت أفضل النباتات المختارة هى الحسكيت الخشن *Cenchrus biflorus* 42% والدفرة *Echinochloa colonum* 12.8%. كانت أفضل النباتات المختارة من جانب الضأن فى موسم إنتاج البذور فى المرعى المحمى هى القو *Aristida mutabilis* 22.3% والفريشة *Tephrosia spp.* 12.8% وشكلت أعلى نسبة فى النباتات المختارة, بينما فى المرعى المفتوح كانت أفضل النباتات المختارة هى البنو *Eragrostis tremula* 68% والقو *Aristida mutabilis* 21.9%. كان إختيار الماعز للنباتات فى موسم الإزهار فى المرعى المحمى أعلى فى شجرة الهشاب *Acacia* 26.6% ونبات الدفرة *Echinochloa colonum* 11.3%, بينما فى المرعى المفتوح كان أعلى إختيار لشجرة الهشاب *Acacia senegal* 22.6% والبنو *Eragrostis tremula* 13.8%. فى موسم إنتاج البذور فى المرعى المحمى كان إختيار الماعز أعلى فى نبات النعناع *Justica kotschy* 18.4% وشجرة الهشاب *Acacia senegal* 15%, بينما فى المرعى المفتوح شكل البنو *Eragrostis tremula* 52.9% والهشاب *Acacia* 25.6% أعلى نسبة إختيار.

أوضحت نتائج كمية الغذاء المأكول للضأن والماعز بعدم وجود فروق معنوية فى المرعى المحمى والمفتوح فى موسم الإزهار. كانت كمية الغذاء المأكولة فى المرعى المحمى للضأن والماعز 1199.5 و 1259.3 جرام/مادة جافة/اليوم على التوالي, بينما كانت فى المرعى المفتوح 1339.3 جرام/مادة جافة/اليوم للضأن و 1232.9 جرام/مادة جافة/يوم للماعز.

أظهرت نتائج قياس مسافة السير للحيوانات أثناء الرعى فروق معنوية عالية جداً ($P < 0.001$) بين نوع الحيوان (الضأن والماعز) وبين موسم الإزهار وإنتاج البذور. وجد فى

المرعى المحمى فى موسم الإزهار أن الضأن والماعز قطع مسافة 4.9 كلم/اليوم تقريباً، بينما فى موسم إنتاج البذور الضأن قطع مسافة 8.3 كلم/اليوم تقريباً والماعز 4.4 كلم/اليوم. وجد فى المرعى المفتوح فى موسم الإزهار أن الضأن قد قطع مسافة 12.4 كلم/اليوم بينما الماعز 5.3 كلم/اليوم وفى موسم إنتاج البذور قطع الضأن مسافة 13.9 كلم/اليوم والماعز 7.3 كلم/اليوم.

أوضحت نتائج الطاقة الممتثلة ميه قالكالورى/كجم مادة جافة فى الغذاء المأكول (النباتات المختارة) من جانب الضأن والماعز أنه لا توجد فروق معنوية بين موسم الإزهار وإنتاج البذور وايضاً بين المرعى المحمى والمفتوح. ايضاً لا توجد فروق معنوية فى كمية الطاقة الممتثلة المتناولة فى اليوم (MEI Mcal/day) من الضأن والماعز فى المرعى المحمى والمفتوح. كان تركيز الطاقة الممتثلة فى الغذاء المتناول من الضأن والماعز فى المرعى المحمى فى موسم الإزهار 1.9 و 2.3 ميه قالكالورى/كجم مادة جافة على التوالي. كانت قيمة الطاقة الممتثلة المأكولة للضأن 2.4 ميه قالكالورى/يوم و 2.9 ميه قالكالورى/يوم للماعز.

أوضحت نتائج البروتين الخام فى الغذاء المأكول من جانب الضأن والماعز فروق معنوية عالية ($P < 0.01$) بين موسم الإزهار وإنتاج البذور وايضاً بين المرعى المحمى والمفتوح. كان متوسط البروتين الخام المأكول من الضأن والماعز فى المرعى المحمى فى موسم الإزهار 105.6 و 137.6 جرام/حيوان/يوم على التوالي بينما كان متوسط البروتين الخام المأكول من الضأن والماعز فى المرعى المفتوح فى موسم الإزهار 63.1 و 157.5 جرام/حيوان/يوم على التوالي.

خلصت الدراسة الى ان هذه الفروقات يجب اعتبارها قى عملية ادارة المرعى . وجد ان النباتات السائدة فى المرعى المحمى كانت القوق، الدفرة وام فسيبيات بينما النباتات السائدة فى المرعى المفتوح كانت ام فسيبيات، البنو والحسكيت الخشن. يجب ان يراعى اعادة استزراع النباتات المفضلة للضأن مثل الحنتوت، الحسكيت الخشن والفريشة بينما النباتات المفضلة للماعز كانت الهشاب، التمليكة، الملوخية والنعناع ويجب ان يراعى مكونات المرعى من الاشجار والشجيرات.

خلصت الدراسة ايضاً الى ان الضأن يسير مسافة اطول من الماعز اثناء الرعى وذلك للاختيارية العالية لديه ولذلك يجب تحسين نوعية نباتات المرعى بنثر بذور النباتات

الرعوية ذات القيمة الغذائية العالية لتفى بمتطلبات الحيوان من طاقة الحفظ والانتاج وايضا الحفظ والتخزين الجيد للنباتات الرعوية لتوفير طاقة المشى التى يمكن ان يستفاد منها فى الانتاج. وجد ان استخدام المراعى يستمر لكل العام دون فترة راحة، كما ان الماعز والضأن تمثل المكون الرئيسى للقطيع. نسبه الاميه وسط المبحوثين وجدت عالية (55.8%).