

Dedication

To my father and my lovely mother

To my wife

To my sweet daughters

Omnya and Ala

To Prof. Dr E Itag fadlalla

To my favorite uncle Heyder Makky

I dedicate this work

Mohammed Ibrahim Abdelsalam

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Abstract

This research was conducted during years 2009-2011, in Kadugli locality, South Kordofan State, Sudan. The study aimed to make comparison between two measurement techniques in semi-arid rangeland inventory, and investigate the reliable and appropriate techniques to use in rangeland inventory programs.

Two inventory techniques were used in the study to examine the reliable and appropriate one in semi-arid rangeland inventory program; ground inventory and remote sensing technology.

Study area selected after primary field survey of the study area. Stratified sampling design was used in the ground data collection, using Global Positioning System (GPS), dividing the study area into four sites based on their soil types; namely sandy soil, clay soil, rocky soil and *Gardoud* soil range sites, the area of any site was 1 km². Five transects were established of 100 m length, in each sites systematically. Parker loop method was used along transects with interval 1 m between hits to determine plant composition and cover estimation. Other method used in ground inventory was quadrat of 1 m² size, distributed systematically, along transects with interval 25 m between each other, to determine plant density, frequency, biomass, rangeland productivity and carrying capacity.

The study used Multi-temporal Landsat TM5 satellite, for three years (2009, 2010 and 2011).

Image classification was carried out to produce the land cover map of the study area, and then used NDVI map.

The data obtained from the inventory technique was analyzed and computed using SAS statistical packages and EXCEL spread sheet, to determine the averages and significant differences among the range sites and inventory techniques.

The results obtained from ground survey found that the rocky and clay soil range sites were the best rangelands concerning plant cover, biomass production and carrying capacity, also *Schoenefoldia gracilis* (Danab Elnaga), was found good distribution and more abundance in all types of rangelands in the study area.

The land cover obtained from RS data explained the incensement of grassland from 5015 ha in 2009 to 9378 ha in 2010, but it had on significant differences in 2011. Study found that the RS technique was reliable and appropriate compared with the ground survey, and also explained the direct correlation among plant productivity and NDVI values $r=0.64$.

The study concluded that the ground inventory provides more detailed information about the vegetation attributes, but it needs intensive labor and time.

The remote sensing data gave more reliable results and appropriate relevant to the ground measurements. These results make the remote sensing technique practical in collecting data from the wide area like the vast area in semi arid rangeland.

Based on results obtained from this research the study recommended to use the combination of remote sensing data and ground inventory methods in measurement and monitoring rangeland resources in semi arid area and the use of the species *Schoenefoldia gracilis* for reseeded the deteriorated grassland.

مستخلص الدراسة

أجريت الدراسة خلال الفترة من 2009-2011م في محلية كادقلي، ولاية جنوب كردفان، السودان. هدفت الدراسة لأجراء مقارنة بين اسلوبين للقياسات الرعوية لحصر وجرد المراعي المناطق شبه الجافة، والتحقق من واقعيتها مناسبتها لالتخدامها في برامج حصر وجرد المراعي.

أستخدمت الدراسة اسلوبين من أساليب حصر وجرد الموارد الرعوية، لتحديد واقعية أي منهما في قياسات المراعي في الأراضي شبة الجافة، هي الحصر الأرضي واستخدام تقنية الإستشعار عن بعد.

تم اختيار موقع الدراسة بعد اجراء مسح أولي لمنطقة الدراسة، واستخدمت العينة التطبيقية لتقسيم موقع الدراسة الى مواقع رعوية بناءً على أنواع الترب في الموقع وبإستخدام جهاز تحديد المواقع (GPS). تم تقسيم موقع الدراسة الى أربعة مواقع هي مراعي الأراضي الرملية، مراعي الأراضي الطينية، مراعي الأراضي الصخرية و مراعي الأراضي القردودية، مساحة كل منها واحد كيلومتر مربع. تم إنشاء خمسة قطاعات طولية طول الواحد منها مئة متر في أي موقع من المواقع المختارة. استخدمت حلقة باركر التي نصف قطرها $\frac{3}{4}$ بوصة على طول القطاع على أبعاد واحد متر بين القراءة والأخرى لتحديد التركيب النوعي للنباتات وتقدير التغطية الأرضية. كما أستخدم الإطار ذو المساحة 1 م² على ابعاد منتظمة، 25 متر من الآخر على طول القطاع لدراسة الكثافة النباتية والتردد والكتلة الحية، الإنتاجية الرعوية والحمولة الرعوية.

كما استخدمت الدراسة صور الأقمار الصناعية Landsat TM5 خلال سنوات الدراسة 2009، 2010 و2011م. تم تصنيف الصور الجوية لإنتاج خريطة التغطية كما تم استخدام مؤشر الفرق العام للغطاء

النباتي (NDVI).

تم تحليل النتائج المتحصل عليها من أساليب الحصر والجرد باستخدام برنامج SAS و EXCEL لتحديد المتوسطات ومعرفة الفروقات بين هذه النتائج سواء كانت بين المواقع المختلفة أو بين الإسلوبين المستخدمين في عملية الحصر والجرد.

النتائج المتحصل عليها من أسلوب الحصر الأرضي وجدت أفضلية مراعي الأراضي الصخرية والطينية فيما يخص التغطية النباتية والإنتاجية العلفية والحمولة الحيوانية، كما وجد أن نبات صنّب الناقة *Schoenefoldia gracilis* ذو توزيع جيد وأكثر وفرة في أنماط المراعي في موقع الدراسة.

التغطية الأرضية المتحصل عليها باستخدام بيانات الإستشعار عن بعد أوضحت أن أراضي الحشائش زادت من 5015 هكتار في 2009 إلى 9378 هكتار في 2010 . كما أوضحت الدراسة أن تقنية الإستشعار عن بعد واقعية ومناسبة مقارنة بالحصر الأرضي، كما وجدت علاقة موجبة بين الإنتاجية وقيم ال NDVI $(R=0.64)$.

خلصت الدراسة إلى أن طريقة الحصر الأرضي أعطت معلومات تفصيلية عن السمات النباتية لكنها تحتاج إلى عمالة كثيرة وزمن. أيضاً أن بيانات تقنية الإستشعار عن بعد أعطت نتائج واقعية ومناسبة، قريبة من القياسات الأرضية. هذه النتائج تجعل من تقنية الإستشعار عن بعد عملية في جمع المعلومات من المناطق الواسعة في مراعي المناطق شبه الجافة.

استناداً إلى النتائج التي تم الحصول عليها من هذا البحث أوصت الدراسة إلى استخدام مزيج من بيانات الاستشعار عن بعد وطرق الحصر الأرضي لحصر وجرد الموارد الرعوية في المناطق شبه الجافة، واستخدام نبات صنّب الناقة *Schoenefoldia gracili* لإعادة استزراع أراضي الحشائش المتدهورة.

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Abbreviations

AVHRR: Advanced Very High Resolution Radiometer

DM: Dry Matter

ERDAS: Earth Resources Data Analysis System

ETM+: Enhanced Thematic Mapper

FAO: Food and Agricultural Organization

GIS: Geographical Information System

GPS: Global Positioning System

ha: hectare

IDL: Interactive Data Language

IFAD: The International Fund for Agricultural Development

IFOV: Instantaneous Field of View

IOM: International Organization for Migration

ISODATA: Iterative Self-Organizing Data Analysis Technique

LAI: leaf area index

NDVI: Normalized Differences Vegetation Index

NIR: Near-infrared band

NOAA: National Oceanic and Atmospheric Administration

PUF: Proper Use Factor

R: Red band

RPA: Range and Pasture Administration

SRM: Society for Range Management

TAU: Tropical Animal Unit

TM: Thematic Mapper

USGS: United State Geological Survey

WSARP: Western Sudan Agricultural Research Project