DEDICATION

This work is dedicated to my parents, wife, sons, brothers, sisters and everyone who straggly defends to keep environs clean.

DECLARATION

I hereby solemnly declare that the work presented in this thesis is my own work and that, to the best of my knowledge, it contains no material previously published or written by another person and has not been previously submitted to any University or educational institute for an academic qualification or any other degree. The work I am submitting does not contravene any copyright.

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ABSTRACT

This study was conduct in the Meidob Hills area of El-malha locality about 170 km north El-fasher, North Darfur State. The main objective of the research was to study and describe the quantitative changes in tree composition, structure and species richness as well as to explore the impacts of anthropogenic and environmental factors. In addition, the study attempted to detect the nature of changes affected in structure and composition of the tree species as a consequence of both increased human exploitation and microclimatic effects during the period (1995- 2010) using remote sensing.

The ecological field data for the present work were collected during the period 2010 to 2011. A pilot survey was first conducted to gather enough information which has been used to decide upon the sampling procedure and intensity. Based on the results of the pilot survey, a full inventory was

then designed and executed using a stratified sampling procedure. Thirty four 34 sample plots of one ha sample size each (56.43 m radius) were laid down. Subplots of 0.25 ha (28.21 m radius) were laid down in the center of each sample plot for regeneration studies. Measurements were made to record diameter and height of all trees having a diameter ≥ 6 cm within each sample plot. A regeneration count was then conducted inside the subplots.

The findings revealed that the total sampled population in the study area amount 922 trees, comprising ten species within seven families giving a stocking density of 27 trees per ha. The regeneration count registered a total number of 13 seedlings per ha for all species.

Species wise analysis indicates *Acacia tortilis* subsp. raddiana was the most ecologically dominant species contributing a high importance value index (IVI) of 92.21 %.

The landsat TM image of April 1995 and June 2008 were analyzed using Erdas Imagine software to unveil tree species change detection of the study area. Visual interpretation and digital image processing was applied to process the imagery for determining land cover classes. In addition, post-classification change detection methods were used to detect changes in land cover classes.

After performing unsupervised classification on these images, a total of four land cover classes were identified and

mapped. These were Hills and basement, sparse trees and shrubs, bare land and grassland. An NDVI calculation was made on these images and vegetated areas were identified.

The results of the analysis revealed that from 1995 to 2008 the tree cover has decreased by 3847 ha representing 10 % of the total area. These changes were attributed directly to environmental and anthropogenic factors viz. desertification, drought, illegal cutting of trees for fire wood, building material, agriculture expansion and overgrazing. The field work and remote sensing data were supported by a socioeconomic study through which data collected by using a questionnaire. Information including major indicators for degradation, reasons behind land degradation, useful tree species in the area, and major causes for forest destruction in the area were gathered from local people.

Lessons learned from the use of satellite imagery data and remote sensing techniques in the present work proved to be effective, reliable, suitable and valuable tool for detection, prediction and identification of forest cover change in such degraded areas of arid and semi arid regions under risk.

خلاصة الدراسة

أجريت هذه الدراسة بمنطقة جبال الميدوب، محليـة المالحـة بولايـة شـمال دافـور والـتي تبعـد حـوالي 170 كـم شـمال مدينـة الفاشـر حاضـرة الولايـة.

والغـرض الاساسـي مـن هـذا البحـث هـو دراسـة ووصـف بعـض التغيَّـرات التكوينية والبنيوية للمجاميع والأنواع الشجرية لبيان بعض المؤشـرات البيئيـة و الإنسانية. أيضاً لرصد طبيعة التغّيرات التى تـؤثر فـي الخصـائص التكوينيـة والبنيوية للمجاميع الشجرية كنتيجة لزيادة أنشـطة الإنسـان وظـروف المنـاخ الموضـعي للمنطقــة خلال الفــترة مــن (1995- 2008) باســتخدام تقنيــة الإستشعارعن بعد.

تم جمع المعلومات البيئية الحقلية لهذه الدراسة خلال الفـترة 2010 م. اولاً اجرى مسح إستكشافي لمعرفـة كيفيـة وطبيعـة المنطفـة وجمـع المعلومـات التى تساعد في عملية اختيار العينة. بناءً علي نتائج المسح الأولى تمت تنفيـذ عملية الحصر كاملاً باستخدام طريقة العينة الطبقية العشوائية، و أخـذت 34 عينة دائرية الشكل بمساحة هكتـار واحـد لكـل عينـة (نـق= 56.43 م). كمـا أخذت عينة جزئية بمساحة 0.25 هكتار (نق= 28.21 م) في مركز كل عينــة كاملة. وقد تم قيـاس المعلومـات الحقليـة لكـل عينـة والمتمثلـة فـي أقطـار الأشجار عند مستوى الصدر وأطوال الأشجار الـتي أقطارهـا 6 سـم فـأكثر. و كذلك تم عدّ التجديد الطبيعي في كل عينة جزئية.

لقد أظهرت نتائج هـذه الدراسـة أن حـوالي 922 شـجرة ذات أقطـار 6 سـم فأكثر و 10 أنواع شـجرية و 7 عائلـة شـجرية تـم التعـرف عليهـا وعـدّها فـي المنطقة الممسوحة. و بلغت عـدد الأشـجار فـي الهكتـار حـوالي 27 فقـط شجرة بالنسبة لكل الأنواع. أما التّجديد الطبيعي فكانت حوالي 13 نبتة فقط في الهكتار الواحد لكل الأنواع.

ومن خلال نتائج تحليـل أنـواع الأشـجار الموجـودة فـي المنطقـة حيـث تشـير الدراسة إلى أنّ شـجرة السـيال هـي الأكـثر سـيادة ايكولوجيـا فـي المنطقـة وبلغت ال 92.21 Importance value index %.

كما تم تحليل صور الأقمار الصناعية لأندسات 5 (Landsat) إبريـل 1995 ويونيو 2008 باستخدام برنامج المعالجـة (Erdas Imagine (لرصـد التغيّـر

فـي الأنـواع الشـجرية فـي منطقـة الدراسـة. أيضـاً تـم اسـتخدام االتحليـل والتفسـير البصـري ومعالجـة الصـور الرقميـة، وذلـك لتحديـد أصـناف غطـاء الأرض. بالإضـافة لـذلك اسـتخدم التصـنيف المتقـدم لإظهـار التغيّـرات فـي أصناف غطاء الأرض.

بعد تصنيف الأقمار الصناعية التصنيف غير المراقب ، تم التعرف علي أربعة أصناف من غطاء الأرض وهي: الجبال و الصـخور، الأرض الجـرداء، الأشـجار المتفرقة والشجيرات وأراضـي الحشـائش. بالإضـافة إلـى ذلـك تـم حسـاب مؤشر الفرق العام للغطاء النباتي (NDVI) في صـور الأقمـار الصـناعية و تـم التعرف علي مواقع الغطاء النباتي علي الصور.

ولقد أظهرت نتائج هـذه الدراسـة خلال الفـترة مـن 1995 إلـى 2008 ، أنّ الأشجار تقلصت مساحتها ب 3847 هكتار تمثل 10 % مـن المسـاحة الكليـة لمنطقـة الدراسـة. و هـذه التغيّـرات حـدثت نتيجـة للأنشـطة الإنسـان فـي المنطقة المتمثلة فـي : القطـع غيـر القـانوني للأشـجار لاسـتخدامه كحطـب حريـق، ومـواد البنـاء، والتوسـع الزراعـي التقليـدي فـي مسـاحات شاسـعة، والإفراط الرعوي. بالإضافة إلى عوامل بيئيـة مثـل الجفـاف، و التصـحر الـتي إجتاحت المنطقة في فترات متعاقبة.

أيضـاً جمعـت المعلومـات الخاصـة بـالنواحي الاجتماعيـة الاقتصـادية لإنسـان المنطقة أثناء العمل الميداني باستخدام الاستبيان كمعلومات مساعدة لـدعم المعلومات الحقلية وبيانات الإستشعار عن بعد. حيث تتمثل المعلومات فـي : مؤشرات التدهور، وأسباب تدهور الغطاء الشجري، والأشـجار الأكـثر أهميـة في المنطقة.

الدروس المسـتفادة مـن اسـتخدام بيانـات صـور الأقمـار الصـناعية وتقنيـات الإستشعار عن بعد في هذه الدراسة أثبتت أنها اداة قيمة/ فعّالـة فـي عمليـة الرصد، والتنبؤ والتعرف علي التغيّر في الغطاء الغـابي فـي المنـاطق الجافـة وشبه الجافة المهددة بالتدهور.

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List OF Abbreviations and Acronyms

ASTER	Advanced Space borne Thermal Emission and Reflection Radiometer
AVHRR	Advanced Very High Resolution Radiometer
CCRS	Canada Centre for Remote Sensing
DEM	Digital elevation model
DN	Digital number
ERTS	Earth Resources Technology Satellite
FF	Form Factor
FNI	Forest National Inventory
GFRA	Global Forest Resources Assessment
GIS	Geographic Information Systems
GPS	Global Positioning System
HRV	High Resolution Visible
HTS	Hunting Technical Services
IDPs	internally displaced people

ISODATA	Interaction Self –Organizing Data Analysis Technique Algorithm
KC	Kappa Coefficient
LULC	Land- use/land- cover
MCC	Means Clustering Classifier
MSS	Multi Spectral Scanner
NDVI	Normalized Difference Vegetation Index
NIR	near-infrared
NOAA	National Oceanic and Atmospheric Administration
SPOT	Système Pour l ' Observation de la Terre
SRAAD	Sudan Resource Assessment And Development
SSE	Sum of square of errors
SVI	Spectral Vegetation Index
TM	Thematic Mapper
TOE	tons of oil equivalents
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environmental Programme
UNSO/UNDP	The United Nations Sudano-Sahelain Office/ United Nations Development programe
UTM	Universal Transverse Mercator
VI	Vegetation Indices
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development