The Main Ecological Components of the Management of Dryland Natural Forests

(A case study: Um Sunta forest-White Nile State-Sudan)

By

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Dedication

To my family for their encouragement and patience

Declaration

I hereby declare that the work described in this thesis, is a result of my own investigation, and is not concurrently been submitted for any degree. The work and conclusions of other persons have been acknowledged.

Abdelsalam Osman Sid Ahmed

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Abstract

This study was conducted at *Al Halba* and *Wad Gabur* area, west of Ed Dueim-White Nile State. The area is known to be rich in its natural forests which are facing continuous deterioration practices due to the absence of management plans.

The study is designed to investigate and understand the dynamics of the main ecological components of natural forest system and its related and integrated components affecting their sustainable management. The components include the topography and its related vegetation types (trees, shrubs and grasses). *Um Sunta* forest was selected as a model or example of natural forests that cover the drylands of Western Ed Dueim and spread naturally as a formation according to the soil, topography and climate of the region. This model could provide inference of the same conceptual frame for other natural forests in the area.

The study investigates the dynamics of the vegetation structure and composition as affected by variations in the soil, topography and climate. The study revealed that three main sites were identified in the forest formations that replicate themselves randomly and termed as zones for the purpose of this study:

- Zone I; An area sloping from hillsides, extending along an open grazing area almost without trees or shrubs and covered by herbaceous vegetation, mainly dominated by *Gaw*, *Abu assabi* and *Sharaya*.
- Zone II; Moderate slope areas that lie between zone I, and III as a transitional zone. Trees and shrubs are scattered along the area with a ground cover of herbaceous plants. The dominant tree

species are *Samu*r and *Sayal*, while the dominant herbaceous species are Haskaneet, *Gaw* and *Abu assabi*.

- Zone III; Wetlands that extend along depressions (*khors* and *wadies*), covered by dense trees compared with other zones and different grass types that are adapted to the site characteristics. The dominant tree species are *Sayal* and *Talih*, while the dominant herbaceous species are *Difra, Khodra* and *Rabaa*.

The variation in the site components created a complicated system that needs investigation and understanding prior to any management practices.

The study investigated three main parameters in each of the three identified sites for two successive seasons (2001-2002). Investigations included ground cover assessment, tree cover assessment and soil seed bank.

According to the condition of the forest from the data collected and the forest history, a cover percentage of less than 50, 30 and 10 and a bare soil percentage of more than 40, 60, and 80 may be critical for the perpetuity of forest resources of the three sites I,II and III respectively. A litter percentage of less than 10 for all sites is a causative factor for erosion hazards. *Gaw, Sharaya* and *Abu assabi* were dominating zone I and II, but they invade zone II when rainfall decline from the annual average. *Haskaneet* dominated zone II only on good rainfall seasons. *Rabaa, Khodra* and *Difra* dominated zone III, only when rainfall amount and distribution is suitable for their growth. The occurrence of different species in different zones depends on their adaptability to the site characteristics and their growth requirements.

Tree density across the three zones varies according to topography, soil moisture and other factors. A density of less than 5 and 66 stem/ha for zone II and III respectively, may be critical for site stability and erosion hazard. Herbage mass production varies between different zones according to tree

density and other local factors such as soil moisture and topography. Biomass production of less than 0.5, 0.05, and 0.01 ton/ha may be critical for stability of zone I, II, and III respectively.

The study revealed that tree layering is a good indicator for studying stand development and growth. The disappearance of species from the lower layers indicates the potential decrease of their utilization and the future of their re-growth. The study revealed that there is a variation between seed bank and the above ground vegetation, which may indicate the importance of studying the seed dormancy and dispersion, and hence complete the picture about the vegetation dynamics.

The study concludes that management components should be carefully studied and understood, and it made a design showing the existing status and the anticipated values. The design indicators can be used for integrated management of these natural forests.

خلاصة الأطروحة

أجريت هذه الدراسة بمنطقة الهلبة وود جبر غرب مدينة الدويم بولاية النيل الابيض والتى عرف انها غنية بغاباتها الطبيعية التى تتعرض باستمرار للتدهور بسبب الاستغلال غير المرشد والناتج من عدم وجود خطط عمل لادارتها.

تناولت هذه الدراسة مكونات نظم الغابات الطبيعية المعقدة بسبب اختلاف تضاريس المنطقة وتنوع مكوناتها الاخرى من نباتات رعوية, شجيرات, اشجار وتربة بمخزونها من البذور وطبوغرافية المنطقة. تم اختيار غابة ام سنطة لتكون انموذجا للدراسة وذلك لتشابه تركيبها مع الغابات الطبيعية بالمنطقة..

اظهرت الدراسة ان الغابات الطبيعية عموما تتكون من ثلاثة بيئات رئيسية حسب طبوغرافية الارض وهى المنطقة العالية شديدة الانحدار من المناطق الجبلية (zone I), تتبعها منطقة متوسطة الانحدار وتعتبر كمنطقة انتقالية (zone II), ثم المنطقة المنخفضة على امتداد الوديان والخيران (zone III). تتميز كل منطقة من هذه المناطق بمكونات بيئية مختلفة تتفاعل فيما بينها ومع مكونات المناطق الاخرى لتكون نظاما طبيعيا معقدا يتحتم دراسته وفهمه قبل الخوض فى ادارته فنيا.

أوضحت الدراسة أن المنطقة العليا تتميز بكثافة النباتات الرعوية وخلوها تقريبا من الاشجار والشجيرات مما يشير لخصوصية فى التعامل لادارتها مع مراعاة شدة الانحدار وتأثيره على انجراف التربة بمخزونها من البذور للمناطق السفلى. تسود هذه المنطقة نباتات القو وأبو أصابع حتى فى ظروف قلة الامطار مما يعنى سيادة هذه الانواع وملائمتها لطبيعة وخواص المنطقة بينما تتأثر نباتات الشرايا بقلة الامطار رغم سيادتها مع الانواع الاخرى فى ظروف الامطارالعالية.

المنطقة الوسطى وهى متوسطة الانحدار تقع بين المنطقة العليا والسفلى كمنطقة انتقالية. تسود المنطقة اشجار السمر والسيال والنباتات الرعوية السائدة هى الحسكنيت والقو وابو اصابع.

المنطقة المنخفضة تتميز بكثافة عالية من الاشجار المتنوعة كالسيال والطلح وانواع النباتات الرعوية السائدة هى الربعة والخدرة والدفرة والتى يناسب نموها مع خواص المنطقة.

التغيرات فى مكونات هذه المناطق خلقت نظاما معقدا يحتاج للبحث والفهم قبل الادارة الفنية. بحثت الدراسة ثلاثة مكونات فى كل منطقة من المناطق الثلاثة لموسمين متتاليين 2001و 2002 تضمنت الغطاء العشبى والشجرى ومخزون البذور بالتربة.

أظهرت الدراسة ان النسبة المئوية للغطاء العشبى اقل من 50 – 30- 10 والتربة العارية اكثر من 40 – 60 – 80% يهدد المناطق الثلاثة العليا والوسطى والسفلى على الترتيب وقد تقود لمخاطر بانجراف التربة.

تختلف كثافة الاشجار حسب طبوغرافية التربة ومستوى رطوبتها. اظهرت الدراسة بان الكثافة الشجرية اقل من 10و 66 شجرة للهكتار للمنطقة الوسطى والسفلى على الترتيب يشكل خطرا على ثبات التربة وقد يقود لانجرافها.

تؤثر كثافة الاشجار على الانتاج العشبلى التحتى. اظهرت الدراسة ان انتاجية اقل من 0.5 – 0.04 – 0.01 طن/هكتار للمنطقة العليا والوسطى والسفلى على الترتيب يؤثر سلبا على تربة ونباتات المنطقة.

اشارت نتائج الدراسة الى اهمية دراسة طبقات الاشجار الرأسية حتى يمكن معرفة تطورها ونموها فى كل طبقة حيث ان اختفاء بعض الانواع من الطبقات السفلى يهدد استخدامها فى المستقبل كما اظهرت ان معاينة الاشجار من حيث الطبقات الرأسية تفيد فى معرفة تطور الاشجار ومستقبل نموها كأنواع منفردة أو مجموعات شجرية.

أظهرت الدراسة الاختلاف الواضح بين مخزون البذور للانواع المختلفة مقارنة بالانواع الموجودة فوق التربة مما يشير لاهمية دراسة ديناميكية مخزون البذور وانتشارها حتى تعطى صورة متكاملة لديناميكية تركيب الانواع النباتية.

وضعت الدراسة تصميما لحالات مكونات النظام وايضا الخطورة المتوقعة لتأثر هذه المكونات بالظروف المختلفة كمؤشر هام فى الادارة الفنية المتكاملة لهذا النظام.

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LIST OF ABBREVIATIONS

ha = Hectare

PH = soil ph

FRA = Forest Resources Assessment

ITTO's = International Timber Trading Organizations

N-W = North-West

SFNSW = State Forest of New South Wales

NSW = New South Wales

FAO = Food and Agriculture Organization

UNCED = United Nations Conference on Environment and Development

B.L.M. = Bureau of Land Management

DBP = Diameter at Browsing Point

ICA = International Co-operative Alliance

ILRI = International Livestock Research Institute

FNC = Forest National Corporation

FPCS = Forest Products Consumption Survey

CBD = Convention on Biological Diversity

UNFF = United Nations Forum on Forests

SFM = Sustainable Forest Management

DBP = Diameter at Point of Browse

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