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TECHNOLOGY  
COLLEGE OF GRADUATE STUDIES**

**HIEGHT DIAMETER RELATIONSHIP  
MODEL FOR ACACIA NILOTICA IN  
RIVERINE FORESTS - BLUE NILE**

نمذجة العلاقة بين الارتفاع والقطر في أشجار السنط  
بالغابات النيلية - النيل الأزرق

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## *DEDICATION*

To soul of my father, to my  
mother, wife, brothers,  
sisters, sons, and my sweet  
daughter and to all those  
whom I love.....

*Mohammed*

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# **ABSTRACT**

## **HIEGHT DIAMETER RELATIONSHIP MODEL FOR *ACACIA NILOTICA* IN REVERINE FORESTS - BLUE NILE**

The optimal forests management is concerning with maintaining and increasing the yield of the forest. There for the accurate precise forest resource information in the inventory is very essential. This information can be utilized over time in the most effective way for planning purposes. Forest inventory studies usually measure the diameter of all trees in a plot and the height of some. Individual tree's height and diameter at breast height (dbh) are essential inventory measures for estimating tree volume, site index and other important variables in forest growth and yield models. Tree diameter can be measured easily and at little cost. Total tree height, however, is more difficult and costly to measure due to several reasons: time required to complete measurements, chance of observer error, and visual obstruction.

Therefore the aim of this study is to develop a generalized height-diameter relationship model for predicting tree height of *Acacia nilotica* plantations in the reverian forests that could account for the variability of site and stand conditions. Four commonly models used non-linear growth functions (i.e., Stage, Curtis, Arabatzis and Burkhart) were selected as candidate base



models and were fitted to individual tree's height-diameter data of *Acacia nilotica*. A total of 1127 trees from 20 riverine forests reserves of *Acacia nilotica* along the Blue Nile South Sinnar Dam up to northwest of El Roseiris Dam were measured. This area falls between Latitude 13.28836 – 11.99478 N and Longitude 33.88800 - 34.37298 E. Data collected from systematic sample plots with various spacing, stand age, and site quality were available for this study. The 4 models described in the literature review are non-linear, therefore model fitting was carried out with the NLIN procedure of the SAS/ STAT\_ statistical programme] using the Gauss-Newton algorithm. By previously linearizing the equation and fitting it to the data by ordinary least squares, using the REG procedure of the same statistical programme.

The results showed that the four base models show variation in fitting, Wykoff model performed slightly better than the other models based on the goodness of fit as well as bias and standard errors of the predictions. This model can be fitted easily and provided more satisfactory fit when additional variables were included into the model, hence was selected as the base model.

## ملخص الدراسة

### نمذجة العلاقة بين القطر والارتفاع في أشجار السنط بالغابات النيلية - النيل الأزرق

تختص الإدارة المثلي للغابات بالمحافظة وزيادة الإنتاجية في الغابة. وعليه إن المعلومات الصحيحة لمورد الغابات في الجرد من الأمور الضرورية. يمكن أن تستخدم هذه المعلومات على مر الزمن بطريقة أكثر فعالية لأغراض التخطيط.

في دراسات جرد الغابات يتم قياس القطر لجميع الأشجار في العينة والارتفاع لبعضها. الارتفاع والقطر في مستوي الصدر للشجرة من القياسات الضرورية جدا في جرد المخزون الأساسي لتقدير حجم الشجرة ومؤشر للموقع وغيرها من المتغيرات الهامة. ويمكن قياس قطر الشجرة بكل سهولة وبتكلفة زهيدة. أما ارتفاع الأشجار فقياسه فانه أكثر صعوبة وذو تكلفة عالية وذلك نتيجة لعدة أسباب: الزمن المطلوب لتكملة القياسات ، فرص خطأ المراقب، والمعوقات البصرية.

هدف هذه الدراسة تطوير نموذج لعلاقة عامة للقطر والارتفاع لأشجار السنط بالغابات النيلية بغرض التنبؤ بارتفاع الشجرة التي يمكن أن تتأثر بتقلب الموقع و الظروف المحيطة. تم اختيار أربعة نماذج غير خطية شائعة الاستخدام (Stage, Arabatzis and Burkhardt Wykoff Curtis, منافسة أساسية وتمت مطابقتها لبيانات الارتفاع -القطر لأشجار السنط.

وقد تم قياس 1127 من الأشجار من 20 غابة من غابات السنط النيلية المحجوزة على جانبي النيل الأزرق جنوب خزان سنار وإلى الشمال الغربي لخزان الروصيرص وتقع هذه المنطقة بين

خطي العرض 13.28836 - 11.99478 N وخطي الطول  
33.88800-34.37298.

جمعت البيانات لهذه الدراسة من عينات منتظمة مع اختلاف في  
المسافات البينية والعمر ونوعية الموقع.

النماذج الأربعة التي وصفت في الأدبيات السابقة كانت غير  
خطية ولذلك نفذ النموذج المناسب بالطريقة غير الخطية  
باستخدام خوارزمية Gauss-Newton وفقا لخطية المعادلة  
السابقة ومطابقتها للبيانات بالمربعات العادية الأقل باستخدام  
تقنية الانحدار لنفس البرنامج الإحصائي.

أظهرت النتائج أن النماذج الأربعة المستخدمة تباينا في الملائمة  
وكل-نموذج Wykoff الأفضل أداء من النماذج الأخرى وذلك  
استنادا إلى جودة الملائمة إضافة إلى التحيز والأخطاء المعيارية  
للتنبؤات.

هذا النموذج يمكن استخدامه بسهولة ويعطي نتائج مرضية إذا ما  
أدرجت متغيرات فيه إلى النموذج، ومن ثم اختيار كقاعدة  
نموذجية.