

# GROWTH AND YIELD MODELLING PROJECT

NEWSLETTER NO 1. MARCH, 1998



## *Wanariset, Sangai.*

*A BPK-Samarinda research forest in Central Kalimantan Indonesia, which is the location of 15 Permanent Sample Plots used to calibrate some of the relationships used in SYMFOR. (photo: Dr Paul van Gardingen)*

Welcome to the first Growth and Yield Modelling (GYM) Newsletter, which is designed to update developments and promote advances and outputs of this DFID<sup>1</sup> funded Forestry Research Project throughout its' 3-year term.

The purpose of the project is to develop and apply an individual-based model to predict the growth and yield of tropical forests following management interventions. Different management options will be compared to evaluate the ecological and economic sustainability of management or silvicultural treatments. This work will be carried out through links with selected end-users in Indonesia and Malaysia. The project is linked to an international Criteria and Indicator research programme co-ordinated by the Centre for International Forestry Research (CIFOR). CIFOR will also assist in the promotion of the project outputs internationally.

---

<sup>1</sup> This document is an output from a project funded through the Forestry Research Programme of the UK Department For International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID.

Project R6915 Forestry Research Programme.

## Target Institutions

- National and regional research organisations.
- Government officials (e.g. Ministry of Forestry, Policy)
- Forest Managers
- Certification bodies (e.g. Lembaga Ekolabel Indonesia)
- Centre for International Forestry Research (CIFOR)

The outputs from the project will first be applied in Indonesia, but will be made available internationally for forestry management or research. Information will be made available as computer software with associated application notes and technical documentation.

## Using Models to Assess Sustainability

In order to develop reliable, relevant and cost-effective indicators of sustainability we need to be able to predict the response of tropical forests to a variety of management options. Models need to be able to confirm that management options are sustainable in the long term, and can be used to assist in the identification of suitable indicators for monitoring such a regime.

The model produced by this Project will integrate and extend existing models of forest ecology, and growth and yield, using datasets from the network of permanent sample plots (PSP) in Kalimantan, Indonesia.

Additional information about the Project is available from our WWW site and FTP sites

<http://meranti.ierm.ed.ac.uk/g&y/home.htm>,

<ftp://meranti.ierm.ed.ac.uk>

## Modelling Forest Growth & Yield

**SYMFOR<sup>97</sup>** is an individual-based statistical simulation model that can be used to predict the growth and timber yield of a region of tropical forest. It supersedes SYMFOR, which was designed for the same purposes under the DFID funded Indonesia-UK Tropical Forest Management Programme. The system was designed to run using data inputs from Indonesian managed forests that have limited accuracy and availability.

The growth of a forest is complex, and does not easily submit to empirical modelling (approximations of how a system, e.g., a forest, responds to an influence, e.g., rainfall, based directly on the analysis of data). The growth of individual trees is also complex, but as trees follow growth patterns which are easier to understand and measure than those of forests, they are simpler to model. So the simulation of forest growth is possible if all the trees in a forest are represented in a model, and grown individually. This is what SYMFOR did.

With SYMFOR it was possible to develop and use more than one model constructed from a library of modules forming models, that simulate processes in a different way. This is important, because human factors, as well as other geographically varying factors, are involved, so a given module may be applicable to model only a certain type of region.

SYMFOR<sup>97</sup> was developed from the earlier version of SYMFOR (Version 2.21) with the aim of making the software more accessible to its target end user community. SYMFOR<sup>97</sup> has been designed to be fully compatible with the latest Windows Operating Systems (95/NT 4.0).

The Growth and Yield Modelling project decided to use SYMFOR as a starting point and further develop it with the following objectives:

1. Add facilities to enhance the usability of the code, developed after consultation with the target end-users;
2. Broaden the validity of the model, such that it could be used to predict forest growth and yield for areas of forest not within Permanent Sample Plots (PSPs). This is to be achieved using a process-based approach to tree growth developed in the Hybrid model at ITE, combined with the individual-individual competition based strategy of SYMFOR;
3. Linking the model to inventory and GIS data to make the system more readily used for forest management using existing Management Information Systems;
4. Using the model to develop and evaluate Criteria and Indicators (C&I) for sustainable Forest Management;
5. Disseminate the ongoing products of the project to researchers and forest managers in Indonesia and internationally for their benefit;

6. Restructure the code to modernise it and bring it in line with current best-practice programming (including comprehensive documentation at all levels);
7. Enhance the generality and sustainability of the code by using an object-oriented approach to the modelling of trees.

The project will produce several “release versions” of SYMFOR during the development cycle, before the final version produced at the end of the project in June 2000. The first release version has already been produced, and is called SYMFOR<sup>97</sup>. It is a fully 32-bit programme and so runs on modern operating systems (Windows 95 and Windows NT). Windows 3.x is no longer supported. As part of this development, the structure of the model has been modernised. This will simplify the process of software maintenance and improvement in the future.

SYMFOR<sup>97</sup> includes a number of new features. A “multiple-run” facility has been added, allowing the user to do a series of runs for subsequent statistical analysis according to predefined criteria. The multiple-run facility interface is shown in Figure 1. The model has been modified to use estimates of “tree stem quality”, which enables the simulation of the decisions made by the forest workers during logging.

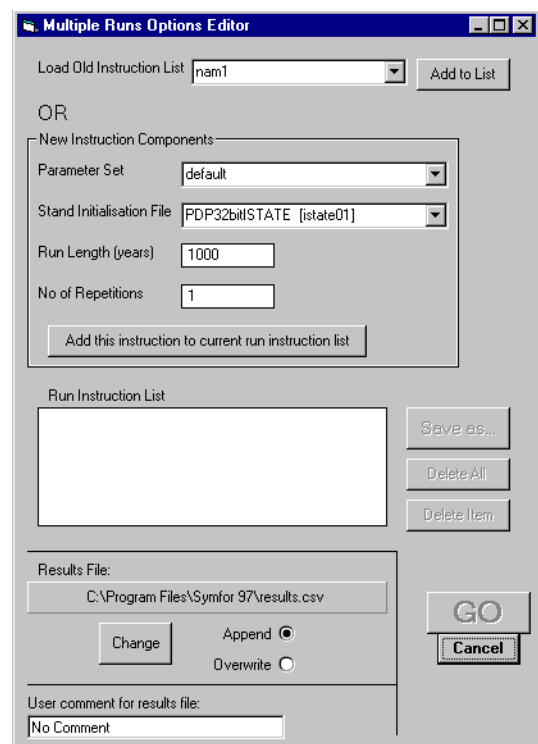


Figure 1. The Multiple Run Facility in SYMFOR<sup>97</sup>

## Model Output

The results are now output in a flexible way, and contain summary information enabling efficient data analysis to be made. Typical sets of end-of-run displays are shown in Figure 2. The changes described above make SYMFOR<sup>97</sup> a much more powerful tool for the tropical forest growth and yield modeller, and represent the first stage of software development in the Growth and Yield Modelling project.

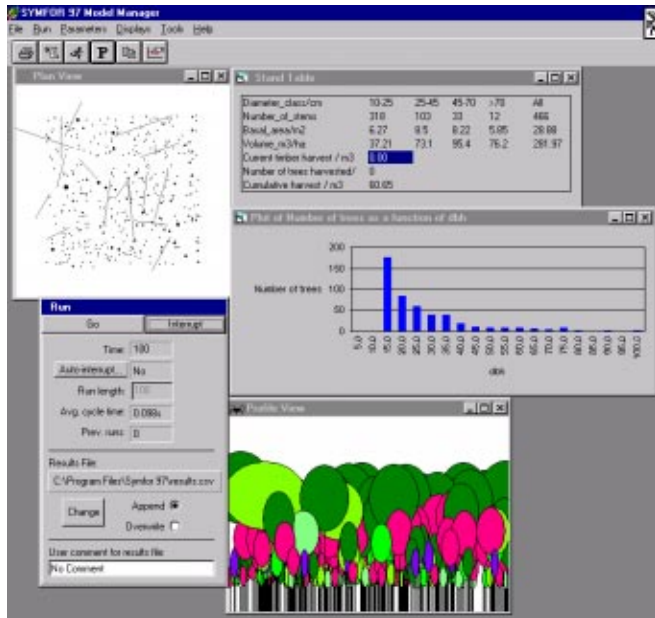


Figure 2. Typical set of End of Run Displays

## Criteria and Indicators of SFM

The Growth and Yield Modelling project is linked with CIFOR's ongoing research programme into Criteria and Indicators of Sustainable Forest Management. The ability to repeat multiple simulations using alternative management strategies and datasets will facilitate the statistical analysis of modelled predictions. An important development has been the implementation of estimates of stem quality so that management decisions made in the field can be more accurately modelled. This will also allow predictions to be made about likely long-term changes in tree quality within a managed stand.

The current version of SYMFOR<sup>97</sup> will be applied to existing Permanent Sample Plot datasets from Kalimantan during 1998 to refine indicators for sustained yield management. This work will contribute to the development of adaptive management systems that relate to the future productive capacity of managed forest areas.

## Agroforestry Modelling Environment

A related DFID funded project at The University of Edinburgh is developing the Agroforestry Modelling Environment. AME is a modelling environment, enabling users to create and run mathematical models of real or imagined physical systems. It uses the System Dynamics modelling paradigm, also known as compartment-flow. In this respect it is similar to the commercial modelling packages Stella, Powersim and ModelMaker. AME resembles these systems in its use of a pick-and-place graphical interface but it has a lot of unique functionality that makes it the most powerful modelling tool for system dynamics applications.

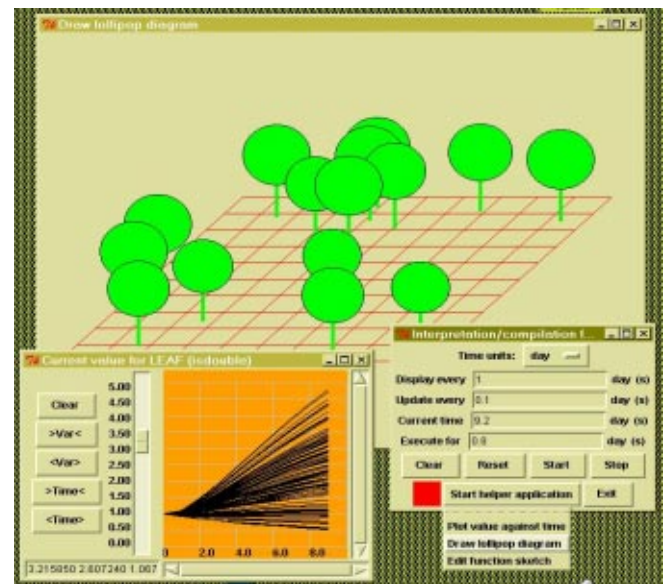


Figure 3. Screen shot from AME showing a diagrammatical representation of the growth of a stand of trees, a graph depicting leaf growth and an interactive window allowing the user to alter parameters at will.

AME gives complete flexibility in the creation of a hierarchical model, supporting nested submodels down to any level. At any time during construction you can

- group a bunch of components (including other submodels) into a submodel (links to other components are preserved),
- dissolve a submodel into its components,
- Load, save or empty the contents of any submodel,
- Change the shape of the submodel border,
- Open a new window to edit a submodel

as well as editing within a submodel on the main window. The display can be customized to any level of detail.

Full details, including a tutorial and a downloadable version of the AME software are available from: <http://meranti.ierm.ed.ac.uk/ame/>

## Project Management and Organisation

The University of Edinburgh



The Growth and Yield Modelling Project is managed by staff at Edinburgh University, led by Dr Paul van Gardingen of the Institute of Ecology and Resource Management, who is responsible for delivery of outputs, reporting and co-ordination between project partners.

Dr Paul Phillips is extending an existing growth and yield model (SYMFOR) in conjunction with Dr Robert Muetzelfeldt whose team developed the previous version of the software.

- Dr Paul van Gardingen  
+44 131 535 4066 [p.vangardingen@ed.ac.uk](mailto:p.vangardingen@ed.ac.uk)
- Dr Robert Muetzelfeldt  
+ 44 131 650 5408 [robertm@srv0.bio.ed.ac.uk](mailto:robertm@srv0.bio.ed.ac.uk)
- Dr Paul Phillips  
+44 131 535 4009 [paul.phillips@ed.ac.uk](mailto:paul.phillips@ed.ac.uk)

Institute of Ecology and Resource Management  
The University of Edinburgh  
King's Buildings  
West Mains Road  
EDINBURGH EH9 3JG  
United Kingdom  
Fax: +44 131 667 2601  
<http://meranti.ierm.ed.ac.uk/g&v/home.htm>

### Institute of Terrestrial Ecology



The Institute of Terrestrial Ecology (ITE) in Edinburgh are modifying one of their models (Hybrid) to improve the growth relationships used by SYMFOR. ITE are also responsible for the statistical analysis of PSP data.

- Mr Gerry Lawson  
+44 131 445 4343 [GKL@ite.ac.uk](mailto:GKL@ite.ac.uk)
- Dr Andrew Friend  
+44 131 445 4343 [ADF@ite.ac.uk](mailto:ADF@ite.ac.uk)
- Mr Ron Smith  
+44 131 445 4343 [RIS@ite.ac.uk](mailto:RIS@ite.ac.uk)

Institute of Terrestrial Ecology  
Edinburgh Research Station  
Bush Estate  
PENICUIK  
Midlothian EH26 0QB  
United Kingdom  
Fax: +44 131 445 3943  
<http://www.nmw.ac.uk/ite/edin/edin.html>

Forest Research Institute, BPK Samarinda.



BPK Samarinda are responsible for the provision of the datasets and application of the growth and yield modelling system in Indonesia

- Dr Boen M. Purnama  
[bpk-smd@smd.mega.net.id](mailto:bpk-smd@smd.mega.net.id)

Director  
BPK Samarinda  
Jalan A. Wahab Sjahrani Sempaja  
Samarinda  
PO Box 1206  
INDONESIA  
Tel/Fax: +62 541 42298

### Centre for International Forestry Research

The Growth and Yield Modelling project is linked to CIFOR's Criteria and Indicator Project to develop and evaluate C&I for yield regulation in sustainably managed forests.

- Dr Ravi Prabhu  
[R.Prabhu@cgnet.com](mailto:R.Prabhu@cgnet.com)

CIFOR  
P.O. Box 6596 JKPWB,  
Jakarta 10065  
Indonesia  
Phone: +62 251 622 622  
Fax: +62 251 622 100

<http://www.cgiar.org/cifor>

The University of Edinburgh is a member of the Edinburgh Centre for Tropical Forests, an association between them and the Institute for Terrestrial Ecology, the Royal Botanic Gardens of Edinburgh, the Forestry Commission and LTS International.