Appendix 2
User's guide to WaNulCAS

Introduction

This user's guide is designed to help users in working with **WaNuLCAS** model. Throughout this document, we assumed users have a basic experience on using software under Microsoft Windows.

To be able to run WaNuLCAS reasonably well the recommended system requirements are:

Pentium processor or better
Microsoft WindowsTM 95
64 MB RAM
VGA display of at least 256 colors

There are two options for running WaNuLCAS:

1. Under Stella 5.0 Commercial Run Time (CRT), which is a 'stripped' version of Stella Research. You can:
   a. run the model
   b. change most of the parameter values within the ranges set (directly or by copying from EXCEL files), and
   c. save/save as to maintain modified parameters
   d. save graphs as pictures for printer
2. Under Stella Research 5.11. In addition to the above you can also:
   a. modify parameters ('constant') not included in the input lists
   b. modify the parameter ranges
   c. save output tables as text files for further data handling with other software
   d. create new graphs or tables
   e. print a listing of all program equations
   f. modify the layout of the model
   g. modify equations, add or delete pools and flows, i.e. modify 'the model itself'.

If you do any modification, please keep track of changes made for any future report on your 'modified WaNuLCAS'.

This document deals with the second option that is running WaNuLCAS in Stella Regular / Research version. A free downloable version of Stella is available at **http://www.iseesystems.com/**. All option available except saving a file.

Installing WaNuLCAS

Decompressed WaNuLCAS model and excel file from the disk. You may copy the model and the excel file into any directory You may change the name of the model but not for the excel file. Change the name of excel file means break the link to the model. You can save on the different directory for representing different parameterization.

Starting WaNuLCAS

Initiate EXCEL. Open **Wanulcas.xls**. It will give warning that the file contains a macro.

Choose **enabled macro**. This is to make sure the macro built to ease inputting parameters in the model is working properly.

Then run **Stella**. It will automatically open a blank working model. Close it then open **Wanulcas.stm** from appropriate directory. You are now inside the **Main Menu** of WaNuLCAS and ready to work! In your screen you will see something like Figure App2.1.

Please be patient in waiting for the model to load. Inside WaNuLCAS you will see several buttons, each has specific function written on it.

To familiarize yourself with WaNuLCAS we suggest you to try the following exercise:

- First, view the model then return to main menu
- Second, run the model using default parameters, then look into the simulation result
- Third, check nitrogen, phosphorus, carbon and water input-output summary of model
- Fourth, modify input parameters and try new run
- Fifth, import output resulting from new run

In the following sections you will find description on how to perform each of the suggested exercise.

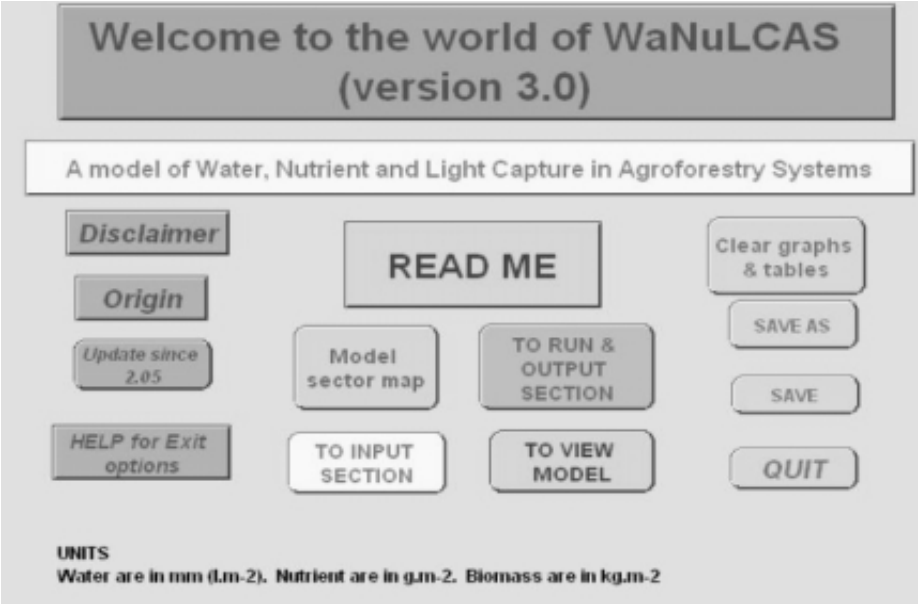

Figure App2.1. View of WaNuLCAS Main Menu

To View Model

This option will give you a bird's eye view of model structure: sectors, pools, flows and influences (see figure below). Using Stella 5.0 Research you can modify the model at this level.

To return to **Main Menu** you may click on the available button or click on an arrow pointing upwards in the top left corner.

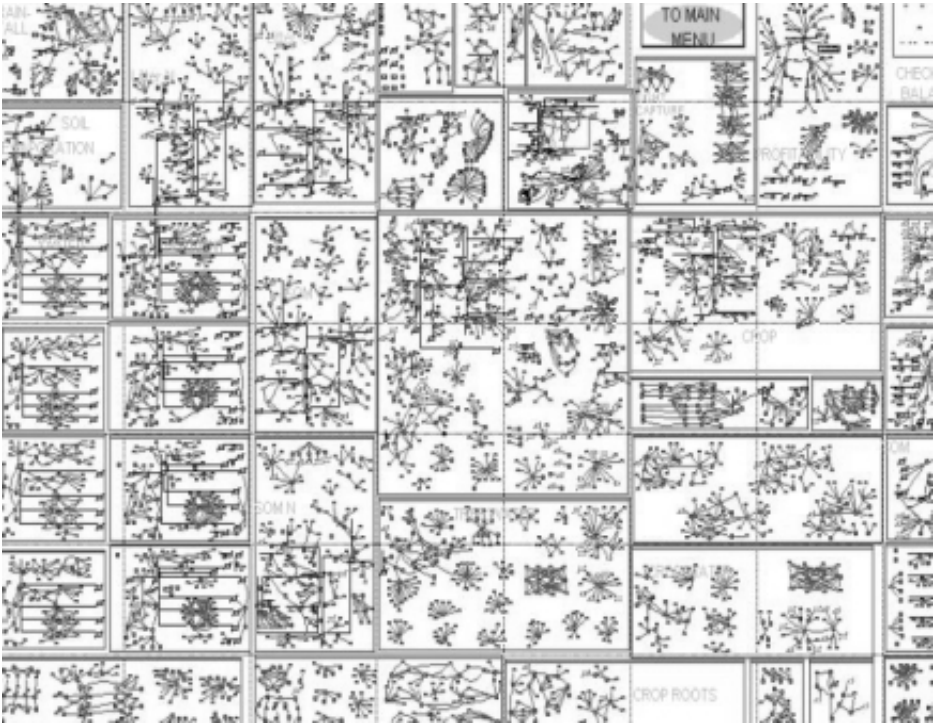

Figure App2.2. A bird's eye view of WaNuLCAS

To Run and See Simulations Results

To run or to see simulation result from **Main Menu** click on **TO RUN AND OUTPUT SECTION** button.

Running WaNuLCAS

On the output screen you will find 5 buttons which control simulation run as listed below.

Buttons	Purpose
Run	To start simulation
Pause	To pause during simulation run
Stop	To stop simulation
Resume	To resume simulation after pausing
Time Spec	To specify length of simulation time

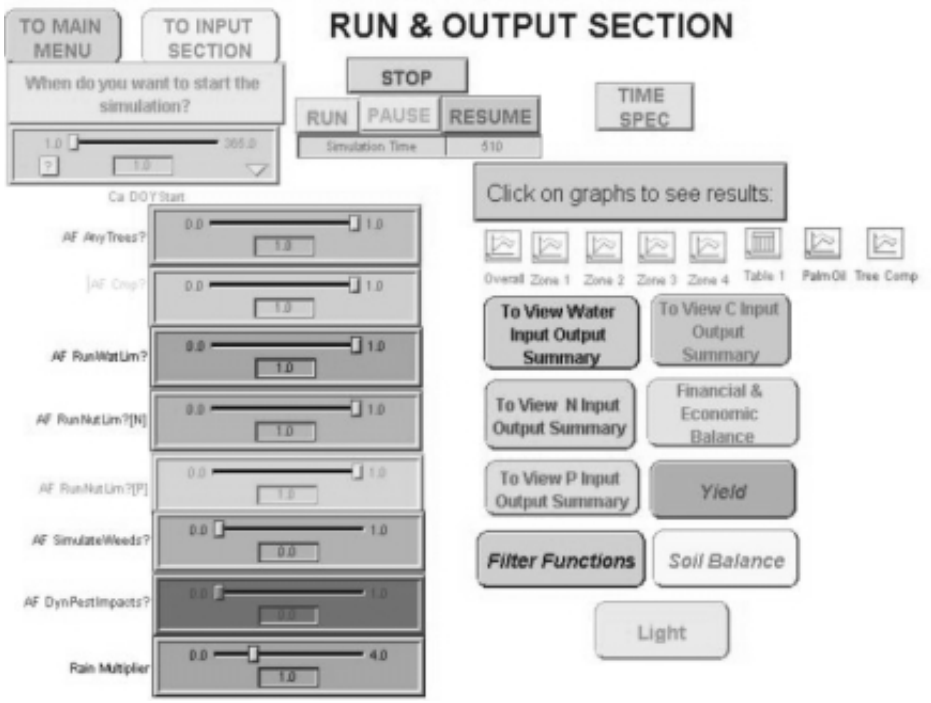

Figure App2.3. View of Output Section

Below the running control buttons, you will see a box displaying time lapsed since start of simulation (see Figure App2.3).

There are 6 sliders to simplify running different type of simulations. See Appendix 7 on acronyms to know more of the function of these sliders. The Time Specs screen will appear (Figure App2.4) allowing you to change beginning and ending period of simulation, also DT which is incremental time of simulation. We strongly advise you to keep DT value at 1.

There are 6 sliders under Click Me button. These sliders are options of a general different simulation you can run. Click on Click Me button to find out more on the function of each slider.

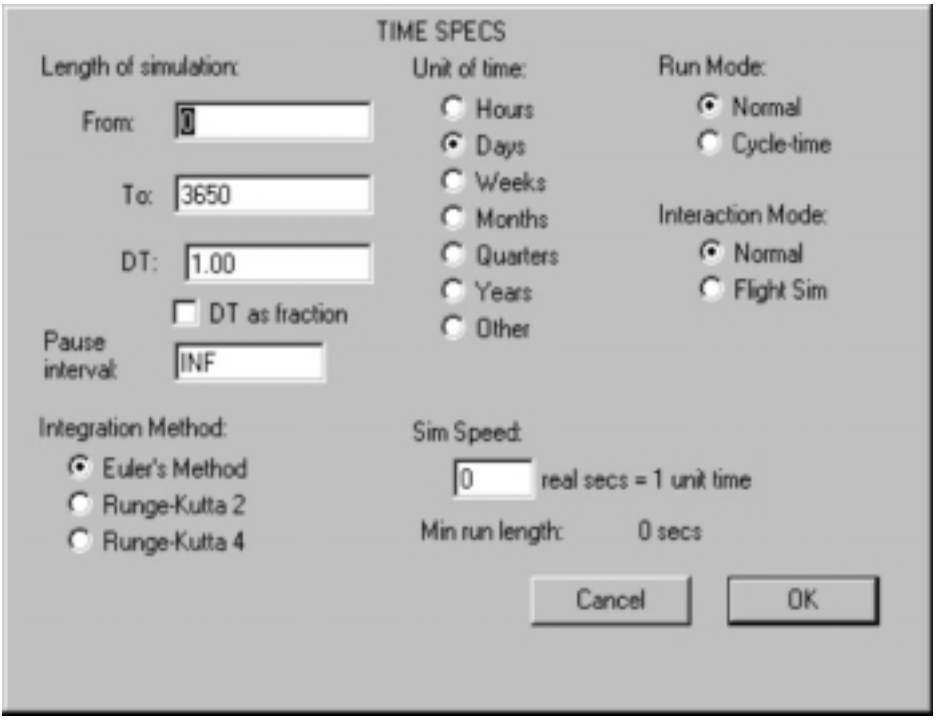

Figure App2.4. View of Time Specification screen

Output Result

There are two types of output result, (1) Tables and (2) Graphs.

To view a graph/table, click twice on the graph icon. What you will see is actually a stack of graphs/tables. To view the rest of graphs, click on the folded page at the bottom left corner.

When you look at graphs, notice that the scale on Y axis between parameters on the same graph can be different. Match the index number of parameters with index number of scales in Y axis.

Listed below is summary of available output on display. More detailed descriptions on output parameters are listed in Appendix 4 of this document.

A. GRAPHS

Overall: Summaries of overall zones and specific output related to Tree

Output	Content	Graph Type
Page 1	Plant biomass, tree biomass presence as total biomass	Time series
Page 2	Distribution of rainfall	Time series
Page 3	Distribution of cumulative amount of water drained out	Time series
Page 4-5	Distribution of cumulative amount of nutrient leached out	Time series
Page 6	Cumulative plant water uptake	Time series
Page 7	Total plant N & P uptake per day	Time series
Page 8-9	Amount of nutrient presence in plant aboveground biomass	Time series
Page 10	Water available, demanded and taken up by tree per day	Time series
Page 11-12	Nutrient available, demanded and taken up by tree per day	Time series
Page 13-15	Factors limiting tree growth	Time series
Page 16	C and Nutrient in SOM + litter pool	Time series
Page 17	Tree biomass and diameter	Time series
Page 18	Plant biomass, tree biomass presence as leaf and twig biomass	Time series
Page 19	Tree canopy biomass and cumulative pruned biomass	Time series
Page 20	Plant (Leaf and Twig) biomass	Histogram
Page 21	Water stock	Histogram
Page 22 - 23	Nutrient stock	Histogram
Page 24 - 25	Pore volume	Histogram

Zone 1, Zone 2, Zone 3, and **Zone 4** : Each of these graphs contain similar output parameter related to zone 1, 2, 3 and 4

Output	Content
Page 1	Factors limiting crop growth
Page 2	Distribution of water stock
Page 3-4	Distribution of nutrient in soil
Page 5	Distribution of crop water uptake
Page 6	Distribution of tree water uptake
Page 7,9	Distribution of crop nutri ent uptake
Page 8,10	Distribution of tree nutrient uptake
Page 11-12	Nutrient available, demanded and taken up by crop per day

OilPalms: spesific output for oilpalm

Output	Content
Page 1-3	Fruit biomass
Page 4	Biomass and oil harvested

Tree comp: spesific output related to the tree phenology

Output	Content
Page 1	Tree Leaf Area Index (LAI)

B. TABLES

There is only one table containing 2 pages of water balance, plant biomass, water, N and SOM in soil.

Adding additional output parameters

To add more parameters to your tables or graphs do the following:

- Click twice on your graph / table. After a graph / table appear, click twice again on it. Now, you will see a box emerge with 2 small boxes in the upper section. The left box contains parameters that can be loaded into graph / table. The right box contains parameters already in the graph / table. A graph can contain up to 5 parameters while a table can contain more than 40 parameters.
- To load a parameter into the graph / table, highlight the parameter in **allowable** box then click an adjacent arrow pointing to the right.
- If you want to load a parameter to a new clean page, prior to the above you need to click an arrow pointing upward at the bottom left corner pointing (**adjacent to Page**). Keep on clicking until you see **NEW** as page number.

Locking graphs or tables to speed your simulation

You can lock pages in your graphs and tables that you do not need. Locked graphs or tables will not be updated in the next simulation run. This would save a lot of time needed to run the model. To lock graph or table click on the lock icon. It is in the bottom left corner of your graph or on the top right corner of your table.

Printing your output

You can print your output by clicking on printer icon. It is in the bottom left corner of your graph or on the top right corner of your table. It will ask you to specify which page of your graph or table you want to print.

Importing Output Results

You can save your table as a text file and your graph as a pct file. You can also use copy (Ctrl-C) and paste (Ctrl-V) your output table. For graphs you can use screen dump (Shift-Print) then paste to your favourite Microsoft software.

To View Input-Output Summary

To view Input-Output Summary, click on button **TO RUN & OUTPUT SECTION** in the **Main Menu**. There are 7 input-output summary you can see, Water, Nitrogen, Phosphorus, Carbon, Financial & economic, Yield, Filter functions, Soil and Light. Choose the relevant one.

This screen gives you summary of input and output in the current system simulated. A list of parameters acronym found in this section is shown in **Appendix 4** under **Balance**.

Modifying Input Parameters

Click on button '**TO INPUT SECTION**' from **Main Menu**. It will lead you to list of input parameters.

Click again on button associated with specific parameters. Refer to **Appendix 7** in Documentation Manual for more detailed information on input parameters.

Basically data for WaNuLCAS model are placed in two locations, (1) the upper layer of the model and (2) WaNuLCAS.xls. When you click on input parameter button, it will either take to the actual input parameter location or inform you to enter it through Wanulcas.xls.

From upper layer of model there are basically three types of input device used, (1) list, (2) sliders and (3) graphical input

Changing Input Values

To modify input value just write over the current value. It will change if the new input value is within allowable range. If not, the maximum or minimum in the range will replace the value specified.

To check allowable value, please refer to Appendix 7 in documentation manual. If you experience problems, please let us know.

Please refer to Stella Technical Manual to change input values on specific input device.

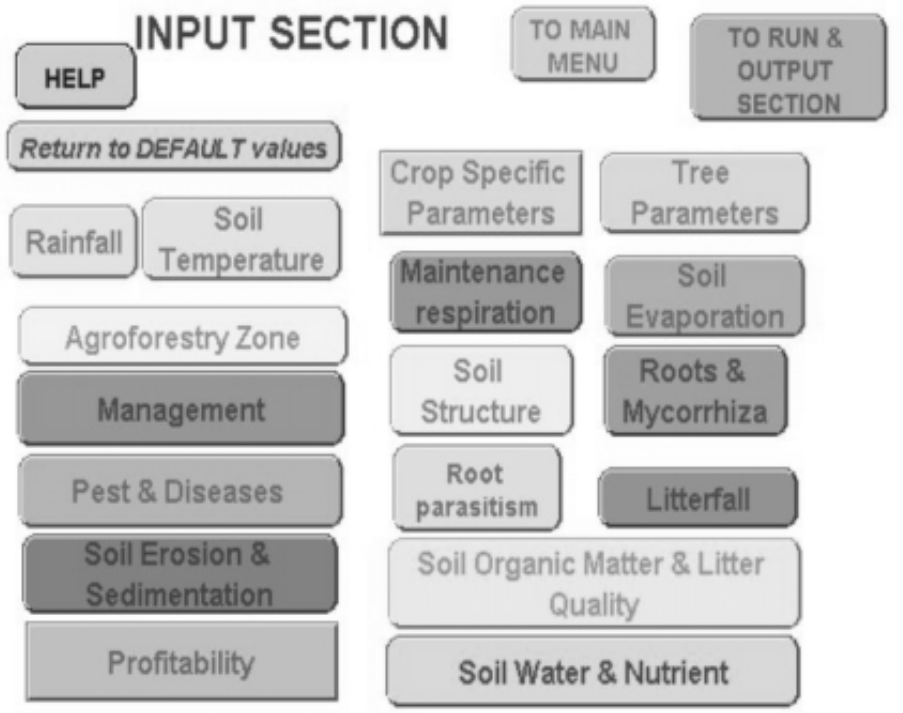

Figure App2.5. View of input menu

Description on Wanulcas.xls

This Excel file is contains data used as input parameters and routines to help users in generating these input parameters. To be able to open the file you need at least Excel ver. 5.0 (MSOffice 97). The Excel must have Visual Basic Application as add-in working. The descriptions of each sheet are listed below.

All the sheets are protected by default in such a way that you will still be able to change input parameters. You can unprotect the sheets using password wanulcas (all lower case).

All input parameters in Wanulcas.xls are linked to WaNuLCAS model. For these parameters you should change it directly from the Excel sheet. For more detail description, please see Appendix 3.

Sheet	Content
READ ME	General information
Pedotransfer	Program to generate soil hydraulic properties. Output generated from this program forms data input for WaNuLCAS. These can automatically be copied to the sheet 'SOIL HYDRAULIC' where it is linked to WANuLCAS model.
Soil Hydraulic	Soil Hydraulic input parameters for each soil layer and zone. Linked to WaNuLCAS STELLA model
Phosphorus	Program to generate Ka (adsorption constant) of P, based on double Langmuir equation and related P_Bray to total mobile soil P content
Weather	Daily rainfall, daily soil temperature and daily potential evaporation
Slash and Burn	Slashing schedule and parameter impacts on the burning event
Crop Parameters/Library	Crop specific parameters
Tree Parameters/Library	Tree specific parameters
Crop Management	Planting schedule, fertilization schedule
Tree Management	Tree planting & timber harvesting schedule and pruning management.
Pedo SOM	Bulk density pedotransfer and Soil Organic Matter pedotransfer
Profitability	Input prices and labour requirement for the agroforestry system simulated and output produced.
Julian day	Information to converting calendar days per month into the 'day-of-year' (DOY) or 'Julian days' format used in the stella model
Link output	Information on how to make proper link between WaNuLCAS.xls and WaNuLCAS.stm and examples output that can get from WaNuLCAS simulation

Linking data

STELLA Research has a DDE facility, which enable users to link model to outside file.

Most of the contents of Wanulcas.xls are linked to WaNuLCAS model as input pa-rameters. Linking enable you to change input value in WaNuLCAS by changing associated values in Wanulcas.xls. The linked values are marked by blue font.

When you open WaNuLCAS model in STELLA Research version, STELLA will ask if you want to establish link. Answer Yes if you want to have the model linked with Wanulcas.xls, but be sure that you already have EXCEL running in the background and Wanulcas.xls have already been copied.

STELLA only allows the changes to occur when both Excel and STELLA files are open simultaneously. Changes made in Excel prior to establishing the link will not change parameter values in STELLA. To overcome this problem we have built an updating macro in Excel. Run this macro by pressing Ctrl-u after you have the link between STELLA and Excel file establish to make sure all the input parameters value in STELLA model corresponds to the value in Excel.

With this macro, you will be able to have different excel files representing different parameterization. Rename the file to Wanulcas.xls when you want to use it. Click the updating macro. All the parameter values in Stella will be updated.

To Make Changes in the Model

There are 2 levels of model changes you can do; (1) change a constant parameter into a dynamic variable and (2) adding additional influencing parameter /factor to existing equations.

Changing a constant into dynamic variable

You can do this by making a constant parameter depends on existing-state variable.For example: change biomass-to-height conversion factor (Cq_HBiomConv[Cr]) into crop stage (Cq_Stage) dependent.

Adding influencing factor to existing equations

You can do this by adding additional parameter to existing equations. For example: add effect of slope as a parameter influencing potential evaporation (Evap_Pot).