MANUAL

"Usage and modification of the model framework"

WESTERKWARTIER BIOMASS AND LANDSCAPE MANAGEMENT MODEL

Written for Revision: 12   Date: 24/06/2011

Table of content

1.   Introduction

This manual accompanies the "WESTERKWARTIER BIOMASS AND LANDSCAPE MANAGEMENT MODEL" which was developed for the biomass committee of the Westerkwartier. The current revision of the model, version 14, comprises of a model framework upon which can be expanded in various ways. This manual consists of two parts:

1. A description of the intended usage of the model when it's completed;

2. Mechanisms in place and technical ways to enhance and add to the model.

A justification report has also been produced alongside the model framework, and this manual, In which an explanation of the decisions behind both of the structure as well as some of the values in the model are given. With this justification report areas of interest can more easily be identified, so that improvements are made in areas where the effect on the model's accuracy is greatest and uncertainty is highest.

The goal of the final revision of this model is to simulate, in terms of costs, benefits and ecological and environmental, the effect of different landscape management options and biomass processing methods. When this goal is attained the local stakeholders will be able to use this simulation to search different ways to reduce the costs of landscape management by matching landscape management with biomass processing.

2.   Using the Model

This part of the manual consists of a description of the intended usage of the model. The current revision of the model is unable to produce an output upon in which confidence can be laid.

manual 1. Describes the usage of the model when it's completion is shown. The construction of the model framework is so that the layout of the model can remain unchanged while the internals are rewritten and/or expanded upon. Therefore the model will closely reflect the actual usage.

2.1 General usage

The model consists of four tabs, "management model", "Pre Processing", "Processing Model" and finally the "Summary". For all these tabs the layout of the model indicates which data can be modified. All the parts that require user input are green. There are two types of input, one where a numerical value can be entered, marked light green and the other where an option can be selected from a drop down list marked dark green.

Numerical values {0...}	15
*Lists {option 1	option 2	...}*	An option

Figure 1: Data entrance indicators

All the headers, indicating what subject is going to be displayed in the cells below it are displayed in a dark grey cell with bold text.

Header or Subject Title	**Example Title**

Figure 2: Header and subject indicators

Finally the input of the model is checked for consistency, the layout of certain cells change based on the internal consistency of the data entered. So if, for example, not all of the biomass produced is used, a cell indicates that there is still biomass available. A yellow cell indicates not everything is used, a red cell indicates too much is used and finally a blue cell indicates that everything is as it should be.

Not all of the quantities are used	35
More than all quantities are used	-35
All quantities are used	0

Figure 3: Data consistency indicators

2.2 Specific Usage

MANAGEMENT MODEL

The first thing you enter in the model is the input cells:

INPUT		
Area type:	*Size*	*Unit*
Hedgerows	0	km
Grasslands	0	ha
Banks	0	ha

Figure 4: The Input of landscape types

This data is used to verify that the data in the model is consistent. These landscape types can then be arranged according to the different landscape management boxes.

In the Landscape Management model multiple boxes with landscape management options are taken, according to Landscape types, they are:

1. Landscape management of natural grasslands;
2. Landscape management of hedgerows;
3. Landscape management of public greenery;
4. Landscape management of banks.

In the light green boxes data can be entered while different equipment types, mowing time and the timing of grass removal can be selected from drop down lists. With this data the costs and production of biomass are already calculated automatically.

LANDSCAPE MANAGEMENT GRASS				
TYPE:	*Mesotrophic Grasslands (h*	Equipment	*Time of year*	*Removal of grass*
Mowing and Removal	10	vacuum mower with eco head	Spring	1st day

Figure 5: Example of selection and usage of landscape management techniques

See below examples of the landscape management of the grass box.

For the management of hedgerows, banks and public greenery similar options are available although landscape management options may obviously vary.

For hedgerows:- the composition of hedgerows are important for the caloric value, therefore the average composition of two hedgerow types can be defined and a caloric value is determined based on this.

Hedgerow composition		
TYPE	*Bushy Hedgerows*	*Tree Hedgerows*
Oak	40%	0%
Elm	10%	10%
Willow	15%	15%
Birch	25%	25%
Hornbeam	10%	42%
Alder	0%	8%
REMAINING %:	0%	0%
AVERAGE CALORIC VALUE:	16,1005	15,6461

Figure 6: Hedgerow composition and caloric content

PRE- PROCESSING

In the pre-processing part of the model some additional processing of the produced biomass can be done. All the biomass produced during the landscape management is automatically sorted here from largest to lowest.

Storage

Using the dropdown menus a user can select, for every biomass stream, if storage is required and if so how long storage will take place.

STORE	TIME (MONTH)
NO	1

Figure 7: storage option and time selection

The storage of biomass has an effect on the moisture contained within the biomass and costs are also associated with storage.

Palletizing

Another pre-processing technique is the palletizing of biomass. For all the biomass streams generated after the storage of biomass (this option is available). Again using a drop down list the usage of this technique can be specified.

PALLET
NO

Figure 8: Preprocessing technique selection

PROCESSING MODEL

The processing model can be used to link the products that are created with the landscape management and pre-processing modules to biomass processing techniques. This is done by selecting a technique for all the products in the product list.

PRODUCT LIST	Product (kg)	Moisture (%)	Technique
Tree Hedgerows	373243	60%	combustion
Bushy Hedgerows	82264		combustion
Bushy Hedgerows (PG)	130		Gasfication
			carrbonisation ,slow pyrolysis
Wood Pallet	70		flash pyrolysis, low temperature
Mesotrophic Grasslands (ha)	56		fermentation
Banks (ha)	17		anarobic digestion
			Market pricing
Grass Pallet	0	10%	Market pricing
Grasslands (PG)	0	0%	carrbonisation ,slow pyrolysis
Eutrophic Grasslands (ha)	0	0%	anarobic digestion

Figure 9: Selection of biomass processing technique

In the picture above the technique fermentation is being selected from the drop down list. The model will automatically calculate based on product type, moisture and caloric composition the energy production resultant from this technique.

Here the option exists to manually enter biomass data. This is done by selecting the manual input box and changing it to yes. After the option "YES" is selected all the input from the landscape management model is ignored and the data from the product and moisture boxes are used instead.

INPUT		
Manual Input?	Product (kg)	Moisture (%)
YES	50	50,00%
	30	50,00%

Figure 10: Manual input of biomass products

The technique "market pricing" can be selected; when this 'technique' is selected users are able to define a price in which the raw products are sellable. There are no costs associated with this part of the model; therefore it should be accounted for in the market price entered.

Market price (euro/kg dry weight)
10

Figure 11: User defined market pricing of products

Summary

A summary of all the data in the model is given in this tab. Here the costs of landscape management, preprocessing and biomass processing are displayed together with the energy produced, household equivalents and benefits of processing. The current version of the framework doesn't support optimization of techniques, users can quickly refer to this tab to find good matches between landscape management practices on one side and biomass processing on the other side.

3.   Changing the Model

The manual examples and techniques that are given can be used to change the model in the future. First the modular design of the model will be explained so that it is clear where variables and data can be changed easily. Secondly some more complex techniques will be explained that affect the structure of the model.

3.1 Changing variables

To the users only the "background Information", "Management Model", "Pre-Processing" and "summary" tabs are displayed. However the model also contains the "Calculation Energy", "Calculation Costs", "Calculation Production" and "Lookup Tables". These calculations and variables are contained and used to calculate the model outputs.

In most of the variables in the model uses are contained in the "Lookup Tables" tab. For example in the figure below the characteristics of mesotrophic grassland with the technique "Mowing and Removal" are displayed. All these variables are used in the calculations of the model.

TYPE:	**Mesotrophic Grassland**
Production (kg/ha/yr)	8
Moisture	60,00%
Quality	1
OPERATIONAL LOSS:	30,00%
Machine1	Drum and disc mower with wagon
Machine2	vacuum mower
Machine3	vacuum mower with eco head
Machine4	
Labour time (ha/h)	2

Figure 12: Mowing and Removal of Mesotrophic Grassland

By changing these variables the calculations within the model using different factors and therefore will generate different outputs. Current estimates of these variables and their confidence are discussed in the justification report; changing these variables will give estimates that will improve model output.

The "Lookup Tables" the "Calculation Costs" tab also contain some variables that were separated from the lookup table for reasons of order. All these variables are marked with a brown background:

Discount rate
0,05

Figure 13: This is a variable in the "Calculation Costs" tab

These variables are changeable whenever a better estimate is found as the model will use the new variables to calculate model output.

Another way to change a variable is by expanding it into multiple factors. For example the capital costs of the model are calculated based partly on the capacity required for processing the biomass. Currently this relationship scales linearly so the capacity cost are calculated according to:

$$Capacity\ Costs = Mass\ to\ be\ processed (kg) * Capacity\ costs\ per\ kilogram$$

The capacity costs per kilogram is a variable in the current model, but by changing the contents of this cell into a formula it can give a better estimates of this variable. In this case it could make the "Capacity costs per kilogram" depend on a lump sum; for example, 1 euro per kg and a capacity formula which would be 10 euro / Mass to be processed. In excel this would look like:

=1+ (10/[cell that contains the amount of biomass that needs to be processed])

In this way simple variables can be changed to reflect complex system and model interactions.

3.2 Changing the structure

Expanding upon formula's

Besides the variables the need may arise to change the structure of the model. This can be done either by simply adding another factor to a calculations. For example the moisture of a product is calculated with the following formula:

$$= Grass\ type + time\ of\ year\ factor + removal\ of\ gras\ factor + (storage\ factor * storage\ time)$$

If another factor is affecting the moisture of the grass by simply adding another variable to this formula can account for these changes.

Changing lists

A lot of the data in the model is stored in lists; these can be edited by pressing CTRL+F3.
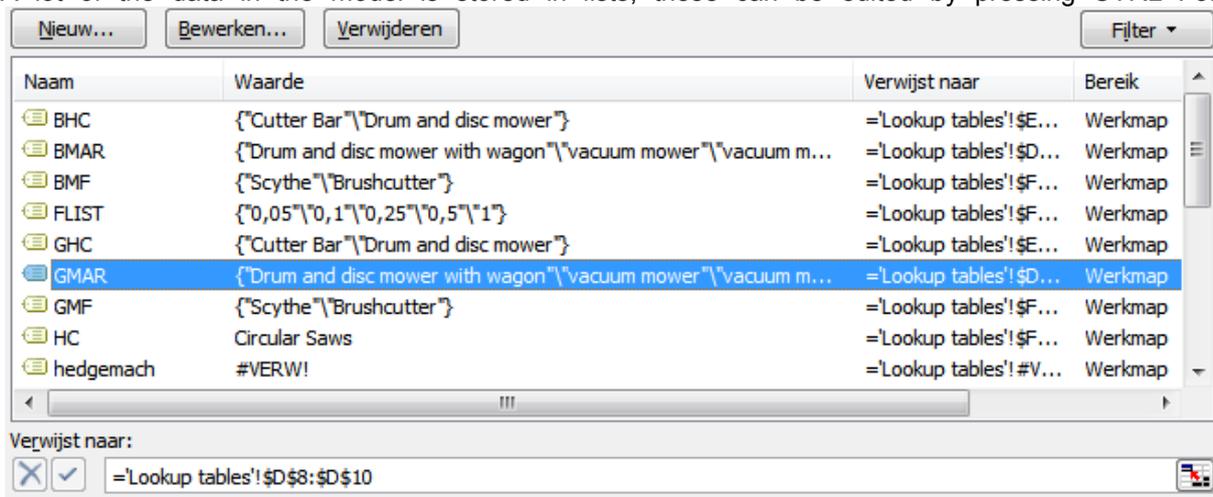

Figure 14: changing selection lists

By editing these lists it will be possible to modify the techniques and options in the selection lists.

PALLET
NO

Figure 15: Example of a selection list in the model.

Adding additional Categories

It is possible that the addition of more categories will be necessary. The model layout is largely uniform so that, by simply copying existing model parts, it can easily be added to additional categories. However this will not be necessary for all the cases. When adding new categories special care must be taken to check if all the IF(logic statement; true; false) and SUM(Number1;Number2;..) Are contained in the new categories.

When adding new data structures to the model, the "Justification report" can be used to find the calculations that underline the model, so that the new structures tie into them.