LIFE

Climate Change Mitigation

Deliverable C.3: Interface development of a software application for accounting tree crop carbon sequestration

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LIFE CLIMATREE (LIFE14 CCM/GR/ 000635)

A novel approach for accounting and monitoring carbon sequestration of tree crops and their potential as carbon sink areas

The **LIFE CLIMATREE** project "A novel approach for accounting and monitoring carbon sequestration of tree crops and their potential as carbon sink areas" (LIFE14 CCM/GR/000635) is co-funded by the EU Environmental Funding Programme **LIFE Climate Change Mitigation**.

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1. Introduction

In this section the web application, which is based on the algorithm presented in C4, will be described. The application is available in http://climatree.open.gr/ . Its access is free for all users, but it requires to create an account.

The following sections describe (a) the login page, (b) the typical home page of a user, where a new calculation is created, saved for future reference and altered and comparisons for various scenarios are made. Lastly, the backed is presented where a user with privileged access can change the various parameters of the algorithm.

2. Main page

The main page is shown in Figure 1. It includes a link to the login page.

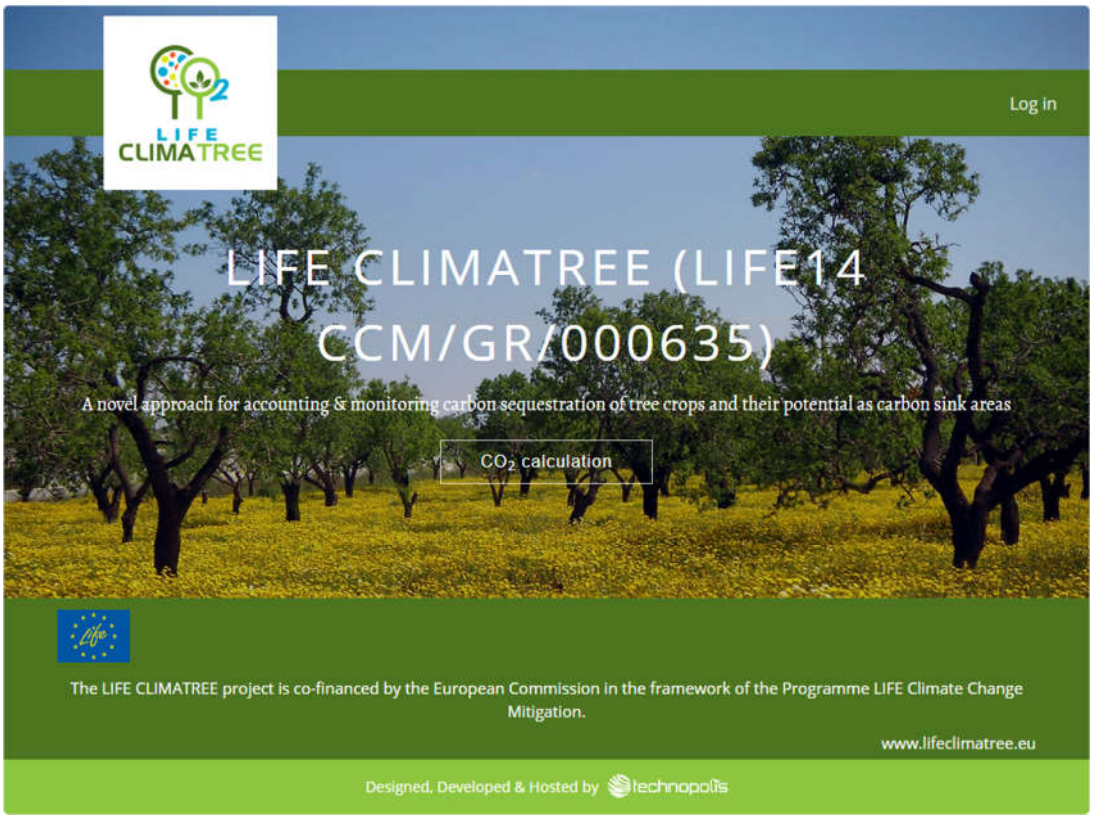

Figure 1. Main page of the web application.

In the login page, the user can create a new account (the first time), insert its credentials or reset a forgotten password (Figure 2).

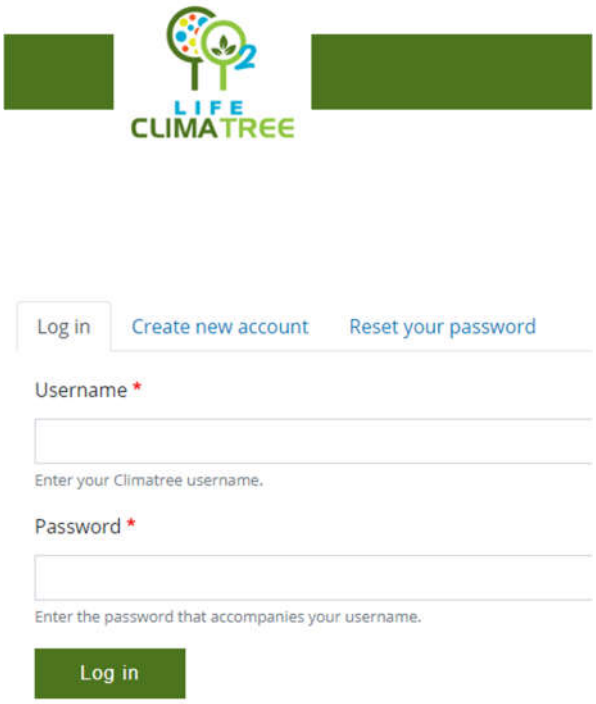

Figure 2. Login page.

3. User environment

The environment is user specific and has three tabs on the left vertical bar. The *first option* holds the user information ("Edit account") as can be seen in Figure 3.

The *second option* shows a list of previous calculations ("My calculations") created in the user's account and can create a new calculation (Figure 4).

In this page, the user, mainly, can create a new CO_2 calculation (1). Further, there is a list of previous calculations and each one has a label created automatically (2), a date that the calculation was created (3), the user type (in 4 with options Policy maker or Local user) and three buttons (5), permitting the user to examine the calculation at any time, to edit the calculation or delete it.

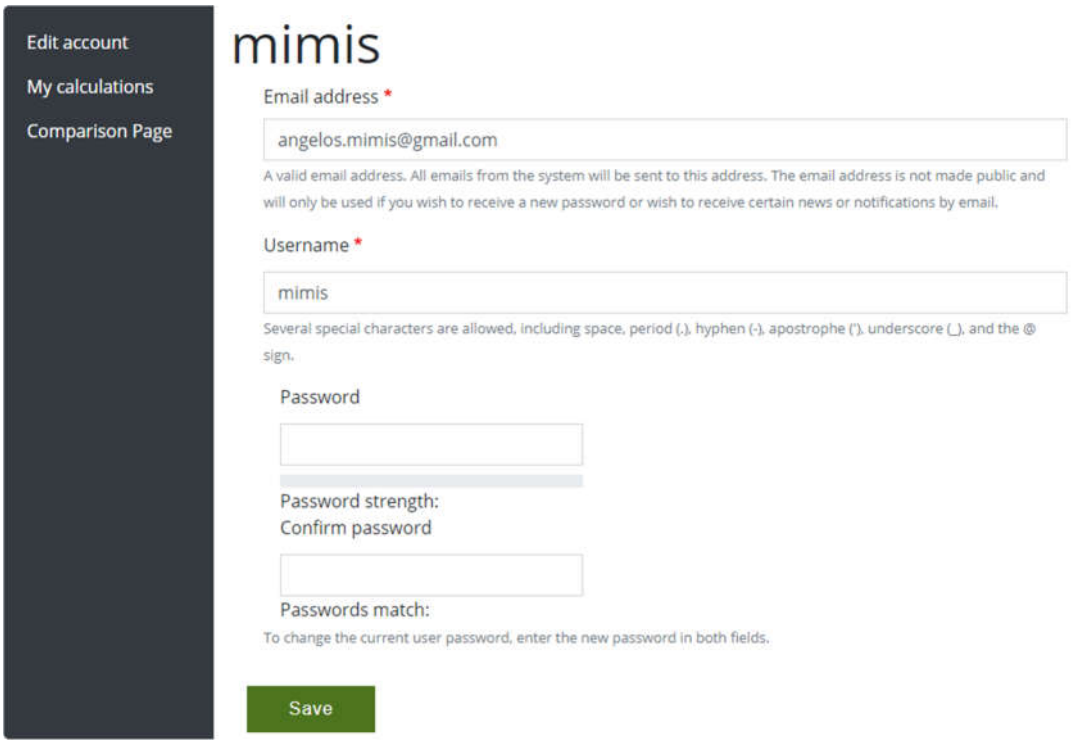

Figure 3. Account information.

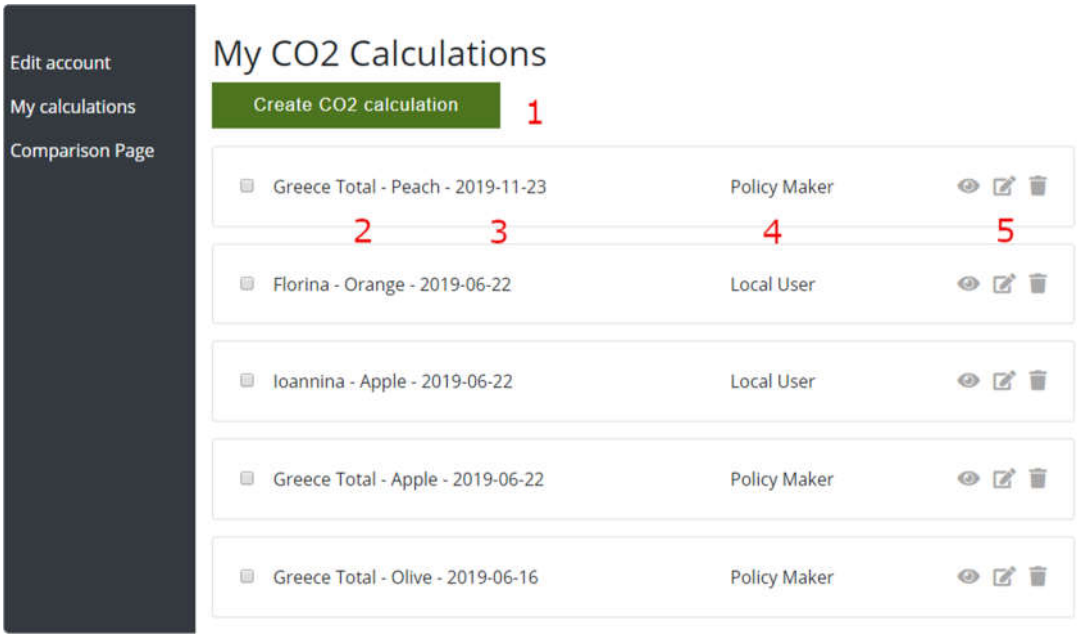

Figure 4. List of previous calculations.

In “My calculations” page (Figure 4) by pressing “Create CO2 calculation”, a new calculation can be created. The new page has all the required input for the calculation and a typical page can be seen in Figures 5a, 5b and 5c. Selecting the compulsory fields (noted by a star) referring to the country (1), the user type (2 with options Policy maker or Local user), the regional unit (3) and tree type (in 4 with options orange, apple, peach almond and olive), has as a result, the rest of the fields in Figure 5a to be filled in automatically by using the country statistics. These fields are the yield density (5), the plant density (6), the surface (7) as well as the percentage of the trees in juvenile (8) and in mature phase (9).

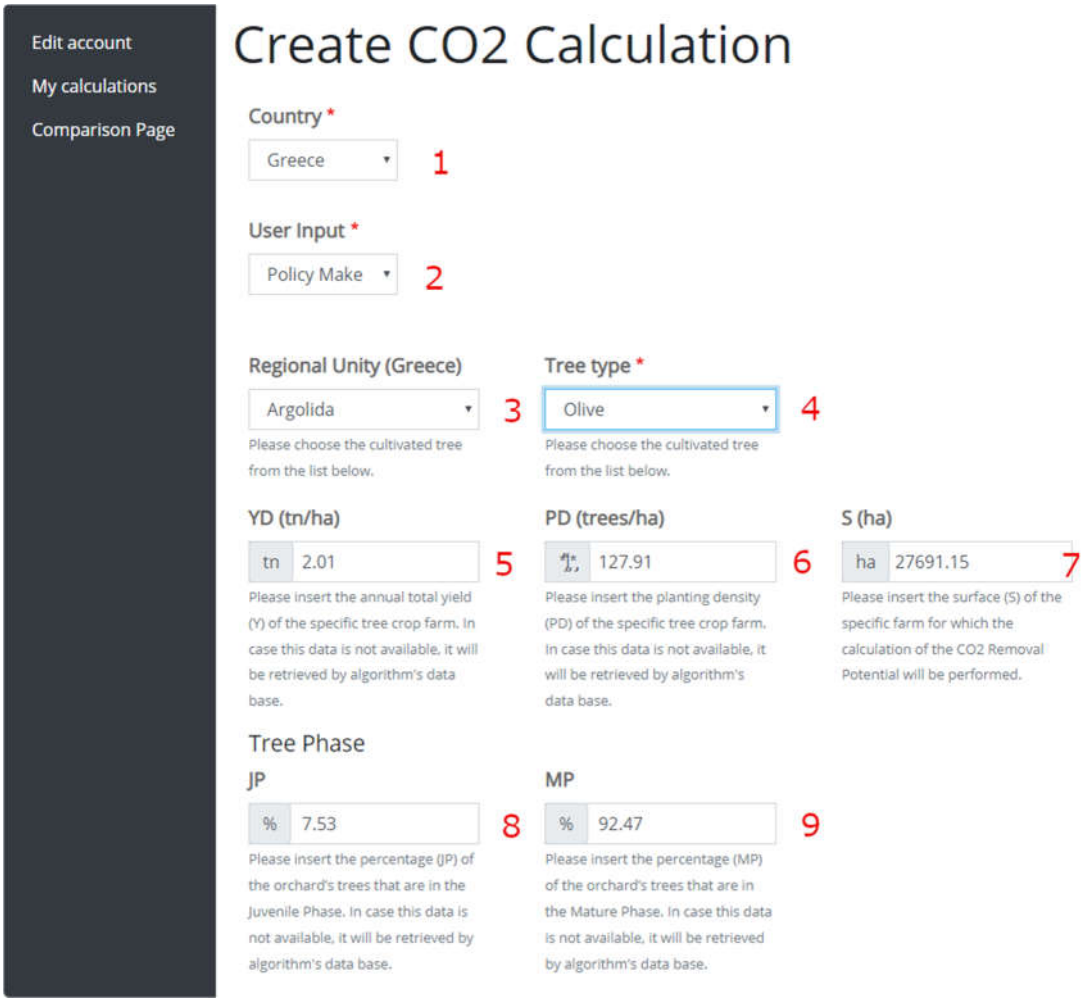

Figure 5a. Input tree specific data required for a new CO_2 calculation.

Further down the same page (Figure 5b), management practices are defined. These include the fossil fuels and electricity consumed (10), the pruning information (11) and the fertilizers that are applied (12). The first two fields are filled in automatically

with typical values for the type of tree, cultivated. Despite that, the used can alter these values if he wishes to do so.

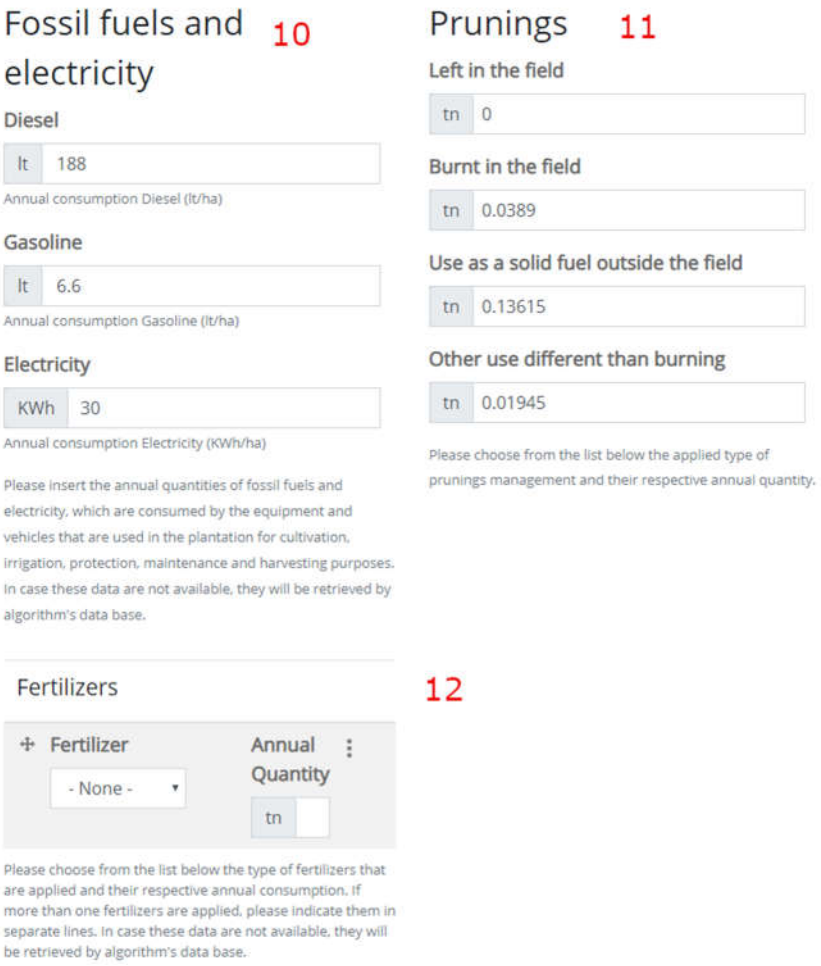

Figure 5b. Input data for management practices.

The last part of the input data required, has the present temperature (13) and the expected increase in temperature in 50 years' time (14). The current temperature is yearly mean temperature for the region chosen, in the first part the page (3). In this part, the save button is shown and by pressing it, the calculation is saved in the user's account.

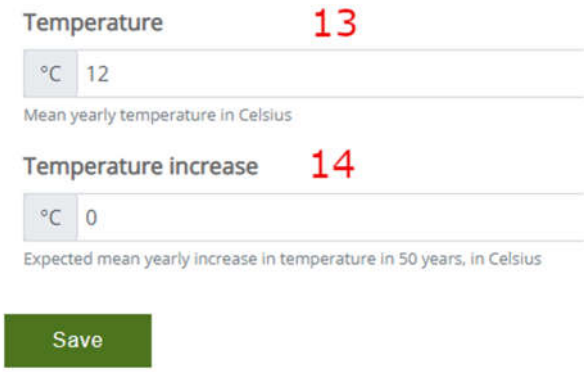

Figure 5c. Temperature input required for soil calculations.

To illustrate the results, the user must press, in “My calculation” page, the first from the three buttons (5 in Figure 4). A typical output is shown in Figures 6a and 6b. In the upper part of the output (Figure 6a), the main input data are displayed. So, all the options inserted in Figures 5a-5c can be seen here. In the lower part of the output page (Figure 6b), all the indices created are presented. The TRP value (green) illustrates the total removal potential. The next set of value in yellow, RPBF, RPBW and SPS captures the CO2 removal potential due to production of fruit biomass, the new trunks, branches and roots and soil respectively. The following set in red captures the emissions potentials due to the use of fertilizers (EPf), fossil fuels and electricity (EPff&e) and pesticides (EPP). The removal potential values (in yellow) summed up with the emissions potential (in red) results in the total CO2 removal potential (in green).

The last part of the output page illustrates three removal potential indexes customized to give the user a broader image of the results. The first index, TRPA, captures the total removal potential per unit of cultivated area. The second, TRPP, captures the total removal potential per unit of produced product and the last, TRPT, illustrates the total removal potential per tree unit.

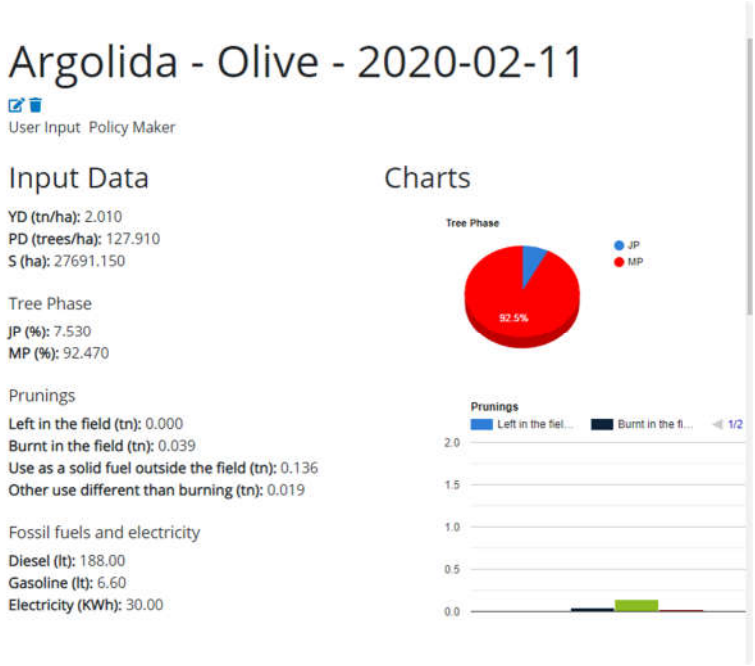

Figure 6a. Upper part of a typical output page.

Total CO_2 Removal Potential

TRP	349.651	CO_2 Total Removal Potential of a specific tree crop farm or a broader area where tree crops are cultivated

Analysis

Type	tn CO_2	Description
RP_{BF}	1.111	CO_2 Removal Potential due to the production of fruit biomass
RP_{BW}	51,286.084	CO_2 Removal Potential regarding the production of annually new trunk, branches and roots biomass
SP_S	311.540	CO_2 Storage Potential of soil regarding the carbon of the fallen biomass
EP_f	-0.000	CO_2 Emissions Potential due to the use of fertilizers
$EP_{ff\&e}$	-14,915.373	CO_2 Emissions Potential due to the use of fossil fuels & electricity
EP_p		CO_2 Emissions Potential due to the use of pesticides

CO2 Removal Potential Indexes

TRP_A	0.013	CO_2 Total Removal Potential of a specific tree crop farm or a broader area per unit of cultivated area
TRP_P	173.956	CO_2 Total Removal Potential of a specific tree crop farm or a broader area per unit of produced product
TRP_T	0.000	CO_2 Total Removal Potential of a specific tree crop farm or a broader area per tree unit

Figure 6b. Lower part of a typical output page.

In the main page, *the third option* helps the user to make comparisons ("Comparison Page") between calculations already performed.

In order to illustrate the comparison page, two calculations have been made, the first one captured in Figures 5a-5c and 6a, 6b which is referring to olives in all Algolida and a similar one for Arkadia (Regions in Greece). So, by choosing the two calculations we want to compare the results, and this can be done by pressing the "Comparison Page". The comparison is shown in Figure 7.

Arkadia - Olive - 2020-02-11	
TRP	27.454
RP_{BF}	1.454
RP_{BW}	35,764.269
SP_S	
EP_f	-0.000
$EP_{ff\&e}$	-9,090.071
EP_p	
TRP_A	0.002
TRP_P	10.439
TRP_T	0.000

Argolida - Olive - 2020-02-11	
TRP	38.111
RP_{BF}	1.111
RP_{BW}	51,286.084
SP_S	
EP_f	-0.000
$EP_{ff\&e}$	-14,915.373
EP_p	
TRP_A	0.001
TRP_P	18.961
TRP_T	0.000

Figure 7. Comparison page.

4. Backend environment

In order to extend the lifetime of the web application and to be able to alter easily the various parameters of the algorithm, an interface has been designed which gives access, only to privileged users, to main values of the algorithm.

The parameters that are captured in that sense are clustered into two categories.

The first category includes all the statistical entries collected for Greek, Spanish and Italian regions and have the yield density (YD in tn/ha), the plant density (PD in

tree/ha) and the surface (S in ha) for orange, apple, peach, almond and olive trees. So, as seen in Figure 8, the rows (records) are the regions in a specific country and the columns (fields), for each tree, have the YD, PD and S. The values seen in Figure 8 are used in the calculations and if we want to change them there is a button  , at the end of each row permitting it.

The second category includes tree specific parameters used in the algorithm. These are tree specific parameters and management practice parameters (Figure 9). The parameters for orange, apple and peach are shown in Figure 9 where at the end of each line, there is a button  , permitting the editing of the dataset.

A seen in Figure 9, the tree specific parameters are the Carbon content of fruits biomass (C_f), the trunk, branches and roots biomass development rates ADR1, ADR2 and the percentage of the trees in Juvenile and in mature phase and the biomass of the leaves (ML).

The management practices parameters are those referring to the biomass through pruning and the fuels and electricity consumption. For the pruning there are values for biomass left in the field, burnt in the field, used as a solid fuel outside the field and other uses different than burning. As far as fuels and electricity consumption is concerned, this is broken down to diesel, gasoline and electricity.

Greek Regions

Regions	Orange trees			Apple trees			Peach trees			Almond trees			Olive trees			Actions
	YD (tn/ha)	PD (trees/ha)	S (ha)	YD (tn/ha)	PD (trees/ha)	S (ha)	YD (tn/ha)	PD (trees/ha)	S (ha)	YD (tn/ha)	PD (trees/ha)	S (ha)	YD (tn/ha)	PD (trees/ha)	S (ha)	
Greece Total	21.53	439.22	36,815.35	19.88	621.23	12,415.53	17.63	429.70	40,462.35	2.02	275.02	14,590.58	2.70	172.46	808,863.78	
Region of Eastern Macedonia and Thrace	13.33	333.33	0.23	11.19	694.00	164.15	6.73	382.94	188.90	3.54	275.36	1,360.48	3.20	189.16	16,627.43	
Rodopi	0.00	0.00	0.00	10.93	430.91	33.08	6.27	271.39	10.78	3.51	228.25	93.60	3.70	203.63	868.90	
Drama	0.00	0.00	0.00	14.36	460.06	23.98	4.99	351.11	11.90	2.11	263.00	44.40	2.83	276.54	712.43	
Evros	0.00	0.00	0.00	9.69	1,300.78	55.10	2.74	512.81	27.75	1.71	280.61	106.33	1.62	171.78	2,324.35	
Thasos	0.00	0.00	0.00	5.47	217.57	3.70	4.35	204.27	11.70	1.40	235.60	19.10	0.98	132.02	7,585.00	
Kavala	13.33	333.33	0.23	13.69	353.42	32.88	9.13	290.10	79.30	3.95	280.43	1,085.25	7.95	275.22	4,461.68	
Xanthi	0.00	0.00	0.00	6.00	294.42	15.43	6.92	539.44	47.48	2.24	246.12	11.80	1.91	211.36	675.08	

Figure 8. Backend for statistical data for the trees.

Tree Data

Tree	Carbon content of fruits biomass	Trunk, branches and roots biomass development				Leaves biomass	Prunings biomass		Fuels & Electricity			Actions
	Cf	ADR1	ADR2	JP	MP	ML			Diesel	Gasoline	Electricity	
Orange	0.019260	0.020000	0.012200	17.65	82.35	1.109000	1. Left in the field	0.210872	187.50	12.50	428.00	
							2. Burnt in the field	0.316308				
							3. Use as a solid fuel outside the field	0.000000				
							4. Other use different than burning	0.000000				
Apple	0.020250	0.013000	0.005720	19.05	80.95	1.329000	1. Left in the field	0.278964	583.00	334.00	163.00	
							2. Burnt in the field	0.418446				
							3. Use as a solid fuel outside the field	0.000000				
							4. Other use different than burning	0.000000				
Peach	0.012930	0.005720	0.002000	36.36	63.64	1.329000	1. Left in the field	0.278964	583.00	334.00	163.00	
							2. Burnt in the field	0.418446				
							3. Use as a solid fuel outside the field	0.000000				

Figure 9. Backend for tree parameters and management practices.