The Smart Forest Management

User´s guide

SmarteloPC VNU v2020.1

SmarteloPC VNU has been developed in the context of the BioEcoN project
(*Erasmus+ EACEA project KA2- No 586183*)

Co-funded by the Erasmus+ Programme of the European Union

Welcome to Smartelo

One of the most important decisions in forest management is signaling. At this stage, the number and type of trees that will remain standing (and, conversely, those that will be harvested) are determined, so as to improve the state of the forest, incorporate the criteria for conservation of biodiversity and ensure sustainable use of the forests.

Over the last few years, different forest marteloscopes have been created throughout Europe. These are forest areas in which all the tree species that make them up have been notated, measured, numbered and spatially located. Some of the main applications of the marteloscopes are focused on the practice of signaling and improvement in decision making (professional field), estimation of tree and stand variables (educational purpose), the carrying out of research projects and the dissemination and transfer of sustainable forest management projects (social purpose), among others.

Directly related to these objectives, Smartelo is composed by two apps:

1. **Smartelo PC**: An app that manages the large amount of data from marteloscopes and allows obtaining and making available different results (dendrometric, economic, ecological) from each one of them for the improvement of decision making in this important activity.

2. **Smartelo Portable**: Adaptation of Smartelo PC that allows the users to carry out forest marking activities in situ by means of an application adapted for mobile devices, in which real time information is obtained about the signaling status based on the forestry objectives pre-established by the user.

The design and interface of Smartelo allows the user to work with it as a general forest information manager, since the main source of information it handles is the forest inventory. That is why this tool has research application in areas such as sustainable forest management, education, exploitation of forest resources, wood transformation industries, climate change, renewable energies (biomass) or valuation. Smartelo aims to introduce new technologies in the forestry sector and related areas.

This manual has been developed with the aim of bringing the structure, operation and main features of the desktop version of Smartelo (known as Smartelo PC) closer to the user.

Smartelo PC is an Excel workbook made up of 10 main sheets, plus 2 additional sheets (Credits and Help).

The following guide explains the main functions and features offered by Smartelo PC, according to the different sheets that constitute it, being these the following:

1. HOME spreadsheet

It is one of the most important sheets in Smartelo because it is where the main parameters that make smartelo works must be set. These are divided into the following sections:

- **General info:** General data must be introduced, such as the name and area of the marteloscope, economic data such as the updating rate, prices of the dead tree, and others referring to ecological aspects and marteloscope management. In addition, data referring to the number of trees (Tree Sheet) and Team/operators (Team Sheet) participating in the management of the marteloscope are automatically obtained.
- **Shaeffer cubic rates:** The total unit volume (in cubic meters) is one of the base data to obtain most of the results that Smartelo offers. To do this, Smartelo allows you to enter volume data per tree (if available), enter your own cubic rate , or use Schaeffer cubic rates for the calculation of each unit volume. In this section, the best cubic rate, an associated rate number, and a morphic coefficient (recommended 0.6 for hardwoods and 1 for softwoods) must be selected for each species. The Schaeffer Rates sheet is designed to facilitate the choice of these parameters.

Note: If volume data is available, "Yes" must be marked on the Home page, and therefore the Schaeffer cubic rate parameters do not need to be completed. More information about obtaining and using this variable (Total volume) is shown on the Schaeffer Rates sheet.

- **Team/Operators:** It shows the different teams or operators that intervene and/or make decisions about the signaling activity. To visualize this information it is necessary to click on the button "Extract".

Note: It is necessary that the Teams sheet is properly filled in so that all of them can be viewed in the Home sheet.

- **Species list:** As with the Teams/Operators, you must click on the "Extract" button to visualize the different species present in the marteloscope. It is necessary that in the Trees sheet there is a relationship between the different trees and the species to which they belong so that these species can be extracted and visualized in the Home page.
- **Limit diameters:** Smartelo offers a series of results referring to the evolution of dendrometric and financial assets, as well as mass analysis and others (See Results Sheet). Many of these results are shown classified by diameter class or type of wood, among other parameters. The determination of the different types of wood (thick, medium or thin) is done by setting a series of limit diameters (lower and upper) for each of them in the Home page.

Note: All the trees with a diameter lower than the minimum fixed in this section, will not be taken into account in the final results exposed in the Results sheet.

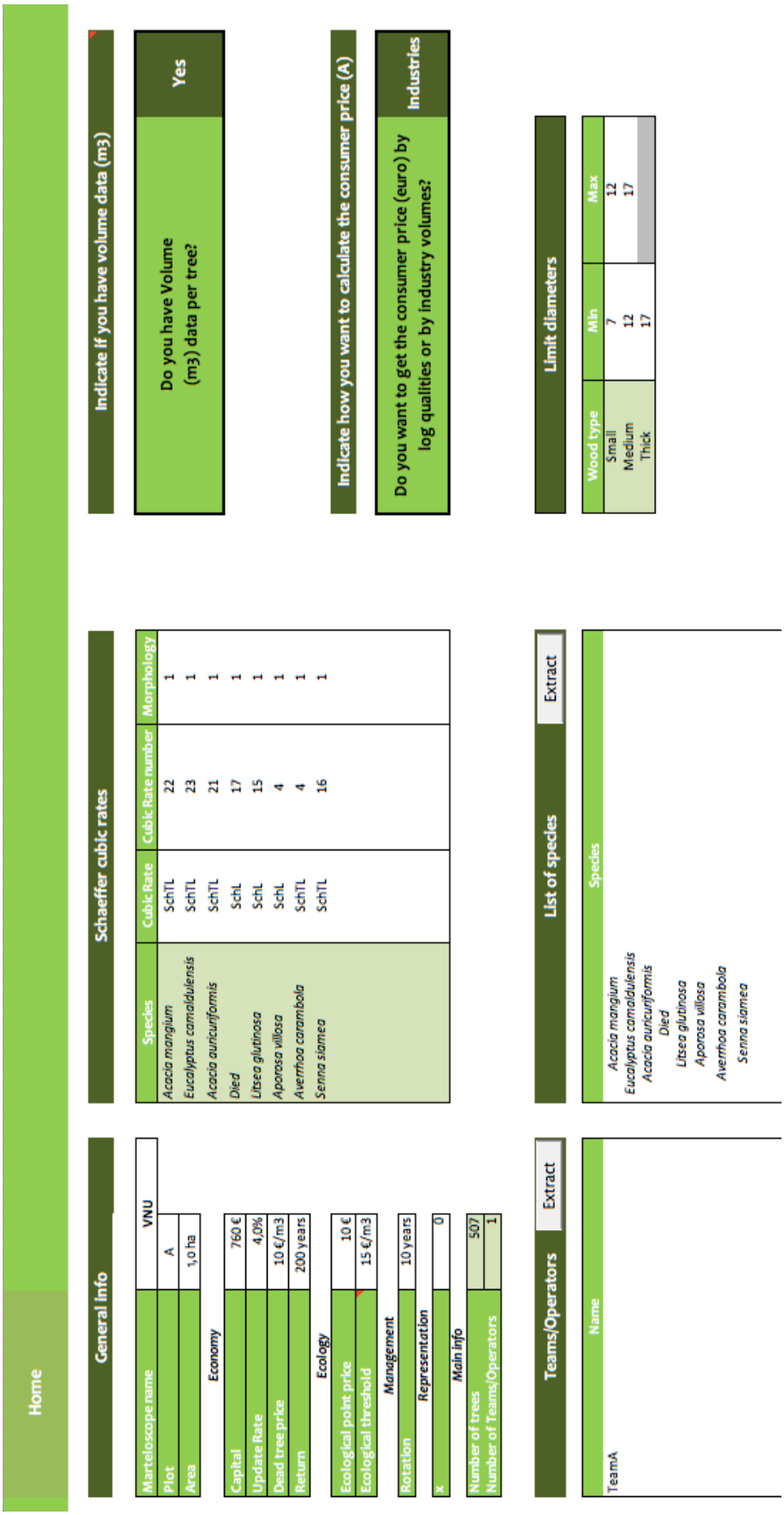


Fig 1. Smartelo´s PC HOME sheet screenshot

2. SCHAEFFER RATES spreadsheet

The Schaeffer Rates sheet is intended to make it easier to choose the most suitable Schaeffer cubic rate for each species in the marteloscope, if no previous unit volume data is available, or if you wish to obtain this data using this method. To do this, the following steps must be carried out:

1. Choose the species for which you want to obtain the most suitable Schaeffer cubic rate. Select such a species in the drop-down list below the Species cell.
2. Then, the mean diameter and the minimum volume difference (%) are calculated automatically for the selected species. For the calculation of the mean diameter per species to be effective, it is necessary that the Tree Sheet is properly filled. Once this has been done, the rates and the most appropriate rate number for each species will appear in green. It is recommended to choose a cubic rate for which there are several rate numbers marked and in which the difference in volume (%) is less, in order to obtain unit volumes closer to reality (less deviation from the average). Once the most suitable tariff and number have been chosen, these parameters should be inserted in the Home page.

In the Schaeffer Rates sheet, you can obtain additional information about Schaeffer cubic rates and the methods available in Smartelo to obtain the total volume per tree (unit).

Once this has been done, the rates and the most appropriate rate number for each species will appear in green. It is recommended to choose a tariff for which there are several tariff numbers marked and where the difference in volume (%) is less, in order to obtain unit volumes closer to reality (less deviation from the average). Once the most suitable tariff and number have been chosen, these parameters should be inserted in the Home page.

As indicated in the Smartelo help, the Total Unit Volume variable is fundamental for obtaining most of the results. In the case of not having this information, Smartelo offers two possible alternatives:

1. Introduction of a cubic rate defined by the user. To do so, write your rate in the form of a formula in the Volume column of the Trees sheet.
2. Use the Schaeffer cubic rates. The Schaeffer cubic rates are mathematical formulas that provide the unit volume according to two variables, these being

   . Mean diameter of the tree at normal height (1.3 meters) in centimeters
   . Rate number, which is a standard that indicates the volume (in cubic meters) of the 45-centimeter diameter tree.

Smartelo offers these rates by default, since they make it possible to determine the volume of the main forest species in a simple and efficient manner. It is only necessary to know the average diameter of a given stand and to use one of the 3 proposed rates (fast, slow or very slow) depending on the growth rate of the species.
Note: It is possible that the study species for which you wish to determine the unit volume is slow growing, and this sheet proposes a Fast rate and a rate number 4. This is due to the data of mean volume that is estimated as a reference. Given this fact, it is advisable to always take the rate and the number that has a smaller or smaller volume difference, since in this way the unit volumes of each tree of that species will be less than the real volume of each one of them.
This Schaeffer Rates sheet is designed to facilitate the task of choosing the number and type of rate most appropriate for each species according to the mean diameter of the trees belonging to that species. For more information on how to use this sheet, visit the section corresponding to the Schaeffer Rates sheet in the Smartelo help.

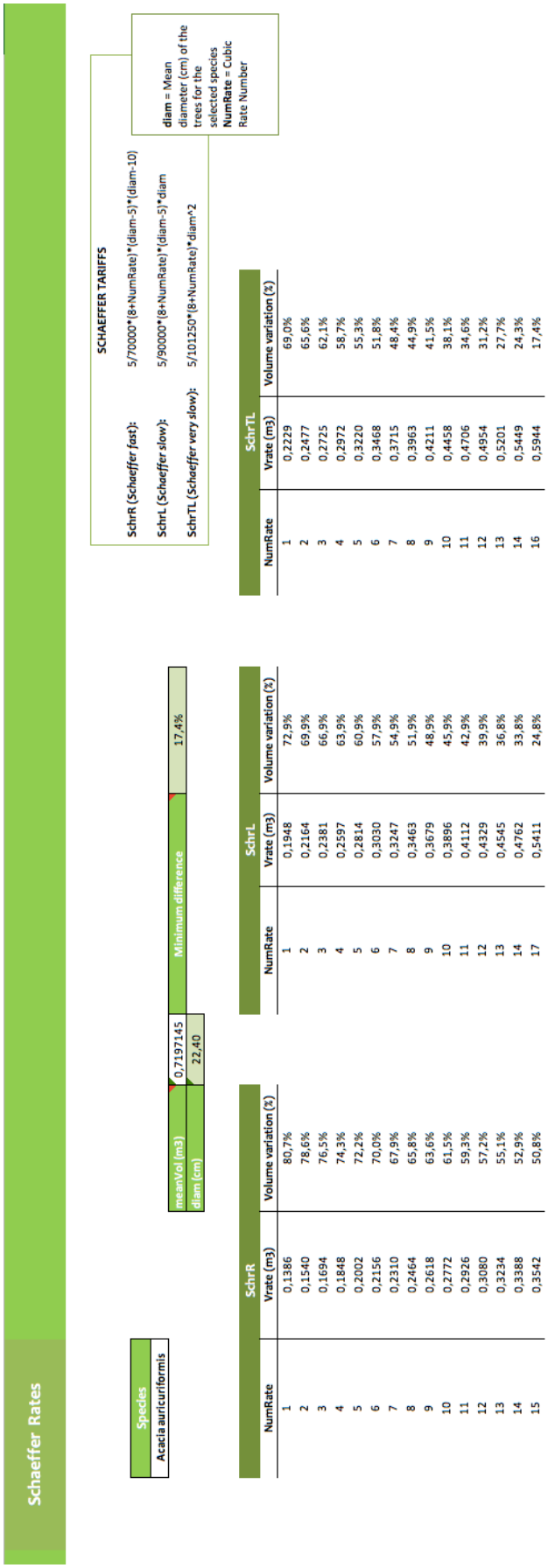
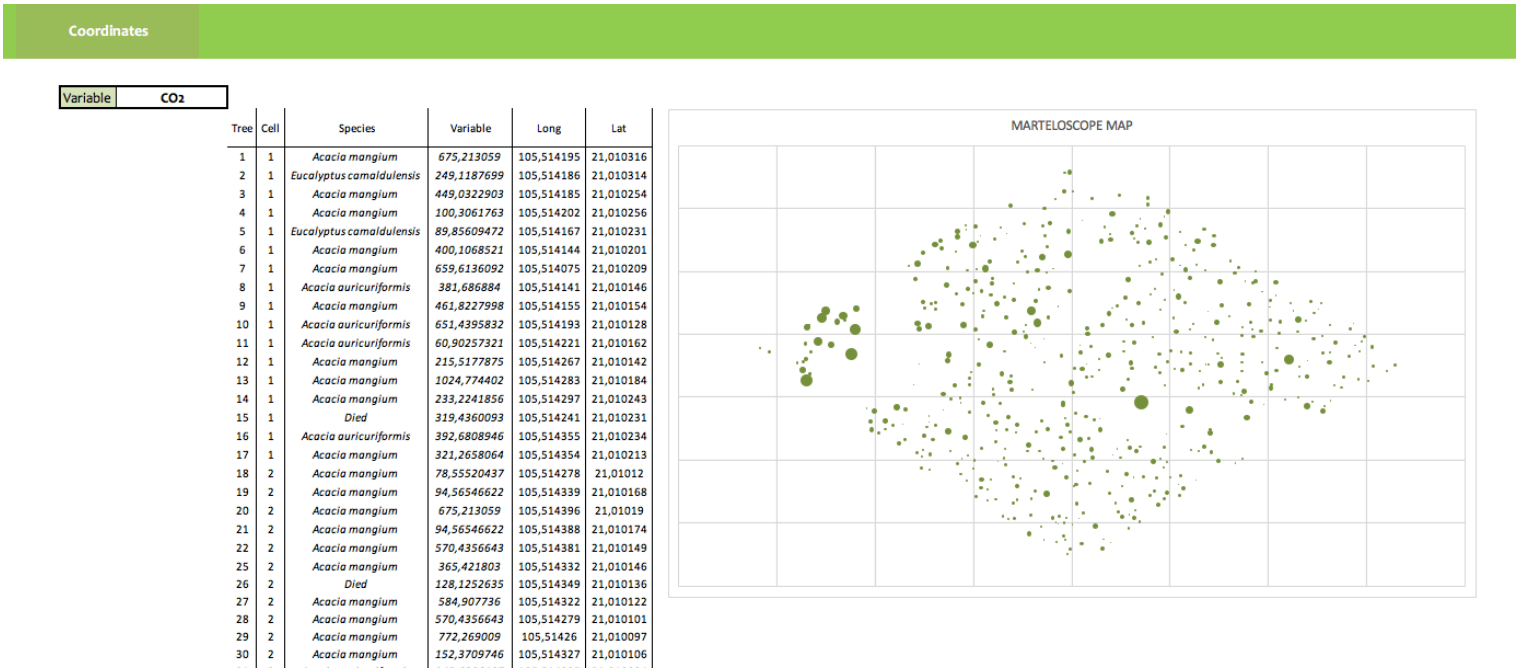


Fig 2. Smartelo´s PC SCHAEFFER RATES sheet screenshot

3. COORDINATES spreadsheet

The Coordinates sheet is designed to represent in an XY scatter plane the different trees and stakes that make up the marteloscope. Using this dynamic map, it is possible to easily visualize the spatial distribution of diameter, height, volume, biomass, carbon and CO2 of the marteloscope.

Note: Additionally, there is the possibility of adding auxiliary data regarding the structure and location of the classroom, such as the reference stakes, azimuth and distance for each stake, in case absolute coordinates are not available and you wish to calculate such XY coordinates using a formula designated by the user. If you want to calculate the coordinates using this method, you need to enter an additional value corresponding to the rotation angle of the plane (in centesimal degrees) on the Home sheet.



Tree	Cell	Species	Variable	Long	Lat
1	1	*Acacia mangium*	*675,213059*	105,514195	21,010316
2	1	*Eucalyptus camaldulensis*	*249,1187699*	105,514186	21,010314
3	1	*Acacia mangium*	*449,0322903*	105,514185	21,010254
4	1	*Acacia mangium*	*100,3061763*	105,514202	21,010256
5	1	*Eucalyptus camaldulensis*	*89,85609472*	105,514167	21,010231
6	1	*Acacia mangium*	*400,1068521*	105,514144	21,010201
7	1	*Acacia mangium*	*659,6136092*	105,514075	21,010209
8	1	*Acacia auricuriformis*	*381,686884*	105,514141	21,010146
9	1	*Acacia mangium*	*461,8227998*	105,514155	21,010154
10	1	*Acacia auricuriformis*	*651,4395832*	105,514193	21,010128
11	1	*Acacia auricuriformis*	*60,90257321*	105,514221	21,010162
12	1	*Acacia mangium*	*215,5177875*	105,514267	21,010142
13	1	*Acacia mangium*	*1024,774402*	105,514283	21,010184
14	1	*Acacia mangium*	*233,2241856*	105,514297	21,010243
15	1	*Died*	*319,4360093*	105,514241	21,010231
16	1	*Acacia auricuriformis*	*392,6808946*	105,514355	21,010234
17	1	*Acacia mangium*	*321,2658064*	105,514354	21,010213
18	2	*Acacia mangium*	*78,55520437*	105,514278	21,01012
19	2	*Acacia mangium*	*94,56546622*	105,514339	21,010168
20	2	*Acacia mangium*	*675,213059*	105,514396	21,01019
21	2	*Acacia mangium*	*94,56546622*	105,514388	21,010174
22	2	*Acacia mangium*	*570,4356643*	105,514381	21,010149
25	2	*Acacia mangium*	*365,421803*	105,514332	21,010146
26	2	*Died*	*128,1252635*	105,514349	21,010136
27	2	*Acacia mangium*	*584,907736*	105,514322	21,010122
28	2	*Acacia mangium*	*570,4356643*	105,514279	21,010101
29	2	*Acacia mangium*	*772,269009*	105,51426	21,010097
30	2	*Acacia mangium*	*152,3709746*	105,514327	21,010106

Fig 3. Smartelo´s PC COORDINATES sheet screenshot

4. TREES spreadsheet

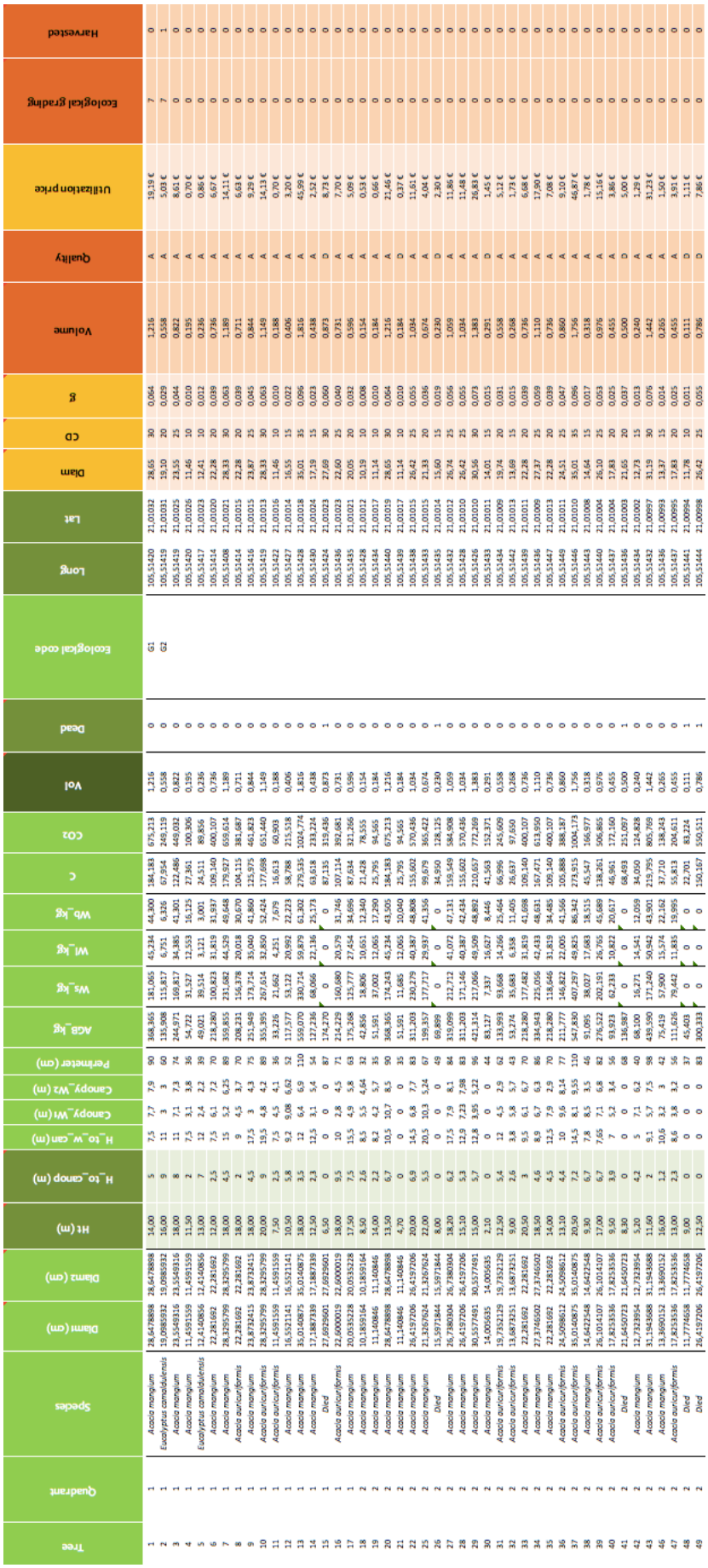
It's the main sheet of Smartelo. In it, all the data referring to the inventory of the marteloscope must be entered, the most representative being the following (cells in white):

- **Tree number**
- **Quadrant:** Each marteloscope is made up of 16 quadrants, which are delimited by reference stakes. It is recommended that a GIS be used to determine the quadrant to which each tree in the marteloscope belongs.
- **Species**
- **Diameter** (in centimeters) at normal height (1.3 meters) measured in 2 directions (diam1, diam2)
- **Total and canopy height** (in meters)
- **Volume:** If you have a unit volume (per tree), you must enter it in this column "Volume" (in cubic meters). Otherwise, if you do not wish to calculate the volume using Schaeffer cubic rates, you can enter a rate or cubic formula in this column and mark on the Home page that volume data is available.

  The total volume per tree (unit, in cubic meters) is one of the main variables Smartelo works with, since most of the results it offers depend on it.
  When you start Smartelo, you must check if you have this data in your inventory, or Smartelo must calculate it for you. Below you will find all the possible options and the way to proceed in each of them:
  - Option A: I do not have volume data. I want to use the cubic rates offered by Smartelo by default.
    These cubic rates are called Schaeffer (more info on Schaeffer Rates sheet). To obtain the volume by this method, select "No" on the Home sheet and follow the instructions indicated in the help on the Home and Schaeffer Rates sheets.
  - Option B: I have no volume data. I want to use my own cubic rates. To do this, select "No" on the Home sheet and access the Trees sheet. Place yourself in the Volume column, type the formula corresponding to your cubic rate and drag down to update all the cells.
  - Option C: I have volume data. Select "Yes" on the Home sheet, and go to the Trees sheet. Then insert the Volume data in the Volume column.

- **Dead, Risk of depreciation, crown defects:** A 1 should be marked if positive, or a 0 if negative. These values apply a percentage reduction on the utilization price of the tree and other economic results.
- **Ecological codes:** Smartelo allows the ecological value of each tree to be determined by means of an ecological mark. Thanks to this mark and a price per ecological point (established in the Home page), it is possible to obtain an ecological or environmental price per tree and for the whole marteloscope. This option can be used for the implementation of payments for environmental services, or help in the management of decision making, such as harvesting or conserving a tree according to its exploitation price, ecological, current and potential, among many other applications.
- **Long, Lat:** Location of each tree

On the right side of this sheet, Trees (orange shaded cells), there are the different calculations that Smartelo performs. These calculations provide results of an economic, dendrometric, and ecological type, among others. For more information about their meaning, see the comments available in each cell of the Trees sheet.



Tree	Quadrant	Species	Diam (cm)	Diam2 (cm)	Ht (m)	H_to_canop (m)	H_to_w_can (m)	Canopy_Wi (m)	Canopy_W2 (m)	Perimeter (cm)	AGB_Kg	Ws_kg	Wl_kg	Wb_kg	C	CO2	Vol	Dead	Ecological code	Long	Lat	Diam	CD	g	Volume	Quality	Utilization price	Ecological grading	Harvested
1	1	*Acacia mangium*	28,64788858	28,64788858	14,00	5	7,5	7,7	7,9	90	368,365	181,065	45,234	44,300	384,183	675,213	1,216	0	G1	105,51420	21,01032	28,65	30	0,064	1,216	A	19,19 €	7	0
2	1	*Eucalyptus camaldulensis*	19,09859332	19,09859332	16,00	9	11	3	3	60	133,908	115,817	6,751	6,326	67,954	249,119	0,558	0	G2	105,51419	21,01031	19,10	20	0,029	0,558	A	5,03 €	7	1
3	1	*Acacia mangium*	23,55493316	23,55493316	11,00	8	11	7,1	7,3	74	244,971	169,817	34,385	41,301	122,486	449,032	0,822	0		105,51419	21,01025	23,55	25	0,044	0,822	A	8,61 €	0	0
4	1	*Acacia mangium*	11,45911559	11,45911559	11,50	2	7,5	3,1	3,8	36	54,722	31,527	12,553	16,125	27,361	100,306	0,195	0		105,51420	21,01026	11,46	10	0,010	0,195	A	0,70 €	0	0
5	1	*Eucalyptus camaldulensis*	12,41408856	12,41408856	13,00	7	12	2,4	2,2	39	49,021	39,514	3,121	3,001	24,511	89,856	0,236	0		105,51417	21,01023	12,41	10	0,012	0,236	A	0,86 €	0	0
6	1	*Acacia mangium*	22,2816921	22,2816921	12,00	2,5	7,5	6,1	7,2	70	218,2803	100,823	31,937	31,937	109,140	400,107	0,736	0		105,51414	21,01020	22,28	20	0,039	0,736	A	6,67 €	0	0
7	1	*Acacia mangium*	28,32957993	28,32957993	18,00	4,5	15	5,2	6,25	89	359,855	231,682	44,329	49,648	179,527	659,614	1,189	0		105,51408	21,01021	28,33	30	0,063	1,189	A	14,11 €	0	0
8	1	*Acacia auriculiformis*	22,2816921	22,2816921	18,00	2	9	4,5	3,7	70	208,231	156,378	20,018	30,670	104,115	381,687	0,711	0		105,51414	21,01015	22,28	20	0,039	0,711	A	6,63 €	0	0
9	1	*Acacia mangium*	23,87324151	23,87324151	18,00	4,5	17,5	3	4,3	75	251,949	173,714	35,040	41,860	125,575	461,823	0,844	0		105,51416	21,01015	23,87	25	0,045	0,844	A	9,29 €	0	0
10	1	*Acacia auriculiformis*	28,32957993	28,32957993	20,00	9	19,5	4,8	4,2	89	355,395	267,614	32,850	52,424	177,698	651,440	1,149	0		105,51419	21,01013	28,33	30	0,063	1,149	A	14,13 €	0	0
11	1	*Acacia auriculiformis*	11,45911559	11,45911559	7,50	2,5	7,5	4,5	4,1	36	33,226	21,662	4,251	7,679	16,613	60,903	0,188	0		105,51422	21,01016	11,46	10	0,010	0,188	A	0,70 €	0	0
12	1	*Acacia mangium*	16,5521141	16,5521141	10,50	5,8	9,2	9,08	6,62	52	117,577	53,122	20,592	22,223	58,788	215,518	0,406	0		105,51427	21,01014	16,55	15	0,022	0,406	A	3,20 €	0	0
13	1	*Acacia mangium*	35,01408875	35,01408875	18,00	3,5	12	6,4	6,9	110	559,070	330,714	59,879	61,302	279,535	1024,774	1,816	0		105,51428	21,01018	35,01	35	0,096	1,816	A	45,98 €	0	0
14	1	*Acacia mangium*	17,1887339	17,1887339	12,50	2,3	12,5	3,1	5,4	54	127,236	68,066	22,136	25,173	63,618	233,224	0,438	0		105,51430	21,01024	17,19	15	0,023	0,438	A	2,52 €	0	0
15	1	*Dead*	27,6029501	27,6029501	6,50	0	0	0	0	87	174,270	0	0	0	87,135	319,436	0,873	1		105,51424	21,01023	27,60	30	0,060	0,873	D	8,73 €	0	0
16	1	*Acacia auriculiformis*	21,60000219	21,60000219	18,00	9,5	10	2,8	4,5	71	214,229	160,980	20,579	31,746	107,114	392,681	0,731	0		105,51436	21,01021	21,60	20	0,049	0,731	A	7,70 €	0	0
17	1	*Acacia mangium*	20,01832281	20,01832281	17,50	7,5	15,5	4,9	5,8	63	175,288	125,777	27,454	34,866	87,834	321,266	0,586	0		105,51435	21,01021	20,05	20	0,032	0,586	A	5,09 €	0	0
18	2	*Acacia mangium*	10,18591164	10,18591164	8,50	2,6	8,5	5,5	4,64	32	42,856	18,806	10,651	12,340	21,428	78,555	0,154	0		105,51428	21,01012	10,19	10	0,008	0,154	A	0,53 €	0	0
19	2	*Acacia mangium*	11,1408446	11,1408446	14,00	2,2	8,2	4,2	5,7	35	51,591	37,002	12,065	17,290	25,795	94,565	0,184	0		105,51434	21,01017	11,14	10	0,010	0,184	A	0,66 €	0	0
20	2	*Acacia mangium*	28,64788858	28,64788858	13,50	6,7	10,5	10,7	8,5	90	368,365	174,243	45,234	43,505	384,183	675,213	1,216	0		105,51440	21,01019	28,65	30	0,064	1,216	A	21,46 €	0	0
21	2	*Acacia mangium*	11,1408446	11,1408446	4,70	0	0	0	0	35	51,591	11,685	12,065	10,040	25,795	94,565	0,184	0		105,51439	21,01017	11,14	10	0,010	0,184	D	0,37 €	0	0
22	2	*Acacia mangium*	26,41972006	26,41972006	20,00	6,9	14,5	6,8	7,7	83	311,203	230,379	40,387	48,808	155,602	570,436	1,034	0		105,51438	21,01015	26,42	25	0,055	1,034	A	11,61 €	0	0
23	2	*Acacia mangium*	21,3267624	21,3267624	22,00	5,5	20,5	10,3	5,24	67	199,357	177,717	29,937	41,356	99,679	365,422	0,674	0		105,51433	21,01015	21,33	20	0,036	0,674	A	4,04 €	0	0
24	2	*Dead*	15,59718441	15,59718441	8,00	0	0	0	0	49	69,899	0	0	0	34,950	128,125	0,230	1		105,51435	21,01014	15,60	15	0,019	0,230	D	2,30 €	0	0
25	2	*Acacia mangium*	26,73803043	26,73803043	18,20	6,2	17,5	7,9	8,1	84	319,099	212,712	41,072	47,131	159,549	584,908	1,059	0		105,51432	21,01012	26,74	25	0,056	1,059	A	11,86 €	0	0
26	2	*Acacia mangium*	26,41972006	26,41972006	15,10	5,3	12,9	7,23	7,58	83	311,203	171,146	40,387	42,434	155,602	570,436	1,034	0		105,51428	21,01010	26,42	25	0,055	1,034	A	11,48 €	0	0
27	2	*Acacia mangium*	30,55774491	30,55774491	15,00	5,7	12,8	3,95	5,22	96	421,314	217,066	49,509	48,892	210,657	772,269	1,383	0		105,51426	21,01010	30,56	30	0,073	1,383	A	26,83 €	0	0
28	2	*Acacia mangium*	14,0056335	14,0056335	2,10	0	0	0	0	44	83,127	7,337	16,627	8,446	41,563	152,371	0,291	0		105,51433	21,01011	14,01	15	0,015	0,291	D	1,45 €	0	0
29	2	*Acacia auriculiformis*	19,7352129	19,7352129	12,50	5,4	12	4,5	2,9	62	133,993	93,668	14,266	25,464	66,996	245,609	0,558	0		105,51434	21,01009	19,74	20	0,031	0,558	A	5,12 €	0	0
30	2	*Acacia auriculiformis*	13,68732351	13,68732351	9,00	2,6	3,8	5,8	5,7	43	53,274	35,683	6,358	11,405	26,637	97,650	0,268	0		105,51442	21,01013	13,69	15	0,015	0,268	A	1,73 €	0	0
31	2	*Acacia mangium*	22,2816921	22,2816921	20,50	3	9,5	6,1	6,7	70	218,2803	177,482	31,819	41,698	109,140	400,107	0,736	0		105,51439	21,01011	22,28	20	0,039	0,736	A	6,68 €	0	0
32	2	*Acacia mangium*	27,37465002	27,37465002	18,50	4,6	8,9	6,7	6,3	86	334,943	225,056	42,433	48,631	167,471	613,950	1,110	0		105,51436	21,01009	27,37	25	0,059	1,110	A	17,90 €	0	0
33	2	*Acacia mangium*	22,2816921	22,2816921	14,00	4,5	12,5	7,9	2,9	70	218,2803	118,646	31,819	34,485	109,140	400,107	0,736	0		105,51447	21,01013	22,28	20	0,039	0,736	A	7,08 €	0	0
34	2	*Acacia auriculiformis*	24,50986112	24,50986112	13,10	4,4	10	9,6	8,14	77	211,777	146,822	22,005	41,566	105,888	388,187	0,860	0		105,51449	21,01011	24,51	25	0,047	0,860	A	9,10 €	0	0
35	2	*Acacia auriculiformis*	35,01408875	35,01408875	20,50	7,2	14,5	8,1	9,55	110	547,830	407,197	49,825	86,342	273,915	1004,173	1,756	0		105,51446	21,01010	35,01	35	0,096	1,756	A	46,87 €	0	0
36	2	*Acacia auriculiformis*	14,6422548	14,6422548	9,30	6,7	7,8	8,5	3,5	46	91,095	36,027	17,683	18,515	45,547	166,977	0,318	0		105,51443	21,01008	14,64	15	0,017	0,318	A	1,78 €	0	0
37	2	*Acacia auriculiformis*	26,1014107	26,1014107	17,00	6,7	7,65	7,1	6,8	82	276,522	202,191	26,765	45,688	138,261	506,865	0,976	0		105,51440	21,01004	26,10	25	0,053	0,976	A	15,16 €	0	0
38	2	*Acacia auriculiformis*	17,8253336	17,8253336	9,50	3,9	7	5,2	3,4	56	91,921	63,233	10,622	20,617	46,961	172,160	0,455	0		105,51437	21,01003	17,83	20	0,025	0,455	A	3,86 €	0	0
39	2	*Dead*	21,6450723	21,6450723	8,30	0	0	0	0	68	136,587	0	0	0	68,293	251,097	0,500	1		105,51436	21,01002	21,65	20	0,037	0,500	D	5,00 €	0	0
40	2	*Acacia mangium*	22,7323954	22,7323954	5,20	4,2	5	7,1	6,2	40	16,271	14,541	12,099	34,050	124,824	0,240	0	0		105,51434	21,01002	12,73	15	0,013	0,240	A	1,29 €	0	0
41	2	*Acacia mangium*	31,19438688	31,19438688	11,60	2	9,1	5,7	7,5	98	439,590	171,140	50,942	43,901	219,795	805,769	1,442	0		105,51432	21,00997	31,19	30	0,076	1,442	A	33,23 €	0	0
42	2	*Acacia mangium*	13,3690152	13,3690152	16,00	1,2	10,6	3,2	3	42	75,419	57,900	15,374	22,162	37,710	138,243	0,265	0		105,51436	21,00993	13,37	15	0,014	0,265	A	1,50 €	0	0
43	2	*Acacia auriculiformis*	17,8253336	17,8253336	9,00	2,3	8,6	3,8	3,2	56	111,626	79,442	19,955	11,835	55,813	204,611	0,455	0		105,51441	21,00995	17,83	20	0,025	0,455	A	3,91 €	0	0
44	2	*Dead*	11,7774658	11,7774658	9,00	0	0	0	0	37	45,403	0	0	0	22,701	83,224	0,111	1		105,51441	21,00994	11,78	10	0,011	0,111	D	1,11 €	0	0
45	2	*Dead*	26,41972006	26,41972006	12,50	0	0	0	0	83	300,333	0	0	0	150,167	550,511	0,786	1		105,51444	21,00998	26,42	25	0,055	0,786	D	7,86 €	0	0

Fig 4. Smartelo´s PC TREES sheet screenshot

5. STAND spreadsheet

The Stand sheet is one of the sheets that are present in both versions of Smartelo. In it we will find a summary with the main mass variables that Smartelo calculates for each quadrant and species in each marteloscope. These stand variables are:

- **Density**
- **Basal Area**
- **Volume**
- **Biomass**
- **Carbon**
- **CO2**

Stand Characterization

Select Species	Acacia mangium

	Density			Basal Area			Volume			AGB			Carbon			CO2		
Cell	*Total (trees/ha)*	*trees/ha*	*%*	*Total*	*m2/ha*	*%*	*Total*	*m3/ha*	*%*	*Total*	*t/ha*	*%*	*Total*	*t/ha*	*%*	*Total*	*t/ha*	*%*
1	272,0	160	*58,8%*	11,053	7,000	*63,3%*	203,262	132,110	*65,0%*	58,361	39,637	*67,9%*	29,181	19,818	*67,9%*	106,976	72,654	*67,9%*
2	608,0	384	*63,2%*	22,522	14,006	*62,2%*	406,736	264,318	*65,0%*	120,244	78,846	*65,6%*	60,122	39,423	*65,6%*	220,407	144,524	*65,6%*
3	592,0	224	*37,8%*	18,874	6,804	*36,1%*	338,766	128,411	*37,9%*	98,978	37,902	*38,3%*	49,489	18,951	*38,3%*	181,427	69,474	*38,3%*
4	576,0	352	*61,1%*	17,415	12,678	*72,8%*	315,607	239,268	*75,8%*	95,067	72,079	*75,8%*	47,533	36,039	*75,8%*	174,258	132,121	*75,8%*
5	320,0	224	*70,0%*	17,296	8,471	*49,0%*	319,590	159,866	*50,0%*	80,142	47,851	*59,7%*	40,071	23,925	*59,7%*	146,900	87,711	*59,7%*
6	576,0	304	*52,8%*	18,000	10,077	*56,0%*	327,147	190,178	*58,1%*	94,360	56,483	*59,9%*	47,180	28,241	*59,9%*	172,962	103,533	*59,9%*
7	400,0	304	*76,0%*	18,320	15,126	*82,6%*	339,416	285,462	*84,1%*	100,737	86,935	*86,3%*	50,369	43,468	*86,3%*	184,652	159,352	*86,3%*
8	592,0	512	*86,5%*	25,811	23,409	*90,7%*	474,230	441,778	*93,2%*	150,194	133,484	*88,9%*	75,097	66,742	*88,9%*	275,306	244,676	*88,9%*
9	272,0	80	*29,4%*	16,206	3,747	*23,1%*	301,280	70,720	*23,5%*	86,968	21,272	*24,5%*	43,484	10,636	*24,5%*	159,413	38,992	*24,5%*
10	496,0	224	*45,2%*	20,658	9,189	*44,5%*	380,010	173,416	*45,6%*	113,122	52,003	*46,0%*	56,561	26,001	*46,0%*	207,353	95,321	*46,0%*
11	496,0	240	*48,4%*	27,557	17,465	*63,4%*	512,229	329,615	*64,3%*	151,779	102,981	*67,8%*	75,890	51,490	*67,8%*	278,211	188,764	*67,8%*
12	624,0	480	*76,9%*	17,596	15,421	*87,6%*	315,937	291,029	*92,1%*	95,322	86,259	*90,5%*	47,661	43,130	*90,5%*	174,725	158,113	*90,5%*
13	704,0	528	*75,0%*	18,806	14,674	*78,0%*	340,323	276,927	*81,4%*	101,920	81,946	*80,4%*	50,960	40,973	*80,4%*	186,820	150,207	*80,4%*
14	720,0	560	*77,8%*	18,077	14,926	*82,6%*	332,775	281,696	*84,7%*	99,017	83,025	*83,8%*	49,509	41,513	*83,8%*	181,498	152,186	*83,8%*
15	512,0	304	*59,4%*	18,947	13,981	*73,8%*	347,215	263,854	*76,0%*	102,904	79,448	*77,2%*	51,452	39,724	*77,2%*	188,624	145,628	*77,2%*
16	352,0	0	*0,0%*	43,209	0,000	*0,0%*	659,615	0,000	*0,0%*	224,672	0,000	*0,0%*	112,336	0,000	*0,0%*	411,824	0,000	*0,0%*
Total	**507**	**305**	*60,2%*	**20,647**	**11,686**	*56,6%*	**369,634**	**220,540**	*59,7%*	**110,862**	**66,259**	*59,8%*	**55,431**	**33,130**	*59,8%*	**203,210**	**121,453**	*59,8%*

Fig 5. Smartelo´s PC STAND sheet screenshot

6. ECONOMY spreadsheet

The Economy sheet is in charge of collecting the necessary information to obtain the main economic and financial results offered by Smartelo. All the necessary information is divided into two tables:

- The **left table** contains a series of essential data for obtaining the economic and financial results.

In it, all the unit prices (PU; in euros/cubic meter), for all the diameter classes (CD) and qualities of each species that form the marteloscope must be inserted.
This process is manual, and is essential to obtain the utilization price, both current and potential, of all the feet that form the classroom.
The column called PRD% (Disaster Recovery Percentage) corresponds to the percentage of the current utilization price that will be received in the event of a disaster with a return period set on the Home page (Table on the left, Economy section). Smartelo increases the utilization price according to the PRD% set for each species, quality and CD.

- The **right table** contains information about the unit prices (PU; in euros/cubic meter) of each species present in the marteloscope according to the wood transformation industry to which it is destined. The info related to the different industries must be added by the user.

Note: The price table for industries should only be completed if you have volume data for them, since Smartelo calculates utilization prices for the different industries, species and trees present in the marteloscope.

Economy

Species	Quality	Unitary prices CD	UP (€/m3)	PRD (%)
Acacia mangium	A	5	8	0,2
Acacia mangium	A	10	8	0,2
Acacia mangium	A	15	15	0,2
Acacia mangium	A	20	15	0,2
Acacia mangium	A	25	30	0,2
Acacia mangium	A	30	40	0,2
Acacia mangium	A	35	55	0,2
Acacia mangium	A	40	60	0,2
Acacia mangium	A	45	100	0,2
Acacia mangium	A	50	100	0,8
Acacia mangium	B	5	4	0,8
Acacia mangium	B	10	4	0,8
Acacia mangium	B	15	10	0,8
Acacia mangium	B	20	10	0,8
Acacia mangium	B	25	15	0,8
Acacia mangium	B	30	15	0,2
Acacia mangium	B	35	40	0,2
Acacia mangium	B	40	40	0,2

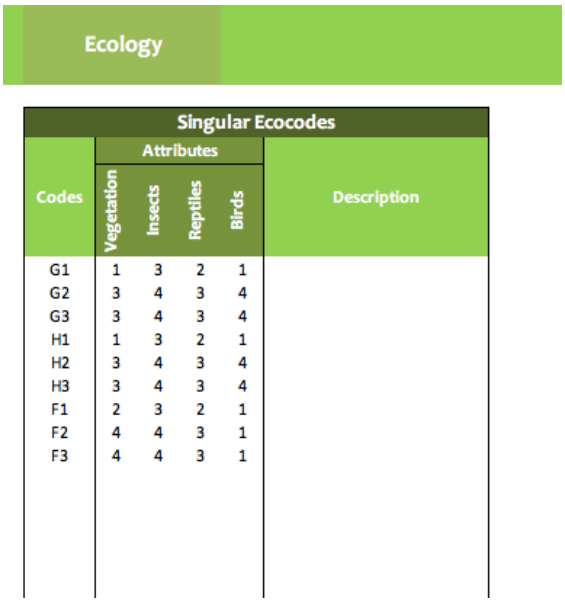
Species	Unitary prices by Industry Industry1 UP (€/m3)	Industry2 UP (€/m3)	Industry3 UP (€/m3)	Industry4 UP (€/m3)	Industry5 UP (€/m3)	Industry6 UP (€/m3)
Acacia mangium	8	25	20	20	40	10
Eucalyptus camaldulensis	8	25	20	20	40	10
Acacia auricuriformis	8	25	20	20	40	10
Died	8	25	20	20	40	10
Litsea glutinosa						
Aporosa villosa						
Averrhoa carambola						
Senna siamea						

Fig 6. Smartelo´s PC ECONOMY sheet screenshot

7. ECOLOGY spreadsheet

One of the main novelties included in Smartelo is the ecological analysis of the marteloscope. This function allows the assessment of each tree in the marteloscope depending on its environmental/ecological importance based on a series of attributes set by the user. In this way, Smartelo will be able to carry out not only an economic evaluation (referring to the direct exploitation of the marteloscope's wood resources), but also an environmental one. This option offers very valuable information for decision making for different actions (harvesting or conserving depending on the utilization price of each tree), as well as for use in possible CDM, REDD, REDD+ projects or the implementation of payments for ecosystem services in a given area. Discover more about the possibilities offered by Smartelo in this area by visiting the official iuFOR site.

The Ecology sheet is designed to generate the above-mentioned unique codes based on a series of attributes (at the manager's choice). These attributes will be evaluated by means of a scale from 0 to 10, depending on the importance that each manager gives to each one of them for each unique code. By default, Smartelo has 4 attributes (vegetation, insects, reptiles and birds). As mentioned before, these attributes can be changed by others, simply by modifying the name of each one of them, as well as adding or removing them. Once the required information has been filled in (singular code, evaluation of attributes and description of each code), one or more codes can be assigned to a given tree in the Trees sheet. The column enabled for this purpose is called Singular Codes.


Ecology

Singular Ecocodes

Codes	Attributes				Description
	Vegetation	Insects	Reptiles	Birds	
G1	1	3	2	1	
G2	3	4	3	4	
G3	3	4	3	4	
H1	1	3	2	1	
H2	3	4	3	4	
H3	3	4	3	4	
F1	2	3	2	1	
F2	4	4	3	1	
F3	4	4	3	1	

Fig 7. Smartelo´s PC ECOLOGY sheet screenshot

8. TEAMS spreadsheet

Another interesting function offered by Smartelo is the possibility of working with different teams or forest managers. This option allows obtaining different results depending on the decisions made by each team/manager. Let's imagine a class with 20 students, in which each one has different performance ideas for the same trees, or they are working with different trees within the same marteloscope. Smartelo allows you to generate a summary of the results (dendrometric, ecological, economic) of all of them and visualize them in the Results sheet. In this way, the Teams sheet contains all the information regarding the different teams/managers that work with the marteloscope.
The way to work with this sheet is the following:

1. First, the name of the team/manager must be entered in the first column, called Name.
2. Then, write down all the feet that you want to select to work with them, that is, those on which you are going to act, either because you want to harvest, keep or carry out any other action of those that appear in the table on the right (Reasons).
3. Once the above has been done, each selected tree will be acted upon. This step consists of deciding for what reason you have selected or wish to work with that trees. To do this, a value must be assigned to the Reason column taking as a reference the table on the right, called Reasons.
4. Finally, note that the last column, called Team reason, should not be edited, since it contains formulas and is automated by Smartelo.

Note: The name of the team/manager must appear in all the rows where trees selected by that team/manager appear. It is recommended to drag the first row down,or copy and paste the name until it contains all the selected trees.

How to update Teams in Smartelo

Smartelo allows you to view the different results by team/operator on the Results sheet.
These equipments/operators can suffer changes over time, so it is necessary to update this information for the correct operation of the application.
Once the equipment/operators have been added/deleted from this sheet, go to the Home page and click on the Extract button in the Equipment/Operators table. The list included in that table will be automatically updated and you will be able to proceed with your work. You can also check that the drop-down list of Equipment/Operators in the Results sheet has been updated with the latest changes.
Note: This same procedure must be done every time you add or remove species in the Trees sheet, although this time you must click on the Extract button located in the Species table of the Home sheet. Every time your inventory undergoes some kind of change it is recommended to perform this action.

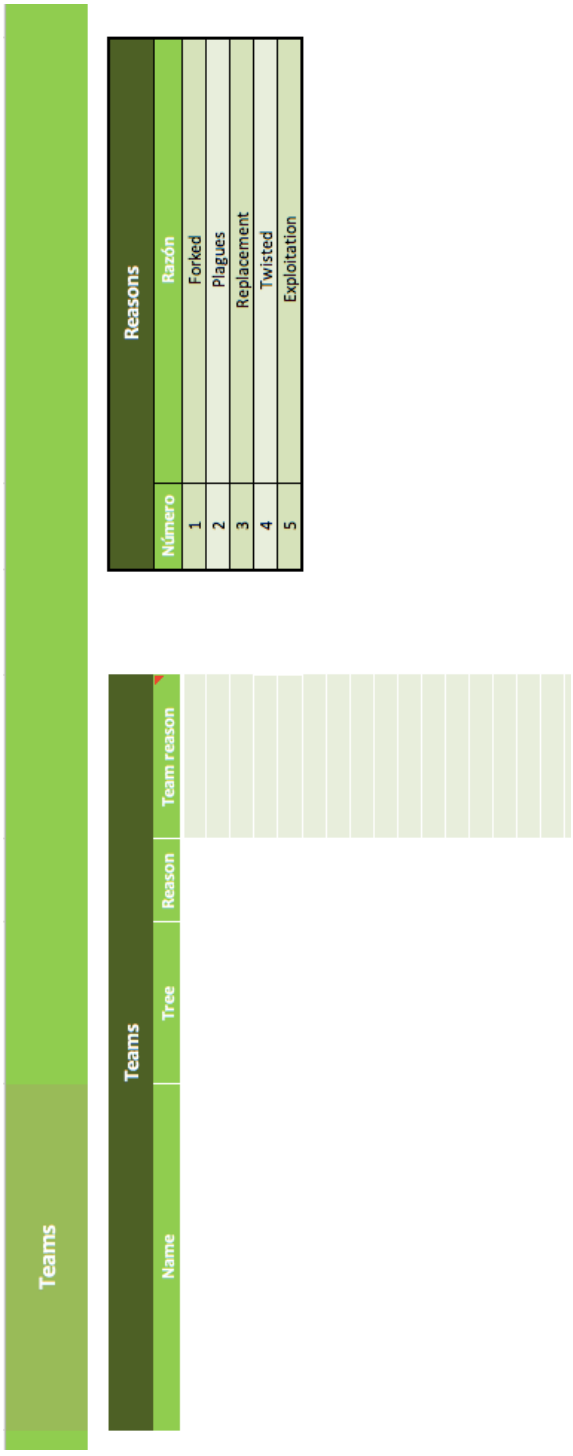


Fig 8. Smartelo´s PC TEAMS sheet screenshot

9. BIOMASS spreadhseet

The Biomass sheet is designed to analyze the contents of it in the marteloscope. This Smartelo function allows the user to obtain information of great importance and impact both current and future, being carbon quantification, help in decision-making in REDD, REDD or CDM projects or the implementation of payments for ecosystem services some of the most significant, among others.

This sheet is divided into two parts:

- ***Biomass*** *(Left side):*
  - ***AGB (Aboveground biomass)***
  - ***Ws (Stem biomass)***
  - ***Wl (Leaves biomass)***
  - ***Wb (Branches biomass)***
  - ***Carbon***
  - ***CO2***

- ***Biomass results*** *(Right side):*

This part of the leaf shows a table that provides total biomass results for each species and type of biomass. If you wish, you can filter one or more species with both the filter located in the cell named Species, with both the markers located just below the table.
Located on the right side of this table is dynamic chart, show information about ***Biomass,carbon and CO2 by cell and Biomass,Carbon and CO2 by species*** *(%)*

Biomass								
			Biomass, Carbon and CO_2 (t)					
Tree	Quadrant	Species	AGB	Ws	Wl	Wb	C	CO_2
1	1	*Acacia mangium*	0,368	0,181	0,045	0,044	0,184	0,675
2	1	*Eucalyptus camaldulensis*	0,136	0,116	0,007	0,006	0,068	0,249
3	1	*Acacia mangium*	0,245	0,170	0,034	0,041	0,122	0,449
4	1	*Acacia mangium*	0,055	0,032	0,013	0,016	0,027	0,100
5	1	*Eucalyptus camaldulensis*	0,049	0,040	0,003	0,003	0,025	0,090
6	1	*Acacia mangium*	0,218	0,101	0,032	0,032	0,109	0,400
7	1	*Acacia mangium*	0,360	0,232	0,045	0,050	0,180	0,660
8	1	*Acacia auricuriformis*	0,208	0,156	0,020	0,031	0,104	0,382
9	1	*Acacia mangium*	0,252	0,174	0,035	0,042	0,126	0,462
10	1	*Acacia auricuriformis*	0,355	0,268	0,033	0,052	0,178	0,651
11	1	*Acacia auricuriformis*	0,033	0,022	0,004	0,008	0,017	0,061
12	1	*Acacia mangium*	0,118	0,053	0,021	0,022	0,059	0,216
13	1	*Acacia mangium*	0,559	0,331	0,060	0,061	0,280	1,025
14	1	*Acacia mangium*	0,127	0,068	0,022	0,025	0,064	0,233
15	1	*Died*	0,174	0,000	0,000	0,000	0,087	0,319
16	1	*Acacia auricuriformis*	0,214	0,161	0,021	0,032	0,107	0,393
17	1	*Acacia mangium*	0,175	0,126	0,027	0,035	0,088	0,321
18	2	*Acacia mangium*	0,043	0,019	0,011	0,012	0,021	0,079
19	2	*Acacia mangium*	0,052	0,037	0,012	0,017	0,026	0,095
20	2	*Acacia mangium*	0,368	0,174	0,045	0,044	0,184	0,675
21	2	*Acacia mangium*	0,052	0,012	0,012	0,010	0,026	0,095
22	2	*Acacia mangium*	0,311	0,230	0,040	0,049	0,156	0,570
25	2	*Acacia mangium*	0,199	0,178	0,030	0,041	0,100	0,365
26	2	*Died*	0,070	0,000	0,000	0,000	0,035	0,128
27	2	*Acacia mangium*	0,319	0,213	0,041	0,047	0,160	0,585
28	2	*Acacia mangium*	0,311	0,171	0,040	0,042	0,156	0,570
29	2	*Acacia mangium*	0,421	0,217	0,050	0,049	0,211	0,772

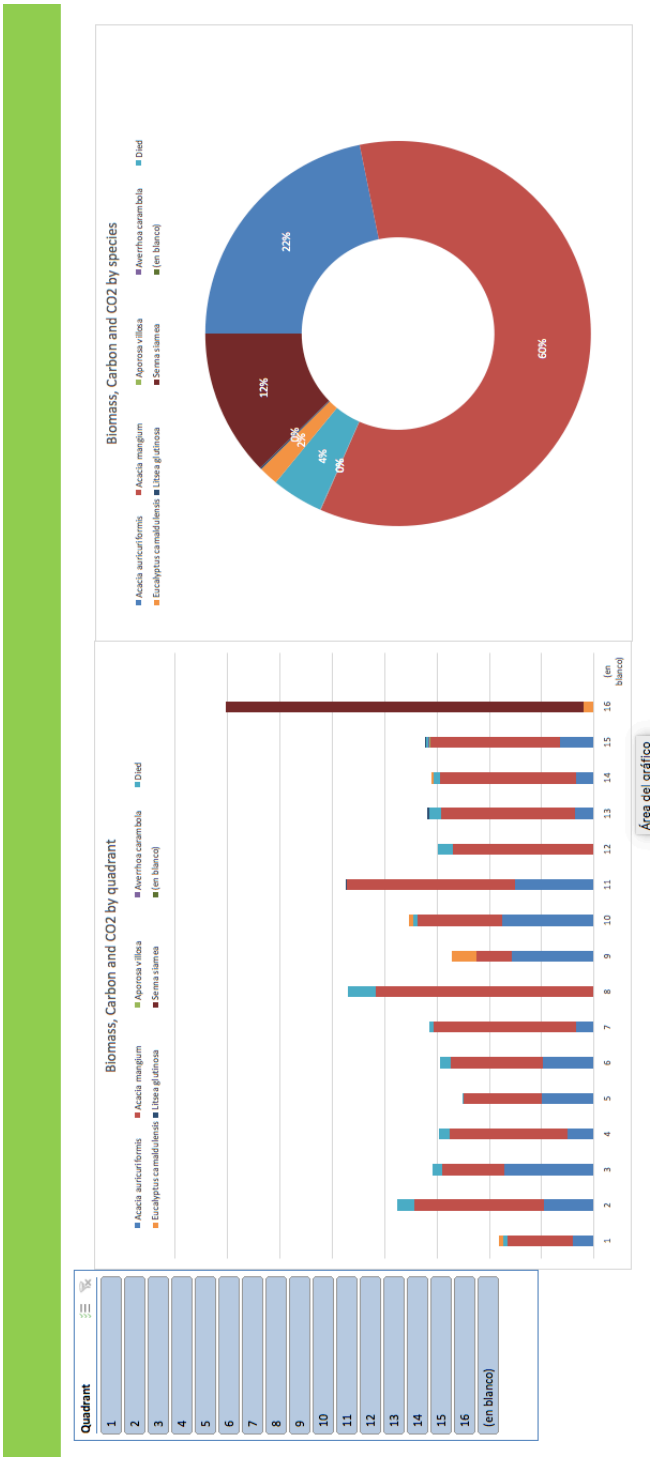


Fig 9. Smartelo´s PC BIOMASS sheet screenshot

10. RESULTS spreadsheet

Results is one of the main important sheets of Smartelo, where the users can visualize the main results of the signaling activity in the marteloscope.
One of the great advantages that this sheet has is the possibility to obtain and compare the different results depending on the team/manager that we select in the top bar (selectable next to Team) and display on this sheet only those of the team /manager that we want. Dynamic tables in this sheet must be updated anytime a new team/operator joins Smartelo PC.

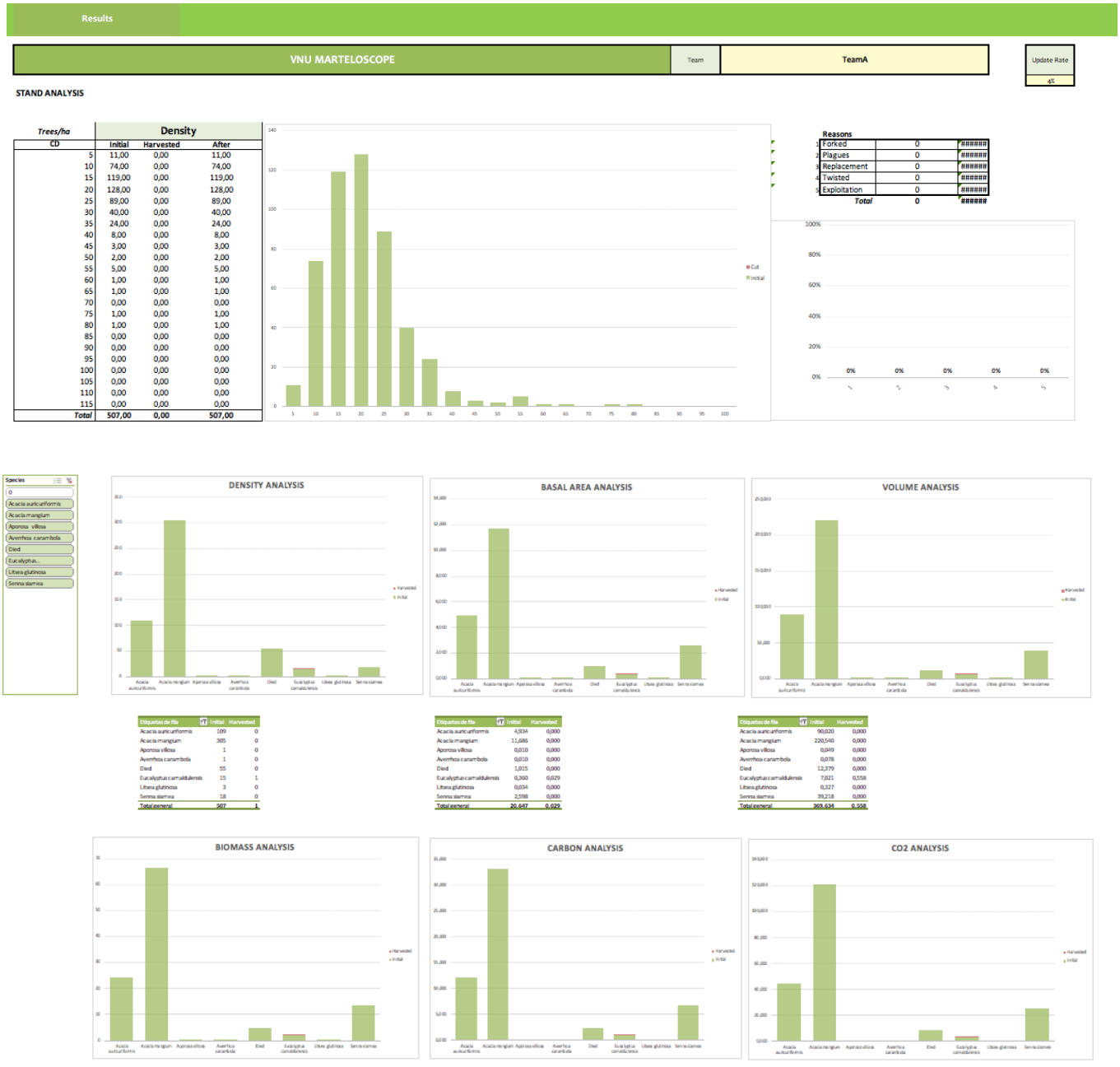


Fig 20. Smartelo´s PC RESULTS sheet screenshot