GlobAllomeTree

Tutorial for Tree Allometric Equation Database Development

Michele Baldasso, Luca Birigazzi, Carlo Trotta, Matieu Henry
November 2012
Rome, Italy

CIRAD : Centre de coopération internationale en recherche agronomique pour le développement

42, rue Scheffer, 75116 Paris, France

UNITUS Università degli Studi della Tuscia

Department for Innovation in Biological, Agro-Food and Forest System (DIBAF)

Via S. Camillo de Lellis, 01100 Viterbo, Italy

FAO Food and Agriculture Organization of the United Nations

Viale delle Terme di Caracalla, Rome 00153, Italy

Disclaimer:

Contents

Tutorial for tree allometric equation database development

The template allows entering allometric equation for trees, sprouts, mangroves and stands for volume and biomass. This tutorial explains how to develop a database for allometric equations using the provided XLS template.

The insertion of the data into the template is performed in two steps. The first step consists in preparing the data and collecting the necessary information. The second step consists in submitting the data and their integration into the existing database.

1. Research of articles, reports and documents containing allometric equations

The documents can be found in libraries, or on internet. The targeted libraries can be universities for the thesis, the departments of forestry for reports and the private companies such as the logging companies for the volume equations. When considering the research on internet, the following keywords can be used to facilitate the research: biomass function, volume function, allometry, equation, model, timber, phytomass, aboveground biomass, belowground biomass. Several research motors exist: ISI web of knowledge, SCOPUS, CAB, CAIRN, WILEY, BIOONE.
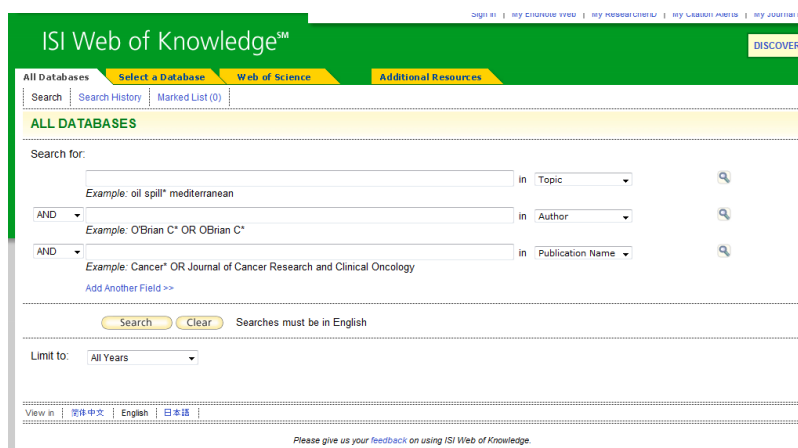

Figure 1: research of scientific articles using ISI Web of Knowledge

1.1 Enter the reference: example using the Endnote software

To make the consultation of the references easier and to export them in excel database, you can use one of these software: Endnote, ProCite, Reference Manager, RefWorks.....

For example, please find here below how to use the software Endnote:

- ✓ Check that the reference does not already exist in the database.

- ✓ When you cannot export references automatically from a website, the reference must be entered manually typing all the necessary information (author/s, year of issue, article title, document type, document name, volume, issue, pages, label); each document, hard or soft copies are identified with one label number. The label corresponds to the identification number of the article (PDF, Word file....). One label can correspond to more than one equation because one article can contain more than one equation.
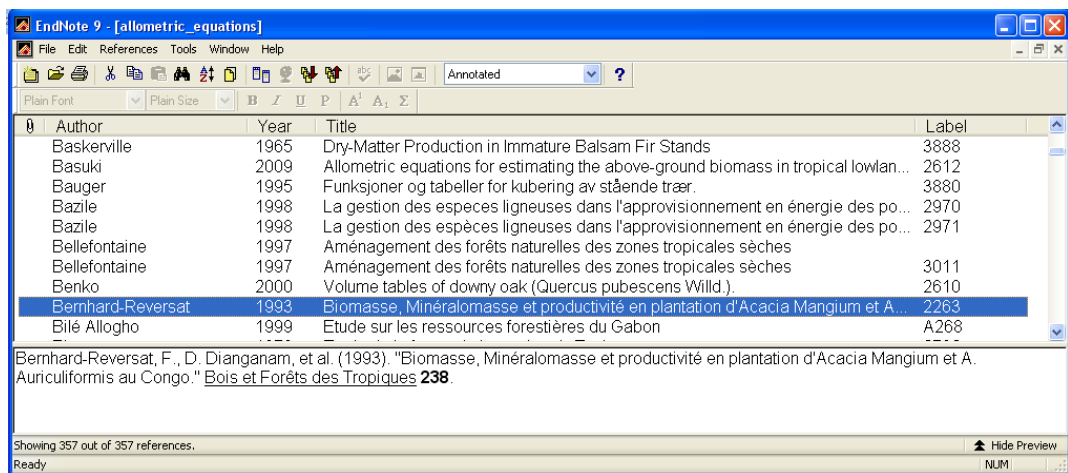
Figure 2: Visualisation of the reference found in the database using Endnote 9.

For more info: www.endnote.com/training

2. Data needed to insert new allometric equations into the database

The first step consists in verifying that the allometric equation is not already present in the database (can be under a different author). In the case that the allometric equation is present in more than one article, the allometric equation would be assigned to the original one.

- ✓ You need the best accurate data you can obtain;

- ✓ Some data may not be present in the document you have;

- ✓ Some data can be obtained using appropriate software (see below);

- ✓ Except for the equations, for the other data (e.g. location coordinates) you need a maximum of 4 figures after the comma/point.

5

Figure 3: List of data needed to insert a new allometric equation into the database

N.	FIELD	DESCRITPION	EXAMPLES	Notes
1	ID	Identification number of the allometric equation. Each equation has its own ID reference, two different equations cannot have the same ID.	1188	a. c.
2	Population	Lianas: woody climbing plants mainly of tropical forests; Mangroves: evergreen trees or shrubs of tropical forests, having prop roots and stems and forming dense thickets along tidal shores; Sprout: is a shoot which grows from a bud at the base of a tree or from a shrub or from its roots; Stand: contiguous area that contains a number of trees; Tree: woody plant having a main trunk and usually a distinct crown.	Tree	a.
3	Ecosystem	Forest Plantation Hedgerow Home garden Tree outside forest	Forest	a.
4	Continent	Name of the continent where the equation was developed	Africa	a.
5	Country	Name of the country using the GAUL nomenclature (Global Administrative Unit Layers, FAO). Write "None" when the allometric equation does not refer to any country.	Burkina Faso	a.
6	ID_Location	Identification number of the location. In the same article for the same location they could be more than one equation.	6772	a. c.

7	Group_Location	Identification number of the group locations. When an allometric equation is valid for a group of locations. Write "None" when the allometric equation does not refer to any group location. Always provide a separate list with the Group_Locations you used in the database, each one with the corresponding ID.	24	c.
8	Location	Location corresponds to the name of the place where the equation was developed It can be a precise location (city, village..) or a geographical area. Search a location as precisely as possible. Write "None" when the allometric equation does not refer to any location.	Laba	a.
9	Latitude	Decimal degrees Write "None" when the allometric equation does not refer to any latitude.	41.899566	b.
10	Longitude	Decimal degrees Write "None" when the allometric equation does not refer to any longitude.	12.515275	b.
11	Biome_FAO	Global Ecological Zones	Tropical dry forest	b.
12	Biome_UDVARDY	Global Ecological Zones	Tropical dry forests / Woodlands	b.
13	Biome_WWF	Global Ecological Zones	Tropical & Subtropical Grasslands, Savannas & Shrublands	b.
14	Division_BAILEY	Global Ecological Zones	SAVANNA DIVISION	b.
15	Biome_HOLDRIDGE	Global Ecological Zones	Tropical dry forest	b.

16	X	Independent variable (see below). e.g.: BA (basal area, the cross-sectional area of the stem at breast height), Bd (diameter at soil), Bd5 (diameter at 5 cm from soil), C (circumference at breast height), Cb (circumference at soil), Cd5 (circumference at 5 cm from soil), D10 (diameter at 10 cm of height from the soil), DBH (diameter of the stem at breast height), H (height), wd (wood density).Look at the end of the tutorial for an exhaustive list of the acronyms to be used.	BA	a.
17	Unit_X	Unit measure (mm, cm, cm2, cm3, dm, gcm-3, m, m2...).Always keep the unit of measurement reported by the author.	cm	a.
18	Z	Independent variable. Cannot be there a second variable. Write "None" when you have not this data.	DBH	
19	Unit_Z	Unit measure Write "None" when you have not this data.	cm	
20	W	Independent variable. Write "None" when you have not this data.	H	
21	Unit_W	Unit measure. Write "None" when you have not this data.	m	
22	U	Independent variable. Write "None" when you have not this data.	-	
23	Unit_U	Unit measure Write "None" when you have not this data.	-	
24	V	Independent variable. Write "None" when you have not this data.	-	

25	Unit_V	Unit measure. Write "None" when you have not this data.	-	
26	Min_X	It is the minimum X value. Write "None" when you have not this data.	10 cm	
27	Max_X	It is the maximum X value. Write "None" when you have not this data.	40 cm	
28	Min_Z	It is the minimum Z value. Write "None" when you have not this data.	3,6 m	
29	Max_Z	It is the maximum Z value. Write "None" when you have not this data.	7,8 m	
30	Output	It is the dependent variable: Y It can express: - Biomass - Volume	biomass	a.
31	Output_TR	The output of the equation can be expressed in the Log(Y) or in the arithmetic value of Y, in which case you don't specify anything. When the result of the equation is a logarithm you have to specify if it is a natural logarithm (Log) or a logarithm to base b = 10, the common logarithm (Log10). Write "None" if "Y" does not refer to any log.	Log10	a.
32	Unit_Y	Unit measure of Y (e.g. cm3, dm3, m3, m3/ha, g, kg, Mg, kg/ha, Mg/ha...).	kg	a.
33	Age	Age of the population considered in the experiment (years). It can be a precise number (e.g. 20) or a range (e.g. 20-40) or a definition (eg. young...). Write "None" when you have not this data.	20	

34	Veg_Component	They are the vegetation components of the plants considered in the equation (see below). e.g. : Branch biomass Branch biomass without twigs Biomass of roots (RC+RF+RS) Biomass of dead branches Biomass of stem bark Biomass of small roots Biomass of fine roots Crown biomass (BR+FL) Prop roots Stem volume Stem wood biomass Stump biomass Total aboveground biomass Total foliage biomass Total stem biomass (SW+SB) Total tree biomass (AB+RT) Total aboveground biomass without leaves Total aboveground woody biomass	Total stem biomass (SW+SB)	a.
35	B	Bark Write "TRUE "if bark is considered in the output; Write "FALSE "if this component is not considered.	TRUE	a.
36	Bd	Dead branches Write "TRUE "if dead branches are considered in the output; Write "FALSE "if this component is not considered.	-	a.
37	Bg	Gross branches: D>7 cm Write "TRUE "if gross branches are considered in the output; Write "FALSE "if this component is not considered.	-	a.

38	Bt	Thin branches: D<7 cm Write "TRUE" if thin branches are considered in the output; Write "FALSE" if this component is not considered.	-	a.
39	L	Leaves Write "TRUE" if leaves are considered in the output; Write "FALSE" if this component is not considered.	-	a.
40	Rb	Large roots Write "TRUE" if write are considered in the output; Write "FALSE" if this component is not considered.	-	a.
41	Rf	Fine roots Write "TRUE" if fine roots are considered in the output; Write "FALSE" if this component is not considered.	-	a.
42	Rm	Medium roots Write "TRUE" if medium roots are considered in the output; Write "FALSE" if this component is not considered.	-	a.
43	S	Stump Write "TRUE" if stump is considered in the output; Write "FALSE" if this component is not considered.	-	a.
44	T	Trunk-underbark Write "TRUE" if trunk-underbark is considered in the output; Write "FALSE" if this component is not considered.	FALSE	a.
45	F	Fruits Write "TRUE" if fruits are considered in the output; Write "FALSE" if this component is not considered.	-	a.

46	ID_Species	Identification number of the species. Each species has its own ID, two different species cannot have the same ID. Write "1" when the allometric equation does not refer to any particular species.	450	a. c.
47	Genus	It is the name of the genus in the binomial literature in a Latin grammatical forms.	Anogeissus	a.
48	Species	It is the name of the species in the binomial literature in the Latin grammatical form.	leiocarpa	a.
49	Family	It is the name of the Taxonomic family to which belongs the species		a.
50	Group_Species	Write "1" when an allometric eq. refers to a group of species. Write "None" when the equation does not refer to any group of species. Always provide a separate list Group_Species you used in the database, each one with the corresponding ID.	1	a.
51	ID_Group	Identification number of the group species. Each group has its own ID, two different groups cannot have the same ID. Write "None" when the equation does not refer to any group of species.	-	c.
52	Equation	It is the allometric equation.	3.21*X+11.74*X^(2)	a.
53	Sample_size	Number of plants measured to obtain the equation. Write "None" where there is not this data.	32	
54	Top_dob	For equations that include a portion of the merchantable stem. Top d.o.b. describes the minimum diameter in cm, outside bark (d.o.b.) of the top of the merchantable stem. Write "None" where there is not this data.	-	-

55	Stump_height	For equations that predict the biomass of any component that includes the tree stem or the stump, this variable lists (in m.) the estimated or measured stump height. Write "None" where there is not this data.	-	-
56	ID_REF	Identification number of the reference. One reference can correspond to more than one equation. In the case one equation is found in more than one document, the oldest document becomes the reference	579	a. c.
57	Label	Identification number of the pdf/word copy of the article in your library. Hard or soft copies are identified with one label number. One label can correspond to more than one equation. The label can correspond to the ID_REF.	3832	a. c.
58	Author	Author's surname. Write only the first two authors. If there are two authors use "**and**" between the names of the two authors. If more than two authors, write "surname of the first author et al.".	Sawadogo et al.	a.
59	Year	Year of publication of the document. When an author has written more than one work in the same year, use **a**, **b**, etc. to differentiate, e.g. **2000a**, **2000b**. Write "None" where there is not this data.	2010	a.
60	Reference	Authors, year of publication, title of issue, journal, volume number, number of the issue, pages . The reference should be entered in using the Fao bibliography editorial guidelines (look at page 24 for more information).	**Barney, R., Van Cleve, K. & Schlentner, R.** 1978. Biomass Distribution and Crown Characteristics in Two Alaskan Picea Mariana Ecosystems; . *Canadian Journal of Forest Research* (8): 36-41	a.

61	R²	Coefficient of determination of the equation. Write "None" where there is not this data.	0.878	a.
62	R²_adjusted	This is an adjustment of the R-squared that penalizes the addition of extraneous predictors to the model. Adjusted R-squared is computed using the formula 1 - ((1 - R²)((N - 1) /(N - k - 1)) where k is the number of predictors.	0.489	
63	Corrected for bias	A "1" value in this column means that the original author developed and reported a correction factor to compensate for the potential underestimation resulting from backtransforming logarithmic predictions to arithmetic units, as suggested by Baskerville (1972), Beauchamp and Olson (1973), and Sprugel (1983). In many cases where (7) is "yes," item (8) will list CF, the bias correction factor to be used. In other cases, the authors embedded the correction factor into the equation parameters, or did not publish the value of CF since it can be obtained from the regression statistics. In such cases, the value of CF in the database will be zero even though the authors used the correction factor (Jennifer C. 2004). Write "None" when there is no "corrected for bias".	-	
64	RMSE	Root-mean-square deviation or error of the equation. Write "None" where there is not this data.	-	a.
65	SEE	Standard error of the mean of the equation. Write "None" where there is not this data.	-	
66	Bias correction (CF)	Value of CF, to correct for potential underestimation resulting from back-transformation of logarithmic predictions to arithmetic units. Write "None" when there is no "CF".	-	

67	Ratio equation	Some authors present methods for predicting the biomass of the merchantable stem to a user-defined top diameter. A "1" value in this column means that a separate ratio equation was presented by this author. Write "None" when there is no "ratio equation".	-	
68	Segmented equation	Paired equations for the same species. E.g. one equation was applicable at the lower end of the diameter range and a second equation was applicable at the upper end of the range. A "1" value in this column means that the equation is one-half of a segmented equation. Write "None" when there is not this data.	-	
69	Contributor	Name of the institution who worked on entering data in the database.	FAO	
70	Name_operator	Name of the operator who entered the data		
71	Remarks	Any other relevant information such as silvicultural treatment, fertility class, soil description etc.	Evergreen forest	

NOTES

a. Very important data
b. Data obtained with other software
c. Data obtained from pre-existing database

3. How to enter new allometric equations into the database

Writing the decimal numbers, always use the point as decimal mark (e.g. write 2.436, not 2,436).

Always provide a legend with the meaning of the acronyms you used.

Always provide a separate list with the ID_Species, ID_Location, Group_Location and Group_Species you used in the database, each one with the corresponding ID.

3.1 Location and ecology

- Data n.1 – ID: Identification number of the allometric equation. The ID is assigned in consecutive increasing numerical order starting from the existing one (one equation corresponds to one identification number ONLY). Any ID refers to an allometric equation that refers to a particular species and to only one location

- Data n.2 – Population: Lianas, Mangroves, Sprout, Stand, Tree.

  Lianas: woody climbing plants mainly of tropical forests; Mangroves: evergreen trees or shrubs of tropical forests, having prop roots and stems and forming dense thickets along tidal shores; Sprout: is a shoot which grows from a bud at the base of a tree or from a shrub or from its roots; Stand: contiguous area that contains a number of trees; Tree: woody plant having a main trunk and usually a distinct crown.

- Data n.3– Ecosystem: Forest, plantation, hedgerow, home garden, tree outside forest. For plantation we mean an intensively managed stand of trees established by planting or/and seeding.

- Data n.4 – Continent: Name of the continent where the equation was developed. Ex: Asia, Africa, Europe etc...

- Data n.5 – Country: Name of the country where the equation was developed using the GAUL nomenclature.

- Data n.6 – ID_Location: Identification number of the location. One ID_Location is for only one location. You cannot have different ID_Location for the same geographical location. The ID_Location is assigned in consecutive increasing numerical order starting from the existing one. Any ID (Data n. 1) refers to an allometric equation that refers to only one location. If an equation is valid for different locations, create an ID (Data n.1) for every location, specifying in Data n.7 that the equation is not valid only for that location but for a group of locations.

- Data n.7 – Group_Location: Identification number of the group location. When an allometric equation is valid for a group of locations. The ID of the group location is assigned in consecutive increasing numerical order starting from the existing one .One ID Group_Location is valid for one and only one group location. You cannot have different ID of Group_Location for the same group location. Always provide a separate list of the groups location you cited in the database, each one with the corresponding ID and with the different locations that belong to that group.

- Data n.8 – Location corresponds to the name of the place where the equation was developed. It can be a precise location (city, village..) or a geographical area. Search a location as precisely as possible. Always provide a separate list of the location you cited in the database, each one with the corresponding ID_Location.

- Data n.9 – Latitude: Decimal degrees.

- Data n.10 – Longitude: Decimal degrees.

When the location/s is/are specified in the article, you have to search the location/s where the study was conducted.

You should search if available:

✓ Country;

✓ Location – search a location as precisely as possible;

✓ Latitude;

✓ Longitude.

Study area

Gazi bay (4° 25'S and 39° 50'E) is situated on the south coast of Kenya about 50 km from Mombasa (Figure 1). The bay is sheltered from strong waves by the presence of Chale Peninsula to the east and
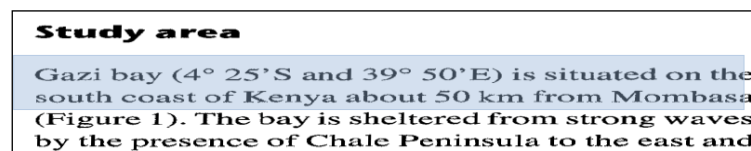
Figure 4: Example of article, material and methods, study area. In the text there are highlighted in the following order: location, coordinates and country

When there are no coordinates but there are references about a particular location, you must find the correspondent coordinates using Google earth (Figure 4); in the tool options select "show lat/long in decimal degree".

Figure 5: Example of georeferencing the allometric equation using Google earth. The coordinates are highlighted in yellow

Latitude and Longitude: you need the location coordinates in decimal degrees. If you have to convert the data position (e.g. from an article) in Decimal degrees you should use the file Excel WaypointWorkbench.

Insert Latitude and Longitude on the left of the sheet, under DMS (starting from the second line, the first one is an example), and click on "Fill in blanks" to obtain coordinates in decimal degrees.

Figure 6: WaypointWorkbench.zip

- Data n.11 – X: Global Ecological Zones, Biome_FAO. It is categorised according to the ecological classification from the FAO Forestry Resource Assessment (FAO 2001).

- Data n.12 – X: Global Ecological Zones, Biome_UDVARDY.

- Data n.13 – X: Global Ecological Zones, Biome_WWF.

- Data n.14 – X: Global Ecological Zones, Division_BAILEY.

- Data n.15 – X: Global Ecological Zones, Biome_HOLDRIDGE.

3.2 Global Ecological Zones

To individuate the biomes corresponding to each location (coordinates) you can use the software Arcview or Arcgis.

✓ When you have found about 20 locations, you can spatialize the data using Arcview or Arcgis;

✓ Save the locations in .txt (space delimited) and replace the comma with the point;

Figure 7: File .txt with the ID_Location, the latitude and the longitude

Figure 8: ArcWiew Gis, the table with the location data

✓ Open the GIS software and "Add tables", select the .txt file you have created before;

✓ In the tools "Click View" – add "Event Theme" – open the file .txt using X=long and Y=lat;

✓ Using the tool "Theme" – "Convert to Shapefile";

✓ In the tool "File" select "Extensions" – "Geoprocessing and Spatial Analyst";

Figure 9: ArcWiew Gis, View – Add Event Theme

✓ Add the themes you are interested in (Udvardy.shp, Bailey.shp and Holdridge.shp). They are downloadable at http://www.carboafrica.net/data_en.asp. FAO ecological zone shapefile is available at the website: http://www.fao.org/geonetwork/srv/en/metadata.show?id=1255&currTab=simple.

✓ In the tool "View" select "Geoprocessing Wizard" – "Assign data by location" combining your data .shp with map .shp of the theme you are interested in, as in Figure 10;
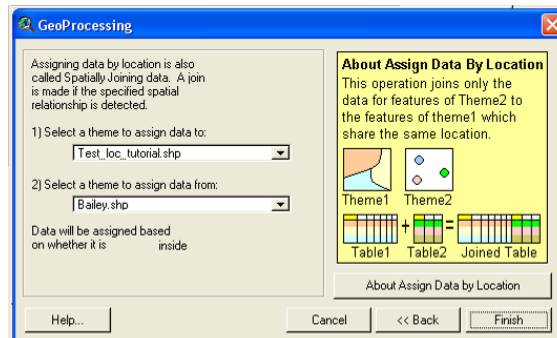

Figure 10: Geoprocessing Wizard

✓ Open the theme table obtained which shows the Bailey biome correspondent to every coordinates;

Figure 11: Theme table

✓ Use the tool "File" – "Export" – "DB base" and then open the table with the software excel;

✓ Follow the same process for all biomes (Baileys, Udvardy, Bailey and Holdridge);

✓ Copy the data you need (eg. In Baileys "Dom_desc") and insert them in the database excel.

3.3 Variables and vegetation components

• Data n.16 – X: independent variable. It is the acronym of the independent variable of the equation.

20

BA (basal area, the cross-sectional area of the stem at breast height), Bd (diameter at soil), Bd5 (diameter at 5 cm from soil), C (circumference at breast height), Cb (circumference at soil), Cd5 (circumference at 5 cm from soil), D10 (diameter at 10 cm of height from the soil), DBH (diameter of the stem at breast height), H (height), WD (wood density). Look at the end of the tutorial for an exhaustive list of the acronyms to be used. Please use only the acronym included in the list. If the equation has a variable not included in the list, you could create a new acronym for the variable, explaining his meaning in a specific legend.

- Data n.17 – Unit_X: Unit measure (mm, cm, cm2, cm3, dm, gcm-3, m, m2...). Always keep the original unit of measurement used by the author.

- Data n.18 – Z: independent variable.

- Data n.19 – Unit_Z: unit measure.

- Data n.20 – W: independent variable.

- Data n.21 – Unit_W: unit measure.

- Data n.22 – U: independent variable.

- Data n.23– Unit_U: unit measure.

- Data n.24 – V: independent variable.

- Data n.25 – Unit_V: unit measure.

- Data n.26 – Min_X: it is the minimum X value (cm).

- Data n.27 – Max_X: it is the minimum X value (cm).

- Data n.28 – Min_H: it is the minimum H value (m).

- Data n.29 – Max_H: it is the minimum H value (m).

- Data n.30 – Output: unit measure. It is the dependent variable: Y

  It can express: Biomass or Volume.

  If the output are not Biomass or Volume, please explain in detail

- Data n.31 – Output_TR: The output of the equation can be expressed in the Log(Y) or in the arithmetic value of Y, in which case you don't specify anything. When the result of the equation is a logarithm you have to specify if it is a natural logarithm (Log) or a logarithm to base b = 10, the common logarithm (Log10).

- Data n.32 – Unit_Y: Unit measure of Y (e.g. cm3, dm3, m3, m3/ha, gr, Kg, Mg, Kg/ha, Mg/ha...).

- Data n.33– Age: Age of the population considered in the experiment (years). It can be a precise number (e.g. 20) or a range (e.g. 20-40) or a definition (eg. young...).

- Data n.34 – Veg_Component: They are the vegetation components of the plants considered in the equation (see below).

e.g. : Branch biomass
Branch biomass without twigs
Biomass of roots (RC+RF+RS)
Biomass of dead branches
Biomass of stem bark
Biomass of small roots
Biomass of fine roots
Crown biomass (BR+FL)
Prop roots
Stem volume
Stem wood biomass
Stump biomass
Total aboveground biomass
Total foliage biomass
Total stem biomass (SW+SB)
Total tree biomass (AB+RT)
Total aboveground biomass without leaves
Total aboveground woody biomass

Veg_Component: Vegetation component. You can explain what the allometric equation represent (eg. the components of the plants considered in the equation).
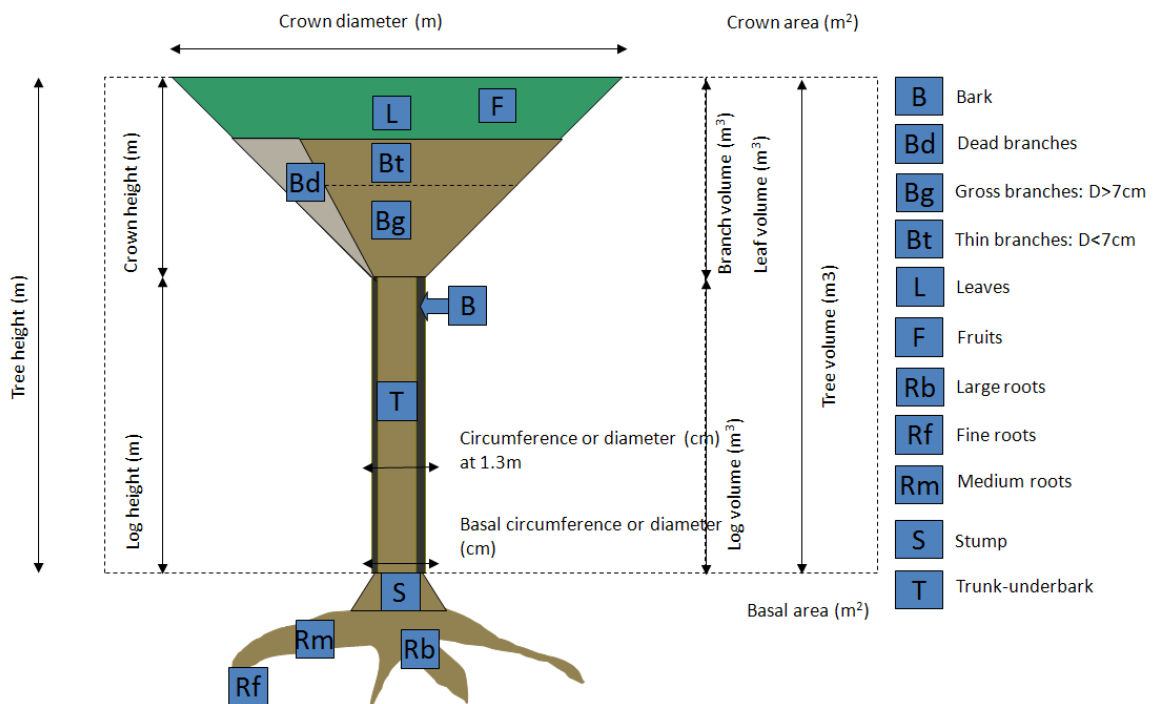

Figure 13: Tree compartments (Matieu H. 2011)

- Data n.35 – B: Bark.

- Data n.36 – Bd: Dead branches.

- Data n.37– Bg: Gross branches (D>7 cm).

- Data n.38 – Bt: Thin branches (D<7 cm).

- Data n.39 – L: Leaves.

- Data n.40 – Rb: Large roots.

- Data n.41 – Rf: Fine roots.

- Data n.42 – Rm: Medium roots.

- Data n.43 – S: Stump.

- Data n.44 – T: Trunk-underbark.

- Data n.45– F: Fruits.

3.4 Species and Taxonomy

- Data n.46 – ID_Species: Identification number of the species. Each species has its own ID, two different species cannot have the same ID. Write "1" when the allometric equation does not refer to any particular species.

- Data n.47 – Genus: It is the name of the genus in the binomial literature in a Latin grammatical forms.

- Data n.48 – Species: It is the name of the species in the binomial literature in a Latin grammatical forms.

- Data n.49 – Family: It is the botanical name of the family to which belongs the species.

- Data n.50 – Group_Species: Write "1" when an allometric eq. refers to a group of species.

- Data n.51 – ID_Group: Identification number of the group species.

3.5 Equation and References

- Data n.52 – Equation (Y): It is the allometric equation. Do not put acronyms in the equation. The independent variables must be expressed with X, Z, W, in order. The descriptions of the input variables must be located in the adequate field (data n.16, 18, 20, 22). In order to avoid mistakes, when writing the equation, always use brackets () after ^ (ex: 0. 1501 D^2.7239 becomes 0. 1501 D^(2.7239)) and avoid spaces within the formula.

- Data n.53 –Sample_size: Number of plants measured to obtain the equation.

- Data n.54 – Top_dob.: For equations that include a portion of the merchantable stem. Top_dob. describes the minimum diameter in cm, outside bark (d.o.b.) of the top of the merchantable stem.

- Data n.55 – Stump_height: For equations that predict the biomass of any component that includes the tree stem or the stump, this variable lists (in m.) the estimated or measured stump height.Data n.63 –n: Number of plants measured to obtain the equation.

- Data n.56 – ID_REF: Identification number of the reference. The ID_REF is assigned in consecutive increasing numerical order starting from the existing one (one reference corresponds to one identification number ONLY). In the same reference they could be more than one equation. In the case one equation is found in more than one document, the oldest document becomes the reference

- Data n.57 – Label: Identification number of the pdf/word copy of the article in your library. The ID_Label is assigned in consecutive increasing numerical order starting from the existing one (one label corresponds to one identification number ONLY). One label can correspond to more than one equation. The label can correspond to the ID_REF

- Data n.58 –Author: Author's surname and initial of the first name. Write only the first two authors, when there are more than two authors, write "surname of the first author et al.".

- Data n.59 –Year: Year of publication of the document.

- Data n.60 – Reference: The reference should be entered in using the FAO bibliography editorial guidelines. All references must include: name of author(s), year of publication, title, place of publication and publisher (for books), journal title, volume and pages (for articles). The names of all authors of a work should be given in bibliographies. Where there are **more than three** authors in the bibliography, abbreviate to *et al.* in the text (but not in the bibliography). When an author has written more than one work in the same year, use **a**, **b**, etc. to differentiate, e.g. **2000a, 2000b**. Entries by the same author/s should be listed in ascending chronological order. Use the **ampersand (&)** between the names of the last two authors in the bibliography but use **and** in the text. The author's name is written in bold, followed by an end point in bold. The year of publication is written in normal type, followed by a period. The title of the publication must be italicized. The place of publication is listed after the name of the publisher. Note that **FAO** should be the corporate author of all FAO copyrighted material. In the case of a corporate author, it is not necessary to repeat the name of the organization as publisher. However, if the corporate author is not well known or defined in the text, the full name may be given after the place of

publication. Titles of books, journals and periodicals are italicized (**do not** use inverted commas). Titles of articles and chapters are **not** italicized. Ex:

Colin, M. 1994. La cuniculture nord-américaine. *World Rabbit Sci.*, 13(2): 33-51.

For further information look the FAO editorial guideline at http://www.fao.org/corp/publications/en/

3.6 Regression statistics and contributors

- Data n.61 – R²: Coefficient of determination of the equation.

- Data n.62 – R²_adjusted: adjusted R squared is the amount of variance in the outcome that the model explains in the population (instead of just the sample). The samples will consistently produce a parametric R2 estimate that is inflated, so the adjusted R2 is used instead. If, however, you regress data from an entire population, it is no longer necessary to adjust the R2 coefficient because it is no longer biased. The adjusted R^2 can be negative, and its absolute value will always be less than or equal to that of R^2. The formula to use is: ((1 - R²)((N - 1) /(N - k - 1)) where k is the number of predictors.

- Data n.63 – Corrected for bias: A "1" value in this column means that the original author developed and reported a correction factor to compensate for the potential underestimation resulting from backtransforming logarithmic predictions to arithmetic units, as suggested by Baskerville (1972), Beauchamp and Olson (1973), and Sprugel (1983). In many cases where (7) is "yes," item (8) will list CF, the bias correction factor to be used. In other cases, the authors embedded the correction factor into the equation parameters, or did not publish the value of CF since it can be obtained from the regression statistics. In such cases, the value of CF in the database will be zero even though the authors used the correction factor (Jennifer C. 2004).

- Data n.64 – RMSE: Root-mean-square deviation or error of the equation

- Data n.65 – SEE: Standard error of the mean of the equation

- Data n.66 – Bias correction (CF): Value of CF, to correct for potential underestimation resulting from back-transformation of logarithmic predictions to arithmetic units.

- Data n.67 – Ratio equation: Some authors present methods for predicting the biomass of the merchantable stem to a user-defined top diameter. A "1" value in this column means that a separate ratio equation was presented by this author.

- Data n.68 – Segmented equation: Paired equations for the same species. E.g. one equation was applicable at the lower end of the diameter range and a second equation was applicable at the upper end of the range. A "1" value in this column means that the equation is one-half of a segmented equation.

- Data n.69 – Contributor: Name of the institution who worked on entering data in the database.

- Data n.70 – Name_operator: Name of the operator who entered the data

- Data n.71 – Remarks: Any other relevant information such as silvicultural treatment, class of fertility, soil description, etc..

4. List of the acronyms to be used in the database

Please use only the acronym included in the list. If the equation has a variable not included in the list, you can create a new acronym for the variable, explaining his meaning in a specific legend. Always keep the original unit of measurement reported by the author. Always provide a legend with the description of the acronyms used in the database.

Acronym	Description	Unit	Population
BA	Basal area: Stem cross-sectional area at DBH (1m30 height)	cm^2	TREE
BA0	Stem cross-sectional area at the soil	cm^2	TREE
BD	Basal diameter	cm	TREE
C	Circumference at 1.3m	cm	TREE
C10	Circumference at 10 cm height	cm	TREE
C180	Circumference at 180 cm height	cm	TREE
C20	Circumference at 20 cm height	cm	TREE
C30	Circumference at 30 cm height	cm	TREE
C50	Circumference at 50 cm height	cm	TREE
Ca	Canopy area	m^2	TREE
CA	Crown area	cm^2	TREE
Cb	Basal circumference	cm	TREE
Cb5	Circumference at 5 cm from soil	cm	TREE
CD	Crown diameter	Cm	TREE
CH	Crown height	cm	TREE
CR	Crown radius	cm	TREE
CV	Canopy volume	cm^3	TREE
D20	Diameter at 20cm height	cm	TREE
D30	Diameter at 30cm height	cm	TREE
DBH	Diameter at breast height	cm	TREE
DM	Dry months	months	TREE/STAND
H	Height	cm	TREE
Hd	Stand dominant height	cm	STAND
Hme	Merchantable height	cm	TREE
Ht	Height of the trunk	cm	TREE
M_DBH	Average of DBH	cm	STAND

N	Number of trees	Tree*ha^{-1}	STAND
R	tree ring	nr	TREE
SUMD10	Sum of the diameters at 10 cm from the soil	Cm	STAND
Yr	Year	yr	TREE/STAND
Vs	Stem volume	dm3	TREE
WD	Wood density	g*cm^{-3}	TREE
Age	Age of the trees	yr	STAND
V.P.	stem volume including bark	cm^3	TREE