

COUNTRY REPORT FOR BELGIUM

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Summary

1. Overview

Belgium is divided into 3 regions: Walloon, Flemish and Brussels regions. Each one has its own political autonomy in various fields, in particular the natural resources management.

Wooded area in the Walloon region covers 530,600 ha. A first temporary inventory has been realised in the beginning of the 1980s. A new permanent forest inventory is carried out since the beginning of the 1994.

The Flemish region will start the first permanent inventory of its 128,600 ha of wooded area in 1997.

With only 2,000 ha the Brussels region does not organise a forest inventory up to now.

The method used in the Walloon region is summarised below as the Flemish inventory method is quite similar.

2.1 Nomenclature

Forest inventory of the Walloon Region covers more than 500,000 ha of wooded area. These includes productive area and non-productive surfaces (firebreaks, roads, meadows, waste lands, ...). A lot of information is collected, namely, based upon a systematic rectangular grid (distances between the points are 1,000 m and 500 m):

- general and administrative information
- soil and vegetation observations
- dendrometric data (stands, trees)
- description of the stands (quality, health, ...).

The main general and administrative information is collected from maps; this concerns geographic region, ecological territory, ownership, ...

All the observations on soil and vegetation are field observations: topography (slope, altitude, relief, exposure, ...), pedology (humus, soil texture, drainage, ...), vegetation (at four different levels).

Information concerning the stands is: structure, type, age, silviculture (clear cutting, complete soil depth and profile, gap, stand regularity, regeneration, ...), forest conditions (health, quality, game damage), accessibility and harvesting.

Following measurements and observations are realised on each sample tree: species, girth at breast height (gbh), total height, dominant height, height at different levels (only for hardwood with gbh 120 cm and softwood with gbh 90 cm), health state and quality of wood.

The main derived values are density, basal area, volumes (for trees and stands, extrapolated to ha), mean girth, dominant girth and height, site index.

Stand type is defined according to the percentage of each species. Regeneration state is estimated and described in terms of percentage or stems numbers.

2.2 Data Sources

The main data sources are sample plot on the field and maps. Aerial photographs are used only when available. No airborne digital remote sensing is used.

2.3 Assessment Techniques

Walloon forest inventory is based upon a systematic grid of points where sample plots (single plots, no clusters) are located. The sample unit is composed of four circular plots which radii are related to the size of the sample trees.

The distances between points are 0,5 km (North-South) and 1 km (West-East).

No a priori stratification is defined.

2.4 Data Storage and Analysis

The data is stored in an ACCESS database, installed on a PC Computer.

Area estimation is made by points counting (1 point per 50 ha).

Area estimation error is determined by the BOUCHON's method (1975) derived from the MATTERON's theory (regionalised variables).

Error estimation for the other parameters and variables (basal area,

volume, ...) is calculated by the random sampling error estimation method. Total error is a combination of both errors (area and variables).

The software is developed from ACCESS software and the hardware is a PC Pentium 100 Mhz with 16 Mega RAM and 1 Giga HD.

2.5 Reliability of Data

Several procedures exist in the data treatments so that mistakes are as reduced as possible.

2.6 Models

13 different volume tables are used in order to determine the volumes of all the trees (solid wood of the stem).

Secondary species volumes are calculated as similar main species.

2.7 Inventory Reports

Many results and papers have been published about the first forest inventory of the Wallon forest. They describe inventory methodology and present many results.

The latest results concerning the whole Wallonia were published in 1984. The new forest inventory has started two years ago and covers up to now only 20 % of the sample plots. Only theoretical and methodological papers are available for this new IFW.

Users of the results are mainly industry, forestry administration and scientific institutes.

2.8 Future Development and Improvement Plans

The new forest inventory of Wallonia has started in 1994 and must be finished in 2003. No important changes will be made in a next future.

INTRODUCTION

This country report for Belgium on analyses of the existing forest inventory and survey systems is prepared as a contribution for the study of the European Forestry Information and Communication System (EFICS). The objective of this report is to provide a standardised description of the Belgian forest inventory systems according to the guidelines prepared by the European Forest Institute.

Belgium is divided into three parts (regions): Walloon region, Flemish region and Brussels region.

	Total area (km ²)	Population (1994) (1000)
Walloon region	16 845	3 313
Flemish region	13 521	5 866
Brussels region	162	952
Belgium	30 528	10 131

Forest policy is an attribute of each region so that Belgian forests are also divided into three parts: Flemish forests, Brussels forests and Walloon forests. The following table gives the distribution of forest area.

	Area (ha)	% of Belgian forest
Walloon region	530 600	80.4
Flemish region	128 600	19.3
Brussels region	2 000	0.3
Belgium	661 200	100 %

Reference year : 1st April 1996 (Poplar excluded).

Abbreviations :

- IGN : "Institut Géographique National"
National Geographic Institute (maps author)
- DNF : "Division de la Nature et des Forêts"
Forestry administration of the Walloon Region
- IFW : "Inventaire Forestier Wallon"
Forest inventory of the Walloon Region

Definition of typical forest expressions:

- "Semis": height < 150 cm
- "Fourrés": height ≥ 150 cm with girth at 1.5 m < 10 cm
- "Definition": height ≥ 150 cm with girth at 1.5 m between 10 and 19 cm.

THE WALLOON REGION

1. OVERVIEW

1.1. GENERAL FORESTRY AND FOREST INVENTORY DATA

Walloon Region

Total forest area : 530,600 ha
Proportion of forested land : 31.5 %
Main tree species : spruce, oak, beech
Average volume per hectare : 258 m³
Average increment per hectare : N.A.⁽¹⁾
Ownership proportions : public : 48.5 %
 private : 51.5 %
Number of inhabitants per hectare forested land : 6
Average size of a stand : N.A.

Name of the survey : **Forest inventory of the Walloon Region**
 "Inventaire des Ressources ligneuses de Wallonie"
First assessment : 1979 - 1983 (temporary inventory)
Second assessment : 1994 - 2003 (first cycle of the permanent inventory)
Area covered : Walloon Region (South Part of Belgium).

Institution and organisation :

First assessment : Faculté universitaire des Sciences agronomiques de Gembloux
Second assessment :
1994 - 1996 Faculté universitaire des Sciences agronomiques de Gembloux
1996 - 2003 Division de la Nature et des Forêts - Ministère de la Région
 Wallonne (collect of data) and Faculté universitaire des Sciences
 agronomiques de Gembloux (scientific follow up).
Forest act : Décret du Gouvernement Régional Wallon du 16-2-1995 (Moniteur belge
 du 7/4/96).

⁽¹⁾ N.A. = Not Available

1.2. OTHER IMPORTANT FOREST STATISTICS

1.2.1. Other Forest Data and Statistics on the National Level

1.2.1.1. Non-Woods Goods and Services

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1.2.1.2. Removals

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1.2.1.3. Other Important Forest Statistics

"Recensement décennal de l'Agriculture et des Forêts".

Source : Questionnaire completed by private and public owners.

Realised by the "INS" (Institut National des Statistiques) every 10 years.

Tables are published in a vulgarisation book. Last complete publication (public and private owners: 1976).

For the statistics specific to public forests "Ministère de la Région Wallonne, Division de la Nature et des Forêts".

1.2.2. Delivery of the Statistics to UN and Community Institutions

1.2.2.1. Responsibilities for International Assessments

Mr Parmentier
 Inspecteur en Chef-Directeur
 Administration des Relations économiques
 Ministère des Affaires économiques
 Rue Général Leman, 60
 B-1040 BRUXELLES
 Phone : + 32 2 230 90 43
 Fax : + 32 2 230 95 65

1.2.2.2. Data Compilation

Joined evaluation with the help of

Regional forest administrations
 Office Central du Commerce Extérieur (OCCE)
 Institut National des Statistiques (INS)
 Fédération Nationale des Scieries et des Industries Connexes (FNS)
 Fédération Belge des Exploitants Forestiers (FEDEMAR)
 Fédération Belge des Entreprises de la Transformation du Bois (FEBELBOIS)
 Fédération Nationale des Négociants en Bois (FNN)
 Fédération Belge du Commerce d'Importation de Bois
 Fédération Belge des Producteurs de Pâte, Papier et Cartons (COBELPA)

2. FOREST INVENTORY OF THE WALLOON REGION

The whole information (descriptions and presentations) concerning the forest inventory of the Walloon Region is included in the "Guide méthodologique de l'Inventaire forestier wallon" (Fac. Univ. Sc. Agron. de Gembloux, Février 1996, 208 p.).

2.1. NOMENCLATURE

2.1.1. List of attributes directly assessed

A) Geographic regions

Attribute	Data Source	Object	Measurement unit
Administrative forest unit (<i>Cantonnement</i>)	Map	Sample plot	categorical
Administrative forest sub-unit (<i>Triage</i>)	Map	Sample plot	categorical
Province (<i>Province</i>)	Map	Sample plot	categorical
Vegetal association (<i>Association végétale</i>)	Field observation	Stand	categorical
Ecological zoning (<i>Territoire écologique</i>)	Map	Sample unit	categorical
Forest Region (<i>Région forestière</i>)	Map	Sample unit	categorical
Locality (<i>Localité</i>)	Map	Sample unit	categorical

B) Ownership

Attribute	Data source	Object	Measurement unit
Kind of owner (<i>Type de propriétaire</i>)	Map	Sample unit	categorical

C) Wood production

Attribute	Data source	Object	Measurement unit
Species (<i>Espèce forestière</i>)	field observation	tree	categorical
Girth at breast height (<i>Circonférence à 1.5 m</i>)	field assessment	tree	cm
Total height (hardwood) (<i>Hauteur totale</i>)	field assessment	tree	m

Dominant height (softwood) <i>(Hauteur dominante)</i>	field assessment	tree	m
Height at different level (hardwood gbh > 120 cm) <i>(Hauteur à différents niveaux)</i>	field assessment	tree	m
Quality of wood (hardwood gbh > 120 cm) (softwood gbh > 90 cm) <i>(Qualité du bois)</i>	field assessment	tree	categorical
Health state <i>(Etat sanitaire)</i>	field assessment	tree	categorical

D) Site and soil

Attribute	Data source	Object	Measurement unit
Topography			
- relief <i>(Relief)</i>	field observation	stand	categorical
- exposure <i>(Exposition)</i>	field assessment	stand	categorical
- slope <i>(Pente)</i>	field measurement	sample unit	degree
- altitude <i>(Altitude)</i>	map	sample unit	m
Pedology			
- humus <i>(Humus)</i>	field observation	sample unit	categorical
- texture <i>(Texture)</i>	field observation	sample unit	categorical
- stone type <i>(Charge caillouteuse)</i>	field observation	sample unit	categorical
- stone quantity <i>(Abondance de la charge caillouteuse)</i>	field observation	sample unit	categorical
- drainage <i>(Drainage)</i>	field observation	sample unit	categorical
- soil profile <i>(Type de sol)</i>	field observation	sample unit	categorical
- soil depth <i>(Profondeur du sol)</i>	field observation	sample unit	categorical

E) Forest structure

Attribute	Data source	Object	Measurement unit
Age (only for softwood) <i>(Age)</i>	field measurement	stand	year

Species (<i>Espèce</i>)	field observation	tree	categorical
Structure (<i>Structure</i>)	field observation	stand sample unit	categorical
Type (<i>Type</i>)	field observation	stand sample unit	categorical
Clear cutting (<i>Mise à blanc</i>)	field observation	stand	categorical
Complete gap (<i>Vide total</i>)	field observation	stand	categorical
Stand regularity (<i>Régularité</i>)	field observation	stand	categorical
F) Regeneration			
<u>Attribute</u>	<u>Data source</u>	<u>Object</u>	<u>Measurement unit</u>
Species (<i>Espèce</i>)	field observation	stand	categorical
Realisation (<i>Réalisation</i>)	field observation	stand	categorical
Species (<i>Espèce</i>)	field observation	sample unit	categorical
Number (<i>Abondance</i>)	field measurement	sample unit	number per m ²
G) Forest condition			
<u>Attribute</u>	<u>Data source</u>	<u>Object</u>	<u>Measurement unit</u>
Health state (<i>Etat sanitaire</i>)	field observation	stand	categorical
Stand quality (<i>Qualité du peuplement</i>)	field observation	stand	categorical
Game damage (<i>Dégâts de gibier</i>)	field observation	stand	categorical
H) Accessibility and harvesting			
<u>Attribute</u>	<u>Data source</u>	<u>Object</u>	<u>Measurement unit</u>
Harvesting condition (<i>Conditions d'exploitation</i>)	field observation	stand	categorical
I) Attributes describing forest ecosystems			
<u>Attribute</u>	<u>Data source</u>	<u>Object</u>	<u>Measurement unit</u>
Humus (<i>Humus</i>)	field observation	sample unit	categorical
Soil study (<i>Pédologie</i>)	field observation	sample unit	categorical

Vegetation observation (<i>Phytosociologie</i>)	field observation	sample unit	categorical
- trees : high level			
median level			
low level			
- plants			

J) Non-wood goods and services

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K) Miscellaneous

Attribute	Data source	Object	Measurement unit
Map number (<i>Carte IGN</i>)	map	sample unit	-
Sample plot number (<i>Numéro de placette</i>)	map	sample unit	-
Date (<i>Date</i>)	-	sample unit	ddmmyy
Beginning hour (<i>Heure de début</i>)		sample unit	hhmm
End hour (<i>Heure de fin</i>)		sample unit	hhmm
X and Y co-ordinates (<i>Coordonnées X et Y</i>)	map	sample unit	km (- 0.1 km)

2.1.2. List of derived attributes

A)

-

B)

-

C) Wood production

Attribute	Measurement unit	Input attributes
Single tree basal area (<i>Surface terrière individuelle</i>)	m ²	girth at 1.5 m
Single tree volume (<i>Volume individuel</i>)	m ³	girth at 1.5 m, total tree height or dominant height by species
Volume at different levels (<i>Volumes à différents niveaux</i>)	m ³	height level individual tree volume
Density/ha (<i>Densité</i>)	-	number of stems (number extended/ha)

Basal area/ha (<i>Surface terrière/ha</i>)	m ²	Sum of individual tree basal area extended to ha
Volume/ha ⁽¹⁾ (<i>Volume/ha</i>)	m ³	Sum of individual tree volume extended to ha
Basal area and volume by categories (trade, miscellaneous, ...) (<i>surface terrière et volume par catégorie</i>)	m ² or m ³	tree basal area, tree volume
Mean girth (<i>Circonférence moyenne</i>)	cm	individual girths of trees
Dominant girth (<i>Circonférence dominante</i>)	cm	individual girths of dominant trees (mean)
Dominant height (<i>Hauteur dominante</i>)	m	individual height of dominant trees (mean)
Site index (<i>Indice de fertilité</i>)	categorical	age - dominant height (spruce, Douglas fir)
Basal area percentage by species (<i>Proportion de chaque essence en surface terrière</i>)	%	basal area by species total basal area

D)

-

E) Forest structure

Attribute	Measurement unit	Input attributes
Stand type (<i>Type de peuplement</i>)	categorical	basal area by species (proportion)

F) Regeneration

Attribute	Measurement unit	Input attributes
seedling (<i>semis</i> ⁽²⁾)	%	percentage of area covered by regeneration
thicket (<i>fourrés</i> ⁽²⁾)	%	percentage of area covered by regeneration
	-	number of stems
sapling (<i>gaulis</i> ⁽²⁾)	%	percentage of area covered by regeneration
	-	number of stems

G)

-

⁽¹⁾ Volumes are always solid wood volume over bark (volume of the stem to 7 cm diameter)

⁽²⁾ The definitions are given in introduction

H)

I)

J)

K)

2.1.3. Measurements rules for measurable attributes

A)

B)

C) Wood production

Girth at breast height (1.5 m)
(*Circonférence à 1,5 m*)

a) measured at 1.5 m above ground, on slopes measured from uphill side.

One reading with tape

b) minimum girth : 20 cm

c) cm, no classes

d) rounded to lower cm (0.0 to 0.4), to upper cm (0.5 to 0.9)

e) tape

f) field assessment

Total tree height (Hauteur totale individuelle)

a) length of the tree from ground level to the top of the tree, on slopes measured from equal side or uphill side

b) minimum tree height : 3 m

c) m

d) rounded to closest level : 0.00, 0.25, 0.50, 0.75

e) Blume-Leiss dendrometer

f) field assessment

Tree height at different levels (Hauteur de la grume à différents niveaux)

a) length of the tree from ground level to these levels (first default, trade

level), on slopes measured from equal side or uphill side

b) minimum tree height: 2 m

c) m

d) rounded to closest level: 0.00, 0.25, 0.50, 0.75

e) Blume-Leiss dendrometer

f) field assessment

Age (Age)

a) measured at 0.30 m above ground level by radial boring

b) minimum age: 1 year

c) year

d) not rounded

e) Pressler borer

f) field assessment

D) Site and soil (*Milieu et sol*)

Slope (Pente)

a) mean of downward and upward measurements

b) minimum: 0°

c) degree

d) rounded to nearest degree

e) Blume-Leiss dendrometer

f) field assessment

Stone quantity (Abondance de la charge caillouteuse)

a) estimate of the percentage of stones with a soil sampler

b) no threshold

c) in four classes: < 5 %, 5-14 %, 15-49 %, ≥50 %

- d) rounded to closest class limit
- e) ocular estimate
- f) field assessment

Soil depth (Profondeur du sol)

- a) measured by soil penetration with a soil sampler
- b) no threshold
- c) in five classes: 0-19 cm, 20-39 cm, 40-59 cm, 60-79 cm and ≥ 80 cm
- d) rounded to closest class limit
- e) soil sampler
- f) field assessment

Altitude (Altitude)

- a) altitude of the unit sample above the sea level
- b) no threshold
- c) m
- d) not rounded
- e) ocular observation
- f) map

E) Forest structure

Stand type (Type de peuplement)

- a) ratio of basal area covered by each tree species and total tree species
- b) no threshold
- c) limit between pure and mixed stand :
66.7 % (hardwoods)
80.0 % (softwoods)
- d) not rounded
- e) ocular estimate (based on the number of trees by species)
- f) field assessment

F) Regeneration

Area covered by regeneration (Surface occupée par la régénération)

- a) ratio of the area covered by regeneration (stems with girth at 1.5 m $<$ 20 cm) and the area of the small sampling plot (radius = 2.25 m)
- b) maximum girth: 19 cm at 1.5 m
- c) % for the different regeneration levels seedling, thicket, sapling, number of stems (per ha) for thicket and sapling
- d) not rounded
- e) ocular estimate (area) and counting for

- thicket and sapling
- f) field assessment

G) Forest condition

Health state (Etat sanitaire)

- a) number of trees (diseased or dead)
- b) no threshold
- c) %, in four classes :
< 25 %,
25-49 %,
50-74 %,
 ≥ 75 %
- d) not rounded
- e) ocular estimate
- f) field assessment

Stand quality (Qualité du peuplement)

- a) number of trees with defaults
- b) only for trees with girth above 120 cm (hardwood) or 90 cm (softwood)
- c) %, in four classes :
< 25 %,
25-49 %,
50-74 %,
 ≥ 75 %
- d) not rounded
- e) ocular estimate and trees counting
- f) field assessment

Game damage (Dégâts de gibier)

- a) number of trees with defaults caused by game
- b) for all trees with girth above 20 cm
- c) %, in five classes:
0 %,
1-24 %,
25-49 %,
50-74 %,
 ≥ 75 %
- d) not rounded
- e) ocular estimate and trees counting
- f) field assessment

H) Accessibility and harvesting
(Accessibilité et conditions d'exploitation)

- a) distance between the point sampling and the nearest way for truck
- b) no threshold
- c) m

- d) rounded to the nearest 10 m
- e) graduate ruler
- f) map

D)

-

J)

-

K)

-

2.1.4. Definitions for all attributes or nominal or ordinal scale

A) Geographic regions

Forest unit (Cantonnement)

- a) territory subdivision in administrative units, specific to the "Division Nature et Forêts", managed by a forest engineer who controls the respect of the forest laws, hunting, fishing and environment rules and manages the public forests
- b) 36 different units grouped in seven local centres
- c) specific maps of the DNF
- d) -

Forest region (Région naturelle)

- a) subdivision of the Walloon Region according to the soil types and geology substratum
- b) seven regions; one of them (Ardenne) is subdivided into three sub-regions according to the altitude
- c) maps obtained by the classification of each village or city in one of the regions based upon the "field knowledge" of the forest engineer
- d) -

Ecological zoning (Territoire écologique)

- a) hierarchical classification of the forest station based upon climate, geology stone type and soil
- b) 27 ecological territories
- c) ecological territories map (DELVAUX and GALOUX (1962) Les territoires écologiques du Sud-Est de la Belgique,

Travaux hors série, Groenendael, Belgium, 2 vol. 315 pp.)

d) -

Vegetal association (Association végétale)

- a) ecosystem characterised by the common presence of a community of herbaceous and woody species which makes it possible the classification of the forest station in terms of aptitude and productivity
- b) 27 vegetal associations and 43 subdivisions
- c) definition from the vegetation included in the sample unit
- d) missing data for some sample units (according to the inventory season)

Province (Province)

- a) administrative division of the Walloon Region
- b) five provinces
- c) administrative maps of Belgium
- d) -

Forest sub-unit (Triage)

- a) subdivision of the "cantonnement" including 300 to 400 ha of public forests managed by a forest ranger (technical level)
- b) 500 *triaux* in Wallonie
- c) "triaux" map (management map of the DNF)

B) Ownership

Kind of owner (Nature du propriétaire)

- a) owner of the forest area
- b) 1) region
- 2) province
- 3) commune
- 4) social assistance centre (CPAS - "Centres Publics d'Aide Sociale")
- 5) church patrimony and other public owners
- 6) natural reserves
- 7) national defence
- 8) private owners
- c) specific map of public owners
- d) confirmation of the owner by the forest ranger

C) Wood production*Stand quality (Qualité du peuplement)*

- a) stand classification according to the presence and frequency of the common defects
- b) tree categories: good, normal or poor according to the damaged trees number:
 - < 25 %
 - 25-49 %
 - 50-74 %
 - ≥ 75 %

main defects: twisted fibre, bad conformation suckers presence, crutches, frost split dead branches, harvesting damages, rotten other defects

- c) field observations
- d) only for the high forests

Game damages (Dégâts de gibier)

- a) stand classification among the frequency of game defects: (abrouissements), (frottures), peelings,
- b) five categories:
 - stands with no damages,
 - low (< 25 % damaged trees),
 - median (25 to 49 %),
 - high (50 to 74 %),
 - generalised (≥ 75 %)

- c) field observations
- d) the observations take into account the damage depth

Cuttings (Coupes)

- a) estimation of the frequency and the intensity of the clearing or thinning
- b) six classes: no cutting, slight cuttings, normal cuttings, hard cuttings, premature cuttings or late cuttings
- c) field observations
- d) concerns mainly softwoods stands in private ownership

Individual quality of trees (Qualité individuelle des grumes)

- a) quality trees estimation based upon several criteria (form conformation, defects, damages, ...)
- b) four classes for hardwoods :

- 1 (cabinet making),
 - 2 (joinery),
 - 3 (industry),
 - 4 (rejects)
- three classes for softwoods :
- 1 (framework),
 - 2 (industry),
 - 3 (rejects)
- c) field observations
 - d) only for high forests

Health state of the trees (individual observations) (Etat sanitaire des arbres)

- a) observation of the health state of each tree according to the vegetation aspect (defoliation, yellowing, sap flow, ...)
- b) five classes :
 - 1 (healthy tree),
 - 2 (affection beginning),
 - 3 (clearly declining),
 - 4 (nearly dead),
 - 5 (dead)
- c) field observation
- d) difficult observations for the hardwoods during the autumn, winter and the beginning of the spring

D) Site and soil (Milieu et sol)*Relief (Relief)*

- a) survey of topography type at the site of the sampling unit
- b) eight classes :
 - plateau = ground without slope,
 - dome = flat ground with slopes on each side,
 - side = ground with a regular slope,
 - depression = small valley between two sides,
 - terrace = not extended flat area in a slope,
 - complex relief = many types of relief are present,
 - revised relief = place where the ground has been modified,
 - abrupt = ground with a very hard slope (rock)
- c) field observation
- d) observation possible on map

Exposure (Exposition)

- a) side orientation from the North
- b) nine classes :
 - no orientation,
 - North,
 - N-E,
 - E,
 - S-E,
 - S,
 - S-W,
 - W,
 - N-W
- c) field observation (compass)
- d) if the slope is complex, the axe of the more important slope is only considered

Humus (Humus)

- a) description and classification of the humus considered as station factor
- b) seven categories :
 - (*mull calcique*),
 - mull,
 - (*moder mulleux*),
 - moder,
 - dysmoder,
 - mor,
 - turf
- c) field observation
- d) voluntarily simplified analysis

Soil texture (Texture du sol)

- a) soil description and classification based upon its granulometric composition
- b) nine classes :
 - limon (A)
 - sanded limon (L)
 - light sanded limon (P)
 - sand with limon (S), sand (Z)
 - light clay (E), heavy clay (U)
 - stay limon (G)
 - turf (V)
- c) field observation (based upon a core)
- d) classes similar to those used in soils cartography

Stone type (Nature de la charge caillouteuse)

- a) description of the type of stones found

in the soil

- b) nine types :
 - limestone (k),
 - schist (f)
 - (*phyllade*) (fi),
 - (*grès schisteux*) (r),
 - sandstone (g)
 - (*psammite*) (Lp),
 - chalk (n),
 - (*dragées de quartz*) (o),
 - (*graviers de terrasses fluviales*) (t)
- c) field observations (based upon a core)
- d) classes similar to those used in soils cartography

Drainage (Classe de drainage)

- a) soil classification according to water economy; observation based upon the depth where the first signs of gley and pseudogley are visible
- b) nine classes of drainage :
 - excessive (a)
 - normal (b)
 - moderated (c): pseudogley deeper than 80 cm
 - imperfect (d): pseudogley from 50 cm
 - quite poor (h): pseudogley from 30 cm
 - poor (i): pseudogley before 30 cm
 - quite poor to poor (c): gley deeper than 80 cm
 - quite poor to very poor (f): gley from 30 cm
 - very poor (g): gley before 30 cm
- c) field observations (based upon a core)
- d) classes similar the those used in soils cartography

Soil profil (Type de sol)

- a) classification of the soil profil in the localisation of the sample unit
- b) nine types :
 - degraded brown soil = *sol brun lessivé* (a)
 - brown soil = *sol brun* (h)
 - degraded soil = *sol lessivé, dégradé* (c)
 - degraded calcareous soil = *sol d'altération de calcure* (d)
 - little developed podzol = *sol*

podzolique peu développée (f)

podzol = *podzol (g)*

undefined profile soil = *sol à profil non défini (x)*

undeveloped profile soil = *sol sans développement de profil (p)*

- c) field observations at the sample unit
- d) classes similar to those used in the soils cartography

Vegetation observations (Observations phytosociologiques)

- a) observation and identification of the woody, herbaceous and moss species in the sample unit
- b) three layers: wood subdivided in
 - high level (> 10 m)
 - median level (3 - 10 m)
 - low level (< 3 m)
 herbaceous
moss
- c) field observation
- d) observations in the 18 m radius plot for woody species and in the 9 m radius plot for herbaceous and moss species

E) Forest structure

Stand structure (Structure du peuplement)

- a) classification of the structure of the sampled stand
- b) eight types :
 - high forest with 1 level (layer)
 - high forest with 2 levels (layers)
 - uneven forest
 - plantation
 - young forest
 - coppices with standard
 - coppices
 - undefined structure
- c) field observations
- d) observations realised in the neighbourhood of the sample unit (in the stand which includes the samples plot), to be related to the observations on the aerial plots.

Stand type (Type de peuplement)

- a) classification based upon species in the stand
- b) ten types: stand with
 - beech
 - oak
 - precious hardwoods
 - mixed or others hardwoods
 - spruce
 - Douglas fir
 - larch
 - pine
 - mixed softwoods or other softwoods
 - poplar
- c) field observations
- d) classification based upon an estimation of the proportion of different species which are growing in the stand.

Clear cutting (Mise à blanc)

- a) specific observations for the clear cuttings
- b) collected data:
 - time since cutting
 - stand age at the cutting
 - cutting causes:
 - normal age (exploitability age)
 - premature cutting
 - cutting after storm damages
 - other causes (expropriation, ...)
- c) field observations
- d) -

Complete gap (Vide total)

- a) observation realised when the sample unit is completely located in a gap (= clearing in a stand)
- b) collected data:
 - species of the surrounding stand
 - stand age
 - probably causes of the gap:
 - silviculture (bad cuttings)
 - storm damages
 - diseases
 - other causes
- c) field observations
- d) -

Stand regularity (Régularité du peuplement)

- a) uniformity and homogeneity of the stand from the point of view of the stems distribution on the field
- b) four classes:
 - regular distribution of the stand (good distribution)
 - irregular density (had distribution of the stems in the stand = gaps, high densities, ...)
 - gaps in the stand
 - high density in the stand
- c) field observations
- d) data collected in the stand where the sample unit is located

Sample unit structure (Structure de l'unité d'échantillonnage)

- a) classification of the sample unit structure
- b) eight classes :
 - high forest with one level (layer)
 - high forest with two levels (layers)
 - uneven forest
 - plantation
 - young forest
 - coppice with standards
 - coppice
 - undefined structure
- c) field observations (on the sample unit)
- d) structure independent of the surrounding stand structure

Sample unit type (Type de l'unité d'échantillonnage)

- a) classification of the sample unit based upon the forest species which are identified on the sample unit (measured trees)
- b) ten types: sample unit with
 - beech,
 - oak,
 - precious hardwoods,
 - mixed or other hardwoods,
 - spruce,
 - Douglas fir,
 - larch,
 - pine,

mixed or other softwood,
poplar

- c) classification based upon computer definitions (basal area species)
- d) classification independent of the type of the surrounding stand

Forest species (Espèces forestières)

- a) forest species identification of each measured tree
- b) identification of 33 hardwood species and 15 softwood species
- c) field observations
- d) rare or non-economic species classified as "other softwoods" or "other hardwoods"

F) Regeneration*Stand regeneration (Régénération dans le peuplement)*

- a) description of the natural regeneration in the stand and estimation of the possible necessity to regenerate the stand
- b) four categories:
 - regeneration in progress (good for the future)
 - realised (existing regeneration)
 - none (no regeneration in the stand)
 - should be present (old stand without regeneration)
- c) field observation
- d) observation for the three main regeneration species

Regeneration on the sample unit (Régénération sur l'unité d'échantillonnage)

- a) study of the natural regeneration on the area of the sample unit
- b) three steps of development for the natural regeneration
 - seedling (*semis*) (height less than 1.5 m)
 - thicket (*fouffrés*) (height more than 1.5 m, girth at 1.5 m < 10 cm)
 - sapling (*gaulis*) (height more than 1.5 m, girth between 10 and 19 cm)
- c) field observation
- d) observations and measurements for the three main regeneration species

G) Forest condition

Stand health (Etat sanitaire du peuplement)

- a) observation of the global health state of the whole stand, according to the presence, the frequency and the decline degree of trees
- b) six stand categories based upon the diseased trees number :
 - no diseased tree
 - diseased trees: rare and dispersed
 - diseased trees: rare and grouped
 - diseased trees:
 - 25 to 50 % of the stand
 - 50 to 75 % of the stand
 - 75 % and more of the stand
- c) field observations
- d) observations to correlate with aerial photos which were realised for forest decline study; identification of the decline causes (insects, fungi, undefined) and of the decline development state (initial, progressive, final, all states), ...

II) Accessibility and harvesting

Exploitation conditions (Conditions d'exploitation)

- a) estimation of the stand harvesting conditions based upon the mechanisation possibilities and the distance to a road which can be used by a truck
- b) three types of conditions:
 - easy (flat field, hard soil)
 - difficult because of the slope or the soil
 - impossible
 - estimation of the mean distance to access to a road for truck
- c) field observation, map measurement (m)
- d) the distance is measured from the plot centre

I) Attributes describing forest ecosystems

-

J) Non-wood foods and services

-

K) Miscellaneous

-

2.1.5. Forest area definition and definition of "Other wooded land"

Wooded area are considered and inventoried :

- forests (more than 100 ha)
- woods between 10 and 100 ha
- small woods with area between 10 arcs and 10 ha.

Here is no crown cover specification: as the inventory is based upon a systematic grid which is applied on coloured topographic IGN map, all the sampling points included in the green coloured area are considered as wooded points.

Forest edge is defined as the right line between edge trees and does not follow the crowns covers.

The general aspect of the point and his localisation (town, village, near a big house or a castle) tend to consider this point as "park".

A sampling point located in forest area is considered as productive or not productive point if there is growing trees or not on the sampling unit.

The non-productive forest points are :

- firebreaks
- forestry ways and roads
- unforested area under electric lines
- natural or artificial meadows
- waste area
- heathis, peat bogs, miry and marshy area
- slopes and banks of ways, roads, train lines located in forest area
- quarries in forest area
- nurseries
- arboreta
- ponds and rivers.

The stands with a width lower than 9 m are considered as lines and inventoried with a specific methodology.

Poplar stands (clumps or lines) are inventoried separately. Forest species lines are also considered in the inventory.

Are not sampled the following wooded area, which have no productive function: grounds, ornamental alignments, hedges, lonely trees, Christmas trees plantations.

2.2. DATA SOURCES

A) Field data

- sample plot: general and administrative data
soil and vegetation data
dendrometric data
area estimation

B) Questionnaire

not used.

C) Aerial photography

- (only used if available)
- company Walphot S.A.
 - scale 1:25000 or orthophotoplan 1:10000
 - infrared colour
 - last survey: 1989
 - instrument: common stereoscope
 - incomplete air cover
 - cost per photo: \pm 1200 Belgian francs

D) Spaceborne or airborne digital remote sensing

not used

E) Map

- "Institut géographique national" (IGN),
Abbaye de la Cambre, 13, B-1050 Bruxelles
 - . date : from 1985 to 1996
 - . scale : 1:25000
 - . type : topographic map printed (multicolour)
- "Division Nature et Forêts" (Ministère de la Région Wallonne),
Avenue Prince de Liège, 7, B-5100 Jambes
 - . date: from 1980 to 1995
 - . scale: 1:25000
 - . type: forest map for ownership

F) Other georeferenced data

not used

2.3. ASSESSMENT TECHNIQUES

2.3.1. Sampling Frame

The inventory covers the whole forest of Wallonia, independently of ownership and forest kind. As there is one point per 50 ha wooded land, nearly 10,600 sample units are located in Walloon forest.

Some of these points (about 1 percent) are not accessible for different reasons : relief (high slopes), or impossible approach (point located on an island).

2.3.2. Sampling Units

Field sample plots

- Sample unit composed of four fixed area circular concentric plots :

radius of 2.25 m :	regeneration (girth < 20 cm)
radius of 4.5 m :	high forest with girth from 20 to 69 cm (at the level 1.5 m) coppice (all girths)
radius of 9 m :	high forest (girth between 70 to 119 cm)
radius of 18 m :	high forest with girth of ≥ 120 cm

- Each plot area is calculated from the relation $S = \pi r^2 \cos \alpha$

S = area (m²)
r = plot radius (m)
 α = slope (degree)

These sample plots are circular on the field: no slope correction is realised on the field but is calculated by computer procedures.

- Determination of an "plot expansion factor" to ha for each plot
$$f_{ext} = 10\,000/S$$
$$S = \text{plot area (m}^2\text{)}$$
- Permanent sample unit materialised by a metallic stake in the soil located at the plot centre; 4 trees colour marked ("witness trees"); numbered from 1 to 4 from North to West. All the measured trees are identified by their distance and azimuth from the centre.
- Systematic distribution of the sample units based upon a rectangular grid 1 km*0,5 km (1 km W-E and 0,5 km N-E axes).
- Sample unit centre located by a compass approach from a permanent field point; the azimuth is measured by compass and the distance by a "lost cotton yarn measurer". The covered distances are corrected according to the slope if necessary.

2.3.3. Sampling Designs

The sampling used in the frame of the Forestry inventory of Wallonia is a systematic sampling. No stratification has been defined.

It is important to note that no clusters are used but single plots localised at the knots of the grid.

Aerial photos study is independent of the field work and will only be realised if the necessary documents are available.

The main objectives of the photos study are: stands cartography, area estimation.

2.3.4. Techniques and Methods for Combination of Data Sources

At this time, there is no combination between data obtained by aerial photos and by maps and field measurements.

GIS is nevertheless used for combination data found on maps with these collected in forest:

- province
- forest region
- ecological zoning
- coordinates X and Y
- city or village
- ownership (for public forests).

2.3.5. Sampling Fraction

Data source and sampling unit	proportion of forested area covered by sample	represented mean area per sampling unit
field assessment area sample plots	0.1 %	50 ha

2.3.6. Temporal Aspects

Inventory cycle	Time period of data assessment	Publication of results	Time period between assessments	Reference data
1st IFW	1979 - 1983	1984	-	1980
2nd IFW (permanent)	1994 - 2003	2004 (expected)	10 years	1994

2.3.7. Data Capturing Techniques in the Field

Data recorded on tally sheets in the field and edited by hand into the computer at the office.

2.4. DATA STORAGE AND ANALYSIS

2.4.1. Data Storage and Ownership

The data are stored in a data-base system at the "Ministère de la Région Wallonne" "Direction Générale des Ressources Naturelles et de l'Environnement", "Division de la Nature et des Forêts", Namur (Jambes) who is the owner of the data. (Phone: +32 81 32 12 11, Fax: +32 81 32 12 63).

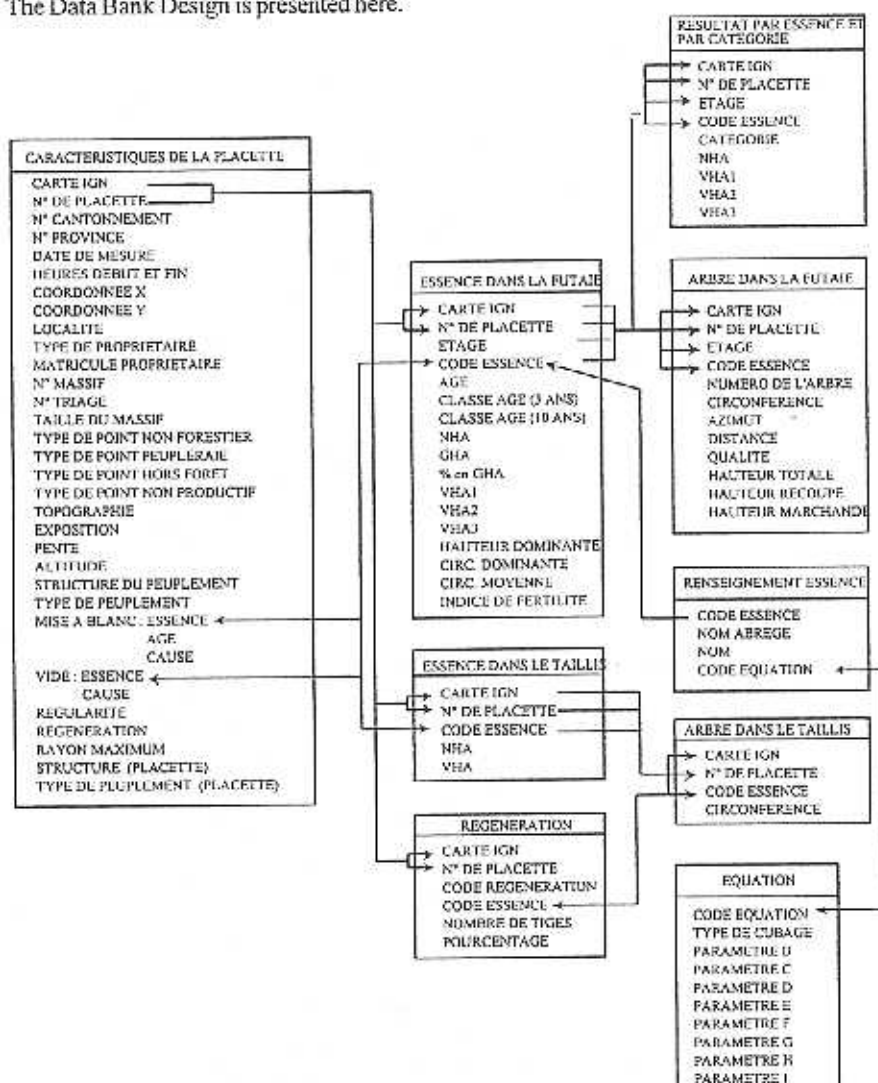
It is possible to ask for the results of the first inventory at the FUSAGx, Gembloux, Prof. J. Rondeux, Phone/Fax: + 32 81 62 23 01; Email: "rondeux@fsagx.ac.be".

2.4.2. Database System Used

The data are stored in an ACCESS database (installed on a PC computer).

2.4.3. Data Bank Design

The Data Bank Design is presented here.



2.4.4. Update Level

For each sample unit, the date of data collection is available. Until now there is no reference date and the data are not updated to a common point in time. They reflect the situation at the time of assessment (the new inventory has started only two years ago). Error estimate is not published.

2.4.5. Description of statistical procedures used to analyse data including procedures for sampling error estimation

a) Area estimation

Area estimations are dealing with forest units identified on a map or a photo but also with some particular results like the area distribution according to the age. For this reason, the adopted area estimation method is dot-counting or point-counting.

$$S_n = n a b$$

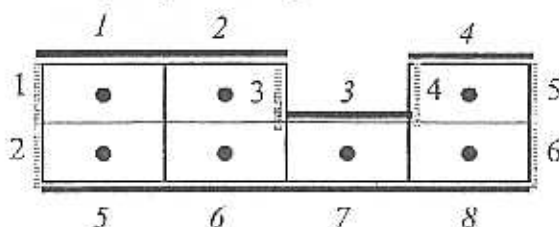
where S_n = area estimation (ha)
 n = number of dots within the area
 a and b = lengths of the grid unit (hm = 0.1 km)

As we use a systematic dot-grid, the standard error cannot be estimated according to the general rules of the random and simple sampling. We have to take into account the form of the area but often we have only the coordinates of the point located inside the area to be estimated. We use the BOUCHON's method (1975) derived from the MATTERON's theory (regionalised variables) and confirmed by PERROTTE in 1981. (See especially BOUCHON, J. and TOMIMURA, S. (1979) Comparaison des mesures de surfaces par comptage de points. Annales des Sciences Forestières 36(4): pp.321-330)

$$\hat{\sigma} = \frac{100}{n} \sqrt{\frac{N_2}{12} + 0.305 \frac{N_1^2}{N_2}}$$

where= $\hat{\sigma}$ =standard error (%)
 n = number of dots within the selected area
 N_1 = values obtained by separate addition of the number of horizontal and vertical grid unit sides located along the perimeter of the area formed by all the grid units build around the selected dots. N_1 is the larger of both values.

The best way is to give an example.



In this case, we have

$$\begin{aligned} n &= 7 \\ S_n &= 7 a b \\ N_1 &= 8 \\ N_2 &= 6 \end{aligned}$$

$$\hat{\sigma} = \frac{100}{7} \sqrt{\frac{6}{12} + 0.305 \frac{8^2}{6}} = 13\%$$

b) Aggregation of tree and plot data

The aggregation of single tree data is done by weighting each single tree attribute by its plot expansion factor. As we use concentric sample plots, the plot expansion factors are different for each sub-plot and take into account the slope α .

Girth at 1.5 m (c)	Sample plot radius	Plot expansion factor (w)
< 20 cm	2.25 m	628.8 / $\cos(\alpha)$
20 - 69 cm	4.5 m	157.2 / $\cos(\alpha)$
70 - 119 cm	9 m	39.30 / $\cos(\alpha)$
> 120 cm	18 m	9.824 / $\cos(\alpha)$

The total values for one plot can be calculated by summing the single tree attributes multiplied by their plot expansion factor. As an example, the estimation of the volume per ha VHA for the sample plot i is computed as follows

$$VHA_i = \sum_j v_{ij} w_{ij}$$

where v_{ij} is the volume estimation for the tree j of the sample plot i and w_{ij} is the plot expansion factor for the tree j of the sample plot i .

In the same way, we can compute the arithmetic mean girth for the sample plot i :

$$\bar{c}_i = \sum_j c_{ij} w_{ij} / \sum_j w_{ij}$$

c) Estimation of total values

From n points selected from our database according to different criteria, we can compute the various mean values (VHA, GHA, NHA) with their standard errors

$$\bar{y} = \frac{1}{n} \sum_{i=1}^n y_i \quad \text{and} \quad \hat{\sigma}_y = \sqrt{\frac{\sum_{i=1}^n (y_i - \bar{y})^2}{n(n-1)}}$$

as each estimation gained from the different n points has the same weight. The total value for the area S_n is estimated as follows

$$Y_{tot} = \bar{y} S_n$$

As far as we can consider \bar{y} and S_n as independent variables, the standard error of y_{tot} can be computed as

$$\hat{\sigma}_{y_{tot}} = \sqrt{\hat{\sigma}_y^2 \hat{\sigma}_{S_n}^2 + \hat{\sigma}_y^2 S_n^2 + \hat{\sigma}_{S_n}^2 \bar{y}^2}$$

and generally simplified as

$$\hat{\sigma}_{y_{tot}} = \sqrt{\hat{\sigma}_y^2 S_n^2 + \hat{\sigma}_{S_n}^2 \bar{y}^2}$$

d) Estimation of ratios

As all our estimations (volume per ha, number of stems per ha, ...) are linked to the centre of the plot (point sampling), we never have an estimation of ratio. As an

is a random variable which takes a different value for each plot depending on the coordinates of the centre of the plot. It is not the estimation of a ratio. For the other kinds of ratio like proportion of two areas, the information on standard value is given only for the area, not for the ratio.

e) Sampling at the forest edge

If necessary, the centre of the sample plot is shifted in such a way that the whole plot is just included in the stand where the centre of the plot was initially located. When it is not possible (stand too narrow), the plot area is adapted and the plot expansion factors are corrected (very rare situation).

f) Estimation of growth and growth components (mortality, cut, in growth)

No definitive decision has been taken on this subject. In fact, our permanent forest inventory has started in 1994 with a 10 years periodicity. The next occasion at an old place is planned in 2003.

g) Allocation of stand and area related data to single sample plots/sample points

We have chosen the "point decision": as we can move the centre of the sample plot in order to have the whole plot in the same stand, it is not necessary to assign information to a proportion of the plot area. In case of several species (mixed stand), information is distributed in proportion of the basal area of each species.

h) Hierarchy of analysis: how are sub-units treated?

Many selections of points can be produced according to the species, the kind of owner, the administrative division, ... but also the age, the altitude, the slope, the mean distance to the nearest road or the importance of damage. All these kinds of selections are treated as a whole. The only problem is to aggregate enough points to get relevant estimations. Generally, 30 sample points are considered as a minimum.

2.4.6. Software Applied

Home made software developed with MS-Access

2.4.7. Hardware Applied

Data capture: paper sheet
Data storage: PC pentium 100 Mhz, 16 Mega RAM, 1 Giga HD
Data analysis: idem
Operating system: Window

2.4.8. Availability of Data (Raw and aggregated data)

All data can be available for anyone with the authorisation of the Walloon Region. The database cannot be consulted directly but results tables can be obtained from the IFW service.

For special requests with specific analysis and/or program, costs will be added to the user.

2.4.9. Subunits (Strata) Available

Results are available for the Walloon Region, the five provinces and for the "cantonnements" (units of the forest administration). It is possible to obtain results for forest regions, cities or villages (if these contains enough sample units).

Results are also available for other criteria, by example: ownership, structure and type stand, forest species, age, slope classes, soil types, wood quality, girth and height or productivity classes, ...

All the information, observations and variables collected may be used as selection criteria to present results.

2.4.10. Links to other information sources

Topic and spatial structure	Age/period availability	Responsible agency	Kind of data-set
maps for public ownership and cantonnements	permanent	DNF	map
maps for provinces, cities, villages and forest regions	permanent	IGN	map

2.5. RELIABILITY OF DATA

2.5.1. Check Assessments

No field check.

2.5.2. Error Budgets

Only statistic errors are considered and estimated. Classification and measurement errors are not included in the work.

2.5.3. Procedures for Consistency Checks of Data

When the data are collected on the field plot, a first check is realised by the field team, in order to verify if all the information, observations and measures are collected and are correct.

A new control is done at the office when the tally sheets arrive from the forest; data is recorded in the database and just after this operation, a new complete checking is realised by another operator so that all the data are verified one by one to eliminate recording errors.

Some procedures have been introduced in the software in order to detect possible errors (especially for measurement attributes) by searching limit values and by plotting correlated variables.

2.6. MODELS

2.6.1. Volumes

a) Outline of the model

Volumes are calculated from volume tables created for 13 main species. For the other species, the most suitable is chosen. The volume is the solid wood volume of the stem over bark (until 7 cm diameter of the stem). Branch volumes are not included.

Three volume tables are used :

- volume table based upon the girth at 1.5 m level
- volume table based upon the girth and the dominant height
- volume table based upon the girth and the total height for each tree

The single tree volume equations have been published in 1985 by "*Les presses agronomiques de Gembloux*" under the title "*Tarifs de cubage des arbres et des peuplements forestiers*" and signed by DAGNELIE P., PALM R., RONDEUX J. and THILL A.

N°	Main species	Species treated as main species
1	Beech	Hornbeam, others hardwoods, hazel, elders
2	Birch	Aspen, Willows
3	Scots pine	All pines
4	Elm	
5	Wild cherry	Walnut, crab tree, pear tree
6	Larch	
7	Ash	Sorb
8	Sycamore maple	All maples, lime
9	Spruce	Stick spruce, Tsuga, Thuya, Cypress, other coniferous
10	Douglas fir	All firs
11	Red oak	
12	Oak	Alders
13	Poplar	All poplars

b) Overview of prediction errors

No model.

c) Data material for deviation of model

Volumes tables constructed from measurements of nearly 7,000 (exactly 6,800) trees in the Walloon forests (DAGNELIE *et al.*, 1985: p 15).

d) Method applied to validate the model

Due to the large quantity of measurements, no validation has been conducted with external data.

2.6.2. Assortments

At stand level, assortment volume table is available for spruce (according to the stand mean girth) (DAGNELIE, PALM, RONDEUX and THILL., 1988. Tables de production relatives à l'épicéa commun, Les presses agronomiques de Gembloux. 123 p.). At tree level, various assortment volume tables are available for all the main species (12) (DAGNELIE *et al.*, 1985)

2.6.3. Growth components

Site index for two species is identified, based upon age and dominant height of the stand (reference age : 50 years).

Yield tables are used for spruce and Douglas fir, as "stands models".

References:

- for spruce: Dagnelie, P., Palm, R., Rondeux, J. & Thill, A., 1988. Tables de production relatives à l'épicéa commun, Les presses agronomiques de Gembloux. 123 p.
- for Douglas fir: Rondeux, J., Laurent, C. and Thibaut, A., 1991. Construction d'une table de production pour le douglas (*Pseudotsuga menziesii* (Mirb.) Franco) en Belgique, Les Cahiers forestiers de Gembloux 3. 23 p.

2.6.4. Potential yield

The method is defined for species treated in even-aged stands. The needed information are area and volume per ha for all the age classes, growth model like yield table and a silviculture model giving the proportion of clean cutting for each age class.

Our method is described in HEBERT, J. and LAURENT, C., 1995. Estimation de la disponibilité de la ressource forestière. *Revue Forestière Française* 47 (5): pp.572-580.

2.6.5. Forest functions

2.6.6. Other models applied

Single tree model is available for beech.

2.7. INVENTORY REPORTS

2.7.1. List of published reports and media for dissemination of inventory results

Inventory	Year of publication	Citation	Language	Dissemination
First IFW	1981	Principaux résultats relatifs à l'inventaire des massifs forestiers de la province de Liège. FSAGx, Gembloux. 47p.	French	printed
	1982	Principaux résultats relatifs à l'inventaire des massifs forestiers de la province de Luxembourg. FSAGx, Gembloux. 64 p.	French	printed
	1983	Principaux résultats relatifs à l'inventaire des massifs forestiers de la province de Namur. FSAGx, Gembloux. 65 p.	French	printed
	1983	Principaux résultats relatifs à l'inventaire des massifs forestiers de la province du Hainaut et du Brabant Wallon. FSAGx, Gembloux. 47 p.	French	printed
	1984	La pessière wallonne en chiffres. Bull. Soc. R. For. Belg. 91 (3): pp. 89-98	French	printed
	1984	Principaux résultats relatifs à l'inventaire des massifs forestiers de la Région Wallonne. FSAGx, Gembloux. 66 p.	French	printed
	1984	Guide méthodologique de l'Inventaire Forestier Wallon, FSAGx. 170 p.	French	printed
	1985	Quelques considérations chiffrées sur la forêt feuillue wallonne. Annales de Gembloux 92: pp. 111-125	French	printed

	1986	Quelques statistiques récentes sur la forêt wallonne. Bull. Soc. R. For. Belg. 93 (1):1-22	French	printed
	1988	Considération sur la structure actuelle des hêtraies en Ardenne et Région jurassique (Implications en matière de traitement sylvicole). Bull. Soc. Roy. For. Belg. 95 (6):279-293	French	printed
	1991	La pessière wallonne : son évolution entre 1980 et 1990. Sylva Belgica 1992, 99 (4):7-14	French	printed
Second IFW (new since 1994)	1994	Comparaison de plusieurs types d'unités d'échantillonnage dans la perspective d'un inventaire forestier régional. Forestry Chronicle 70 (3):304-310	French	printed
	1994	L'inventaire forestier régional wallon: brève présentation méthodologique. Sylva Belgica 101 (6):9-16	French	printed
	1995	L'inventaire forestier régional: un outil de développement régional. Wallonie, 34:3-8	French	printed
	1996	Inventaire des Ressources Ligneuses de Wallonie. Guide méthodologique. Faculté Universitaire des Sciences Agronomiques de Gembloux, Gembloux. 208 p.	French	printed

2.7.2. List of contents of latest report and update level

Reference of the latest complete report (which contains results about the whole Wallonia): Principaux résultats relatifs à l'inventaire des massifs forestiers de la Région Wallonne. Faculté des Sciences agronomiques de Gembloux. 66 pp. (1984).

Chapitre	Titre	Nombre de pages
1	Présentation générale	2
2	Caractéristiques générale de l'inventaire	1
3	Nature des données récoltées	1
4	Traitement et exploitations des données	2
5	Détermination et contrôle des surfaces boisées	13
6	Quelques résultats types relatifs à l'inventaire	41
7	Conclusions	2
8	Bibliographie	2

2.7.3. Users of the results

Main users of the results of the inventory:

- "Division de la Nature et des Forêts" (forestry administration)
- industry:
 - paper mills,
 - panel factories,
 - sawmills
- members of the forest sector
- private experts
- scientific members (research centres and teaching faculties).

Main questions are put by the industry and the forestry administration.

2.8. FUTURE DEVELOPMENT AND IMPROVEMENT PLANS

The new Walloon forest inventory is planned to be realised between 1994 and 2003. The data collected and analyses procedures will be slightly modified but no important change will be made in a next future. The checking of the field assessment by an independent team will be organised.

The realisation of the inventory is guaranteed by a regional act.

2.9. MISCELLANEOUS

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THE FLEMISH REGION

1. OVERVIEW

1.1. GENERAL FORESTRY AND FOREST INVENTORY DATA

Total Flemish area:	152,730 ha with poplar 128,577 ha without poplar
Proportion of forested land:	11.3 % (9.5 without poplar)
Main tree species:	hardwoods 49,562 ha (32.4 %) poplar 25,153 ha (16.5 %) softwoods 53,608 ha (35.1 %) mixed 15,339 ha (10.0 %) bare terrain 9,069 ha (6.0 %)
Average volume per hectare:	N.A.
Average increment per hectare:	N.A.
Ownership proportion:	public forests: 35,856 ha (23.5 %) private forests: 116,874 ha (76.5 %)
Number of inhabitants per hectare forested land:	38.4 (45.6 without poplar)
Average size of a stand:	N.A.

Name of the survey: **Forest inventory of the Flemish Region**
(*Bosinventarisatie Vlaams Gewest*)

First assessment: First field data collected 1 January 1997

Area covered: Flemish Region

Institutes and organisations involved in the assessments:

Faculty agricultural and applied biological Sciences, University of Gent
(Belgium)
(*Faculteit Landbouwkundige en Toegepaste biologische wetenschappen*
Rijk Universiteit te Gent)

1.2. OTHER IMPORTANT FOREST STATISTICS

See item 1.2 in the report for the Walloon Region.

2. FOREST INVENTORY OF THE FLEMISH REGION

(Bosinventarisatie Vlaams Gewest)

The following information comes out the publication "Concept bosinventarisatie Vlaams Gewest" (Fac. Landbouwkundige en Toegepaste biologische wetenschappen, Gent, Juli 1995. 80 p.)

2.1.1. List of attributes directly assessed

Attribute	Data source
Date of the assessment (<i>opnametijdstip</i>) year (<i>jaar</i>) month (<i>maand</i>) day (<i>dag</i>)	(field)
Administrative data (<i>administratieve gegevens</i>) province and locality (<i>provincie en gemeente</i>) administrative district (<i>bestemming</i>) function (<i>bestemming</i>)	(map)
Ownership (<i>eigenaarscategorie</i>) state (<i>staat</i>) region (<i>gewest</i>) province (<i>provincie</i>) locality (<i>gemeente</i>) other public owners (<i>overige publiekrechtelijke eigenaars</i>) private (<i>privé</i>)	
Stand type (<i>opstand type</i>) hardwoods (<i>loofhout</i>) softwoods (<i>naaldhout</i>) mixed hardwoods (<i>gemengd loofhout</i>) bare terrain (covers recently harvested areas, as well as fire-devastated blocks or simple bare soils) (<i>te bebossen oppervlakten</i>) open area (includes areas of a forest complex having no timber production function) (<i>overige oppervlakten behorend tot het bosdomein</i>)	(field)
Age and development state (<i>leeftijd and ontwikkelingsfase</i>) age classes: 0 1-10 11-20 21-40	(field)

41-60
61-80
81-100
101-120
121-140
141-160
> 160

uneven aged

development steps:

null step or deforested area (*onbeboss*)

first step (*jongwas*) tot complete cover (height \geq 2m)

second step (*dichtwas*) from complete cover to 7 cm dbh

third step (*stookhout*) 7 cm < dbh \leq 14 cm

forward step (*boomhout*) dbh > 14 cm

Structure (*structuur*)

high forest (*hooghout*) vertical: 1 or more levels

horizontal: individual, in groups, homogeneous

coppice with standards (*middelhout*)

coppice (*hakhout*)

to be determined (= bare terrain) (*te bepalen*)

not applicable (= open areas) (*niet van toepassing*)

Crown cover (*sluitingsgraad*)

(field)

<1/3

1/3-2/3

>2/3

not applicable (*niet van toepassing*)

Dendrometric measures and data

(field)

(*dendrometrische gegevens*)

tree coordinates (*coördinaten van de boom*)

tree species (*boomsoort*)

girth at 1.5 m (*omtrek op 1,5 m*)

level (*stade*)

height (*totale hoogte*)

bark thickness (*schorsdikte*)

branch free height (*takvrije stamlengte*)

Coppice (*hakhout*)

tree species (*boomsoort*)

girth at 1.5 m (*omtrek op 1,5 m*)

Coppice with standards (*middelhout*)

same data as high forest and coppice

Regeneration (*verjonging*)

tree species (*boomsoort*)

regeneration type (*verjongingswijze*):

natural

artificial

mixed

number of stems (<i>aantal bomen</i>):	
< 500	
500 - 1499	
1500 - 2499	
2500 - 4999	
5000 - 9999	
> 10000	
mean height (<i>gemiddelde hoogte</i>):	
0 - 50	
50 - 100	
100 - 150	
150 - 200	
> 200	
distribution: individual, in groups, homogeneous	
Quality (<i>kwaliteit</i>)	(field)
four classes:	
A cabinet making (<i>schil- en fineerhout, meubelhout</i>)	
B joinery (<i>constructiehout</i>)	
C industry (<i>industriehout</i>)	
D rejects (<i>pulphout, spaanders, brandhout</i>)	
Vegetation (<i>vegetatie type</i>)	(map)
data collected on vegetation map	
Site conditions (<i>standplaats</i>)	
soil type	
texture (<i>textuurklasse</i>)	
drainage (<i>drainageklasse</i>)	
profil (<i>profielontwikkeling</i>)	
data collected from soil map (<i>gegevens van bodemkaart</i>)	
topography (<i>topografie</i>)	
altitude (<i>hoogteligging</i>)	on map (topographic map)
slope (<i>helling</i>)	on field
exposure (<i>expositie</i>)	on field
Health state (<i>gezondheidstoestand</i>)	
data collected by "Instituut voor Bosbouw en Wildbeheer" (grid of 4*4 km)	
Social function of the forest	
accessibility (<i>toegankelijkheid</i>)	
opening (<i>opening</i>)	
relaxation infrastructure (<i>recreatieve infrastructuur</i>)	
waste (<i>afval</i>)	
penetration of the forest out of the paths (<i>hetreding buiten de paden</i>)	
enclosures (<i>omheiningen</i>)	
proximity of coffee shops, riding schools, sport clubs, ... (<i>nabijheid van horeca, maneges, sportclubs</i>)	

2.1.2. List of Derived Attributes

Tree parameters (*boomparameters*)

- mean girth (*gemiddelde omtrek*)
- mean height (*gemiddelde hoogte*)
- mean bark thickness (*gemiddelde schorsdikte*)
- mean branch free height (*gemiddelde takvrije stamlengte*)

Stand parameters (*bestandsparameters*)

- number of stems (N) (*stamtal*)
- girth distribution (*stamtalverdeling*)
 - < 19 cm
 - 20-29 cm
 - 30-39 cm
 - ...
 - 140 - 149 cm
 - 150 - 159 cm
 - > 159 cm

Data collected from

- basal area (G) (*bestandsgrondvlak*)
- dominant height (*dominante hoogte*) (Hdom)
- timber volume (*werkhout volume*)
 - calculated from volume tables

Dead trees (*dood hout*)

- number (*aantal*)
- mean girth (*gemiddelde omtrek*)
- mean height (*gemiddelde hoogte*)

2.1.3. Measurement Rules for Measurable Attributes

See above or not available.

2.1.4. Definitions for Attributes on Nominal or Ordinal Scale

See above or not available.

2.1.5. Forest area Definition and Definition of "Other Wooded Land"

Forest area :

- area \geq 50 ares
- width \geq 25 m
- cover \geq 20 % (excepted for clear cutting or forest damages).

2.2. DATA SOURCES

- A) field: see above
- B) Questionnaire: not used
- C) Photos: orthophotoplans scale 1:5000 infra-red colour
- D) Spaceborne or airborne digital remote sensing: not used
- E) Maps : maps realised by the Flemish Region mapping ("*Boskartering van het Vlaamse Gewest*") :
1. map (base map) with administrative boundaries, roads, ways, ...
 2. stand type map
 3. stand development map with development stage, crown cover, structure
 4. ownership map
 5. topographic map

Map available in digital or analogue format (scale for 1:5000 to 1:25000).

F) Other georeferenced data :

- soil maps (1:20000),
- topographical maps (1:50000),
- land use planning map (1:25000) (*gewestplannen*) (maps with indications of the function/destination (*bestemming*) of the land, for example agriculture, forestry, residential area, nature reserve),
- vegetation map (1:25000) (*biologische waarderingskaart*)

2.3. ASSESSMENT TECHNIQUES

2.3.1. Sampling Frame

The inventory covers the whole forest of Flemish Region, independently of ownership.

2.3.2. Sampling Units

3 circular plots :

- 1) $r=2.25$ m
seedlings with 20 cm total height < 2 m
- 2) $r=4.5$ m
coppice
trees with girth at 1.5 m < 22 cm and total height ≥ 2 m
- 3) $r=18$ m
trees with girth at 1.5 m ≥ 22 cm and total height ≥ 2 m

2.3.3. Sampling Designs

Two phases are proposed :

- phase 1: wooded/non wooded area classification from "Vlaams boskartering" maps
- phase 2: field work on the points localised in forested area. Grid of 1 km*0.5 km.

2.3.4. Techniques and Methods for Combination of Data Sources

Use of a GIS ARC/INFO and a database management system.

2.3.5. Sampling Fraction

Grid of 1 km*0.5 km

Proportion of forested area covered by sample: 0.1 %

Represented mean area per sampling unit: 50 ha

2.3.6. Temporal Aspects

Three field teams together for a three-years data collection.

2.3.7. Data Capturing Techniques in the Field

A Microflex 9500 field computer will be used.

2.4. DATA STORAGE AND ANALYSIS

2.4.1. Data Storage and Ownership

Data are stored in a data base system.

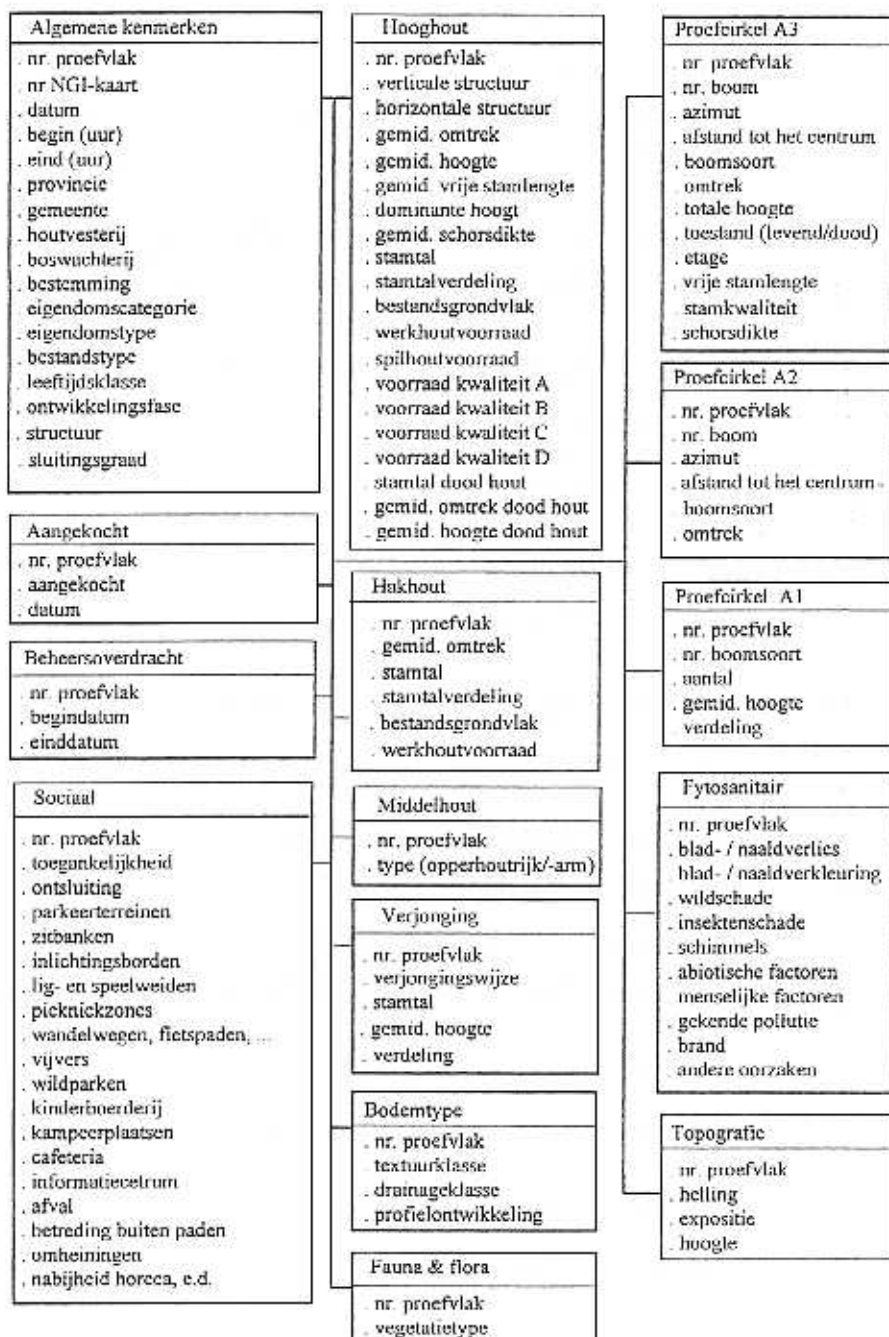
Ownership: "Afdeling Bos en Groen" (Flemish Forestry Commission).

2.4.2. Database System Used

Relational databasc.

2.4.3. Data Bank Design

See table next page.



Structure database for the forest inventory in the Flemish region.

2.4.4. Update level

-

2.4.5. Description of Statistical Procedures Used to Analyse Data

The Flemish Forest Inventory will use the well-known statistical procedures for random sampling since the plots defined in the systematic sampling are far enough from each other.

An "a posteriori" stratification could be considered with the appropriate procedures.

2.4.6. Software Applied

- ARC/INFO geographic information system
- database management system
- word processor software
- graphics spreadsheet

2.4.7. Hardware Applied

- workstation
- PC 80586
- plotter
- laser printer
- digitising table.

2.4.8. Availability of the Data

-

2.4.9. Subunits (static) Available

-

2.4.10. Links to Other Information Sources

Links exist with maps realised by the Flemish forest mapping (Boskartering van het Vlaams Gewest) and with data collected by the "Instituut of Forest and Wildlife" (Instituut voor Bosbouw and Wildbeheer) in relation to the health state of the forest.

2.5. RELIABILITY OF DATA

Information not available.

2.6. MODELS

Information is only available for volume estimation.

Volume tables are used for determination of timber volume.

DAGNELIE, PALM, RONDEUX and THILL., 1985. Tables de cubage des arbres et des peuplements forestiers. Les Presses Agronomiques de Gembloux, Gembloux. 148 p. For birch, oak, red oak, maple, ash, beech, wild cherry, elm, spruce, Douglas fir, larch, scots pine.

FABER and DIK., 1968. De samenstelling van inhouds- en opbrengsttabellen voor *Pinus nigra* Arm. in Nederland. Stichting Bosbouwproefstation "De Dorschkamp", Wageningen. 78 p. For Corsica pine.

FABER and TIEMENS., 1975. "De opbrengstniveaus van populier". Rijksinstituut voor onderzoek in de bos- en landschapsbouw "De Dorschkamp", Wageningen. 117 p. Birch volume tables are used also for willow and alder.

Ash volumes tables are used for other hardwoods and spruce volumes tables are used for other softwoods.

2.7. INVENTORY REPORTS

Vandenbil, V. & Janssens, F., 1989. Een inventarisatienet voor de bossen in Vlaanderen, Een eerst survey. Ministerie van de Vlaamse Gemeenschap, Dienst Waters en Bossen. 120 p.

Waterinckx, M., 1990. Simulatie van een systematische bemonstering tbv de bosinventarisatie in het Vlaamse Gewest. Afstudeenwerk. Faculteit van de Landbouwwetenschappen, R.U.G. 84 p.

Waterinckx, M. & Goossens, R., 1995. Concept bosinventarisatie Vlaams Gewest. Faculteit van Landbouwwetenschappen, R.U.G. 80 p.

2.8. FUTURE DEVELOPMENT AND IMPROVEMENT PLANS

A forest inventory in the Flemish Region is planned for the next months. The report which has been used to write this paper contains a lot of propositions in order to carry out this inventory.

No more information is available at this time.

2.9. MISCELLANEOUS

THE BRUSSELS REGION

The Brussels region has a total forest autonomy but because of its size, there is no statistical inventory.

1. OVERVIEW

1.1. GENERAL FORESTRY DATA

Total forest area: 2,008 ha

Proportion of forest land: 12.4 %

Main tree species: beech

Ownership proportions:	public forest	1,940 ha (97 %)
	private forest	68 ha (3 %)

No other data available.

Information source:

Institut Bruxellois pour la Gestion de l'Environnement, Service Espaces Verts,

Eaux et Forêts. X. LEJEUNE

Gulledelle 100, 1200 Bruxelles

Phone : 32 2 775 77 37 ; Fax : 32 2 775 76 11

1.2. OTHER IMPORTANT FOREST STATISTICS

See report for the Walloon Region.

2. NO FOREST INVENTORY