1 GENERAL INTRODUCTION

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1.1 Definition

Forests of Scots pine and Norway spruce are distributed far beyond their assumed natural range in Europe. Currently Norway spruce has a share of 21% in the total European forest area (thirty countries), Scots pine one of 31% (Spiecker *et al* 2004). Also in Belgium large surfaces of homogenous conifer plantations are on sites naturally dominated by broadleaved species. In Flanders, this concerns about 33,500 ha of Scots pine (*Pinus sylvestris*) and 11,500 ha of Corsican pine (*Pinus nigra var. laricio*) stands on sandy soils (Afdeling Bos & Groen 2001a). In Wallonia, pure Norway spruce (*Picea abies*) stands occupy 172,400 ha (Le Comte *et al* 1999).

Forest conversion is the sylvicultural process of changing the tree species composition from one dominated by conifers to one dominated by native broadleaves.

The changes in forest tree species composition have an impact on the functioning of the forest ecosystem: wood production as well as biogeochemical cycling, biodiversity and resistance against disturbances. Almost all goods and services provided by forests are directly or indirectly affected, including the income of forest owners, the perception by forest users as well as significant environmental services (Spiecker *et al* 2004).

1.2 Feasibility of forest conversion: ecological, social and economic

Forest conversion could be a very strong policy tool with high potentials: (i) as an effect-oriented measure in stopping forest (soil) degradation driven by exogenous emissions, (ii) conservation and protection of biodiversity and (iii) as a technical intervention to raise the economic outcome of forest management. The FEFOCON research project addressed these points and results are given in Chapter 2 and Chapter 3 Ecological feasibility and Chapter 6 Economic feasibility. But, as will become clear from the following sections of this Chapter 1 General Introduction, most of the forests in Belgium and also the secondary conifer plantations are privately owned. At present, little information is available on the readiness to convert by private forest owners, nor on the optimal strategies for the government to encourage it. Both sociological and economical aspects of forest (conversion) management for small private forest owners in Flanders were investigated in the FEFOCON research project and results are given in Chapter 4 Sociological feasibility and Chapter 1 Economic feasibility. Forest policy recommendations concerning conversion result from this research are given in Chapter 6.

The following sections of this introductive chapter address the current situation of secondary conifer forests in Belgium, the ownership situation, the history, the sylvicultural context of management goals and scenarios of conversion and a brief overview of the forest policy aspects relevant to conversion in Flanders.

1.3 Forest situation in Belgium

Pine forest statistics in Flanders (Afdeling Bos & Groen 2001a)

Of the total Flemish forest area of 146,000 ha, homogeneous stands[1] of Scots pine cover 22.7% or 33,140 ha and 11,680 ha or 8% consists of homogeneous Corsican pine stands. The ecoregion of the Kempen, covering the Northeast of Flanders, contains 90% of these stands with 35% of its area being Scots pine stands and around 10% Corsican pine (Figure 1-1). The distribution of pine plantation in Flanders is obviously linked to poor sandy soils.

[1] A forest stand is homogeneous when one tree species occupies more than 80 % of the basal area (Bos & Groen 2001a).

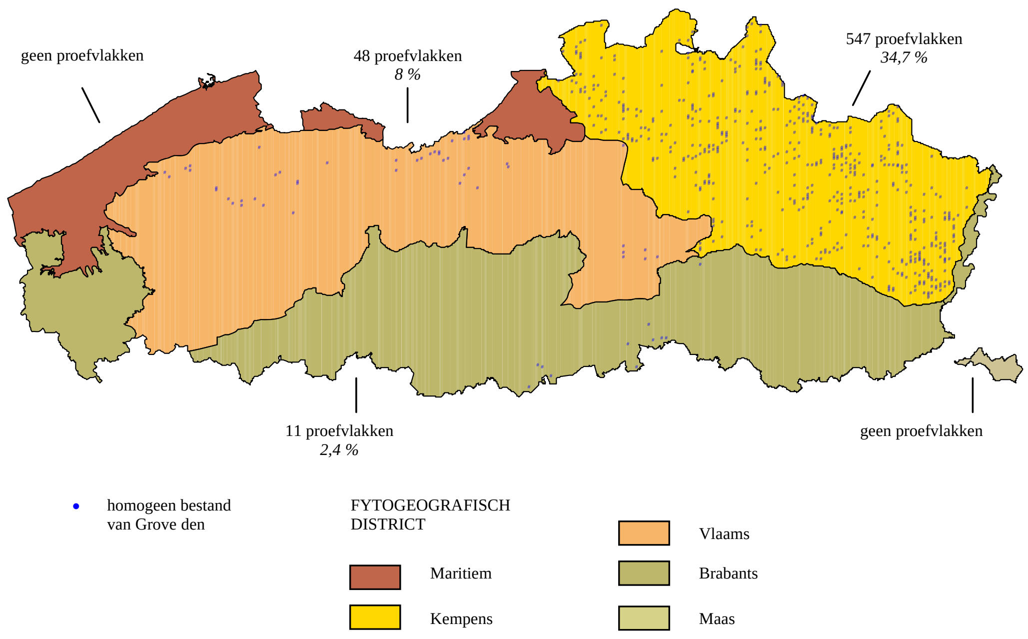

Figure 1-1: Distribution of grid points covered with homogeneous Scots pine stands. The Kempen ecoregion covers the northeast of Flanders (yellow).

The age distribution of Scots pine stands reveals their history: less than 5% of the homogeneous Scots pine stands is under 20 year old, 55 % is between 20 and 40 years old, 35% is older than 40 years and less than 5 % is multiple aged. 75 % of Corsican pine stands is under 40 years old. Public owners have on average a bit fewer older Corsican pine stands (15% as compared to 30% of the stands is over 40 years old). This may be due to continued planting of heathlands by municipalities and to strict clear cutting and replanting management schemes in public forests that continued to be practiced through the late 1970's, some time after the profitability of this practice fainted (see Section 1.5.1).

Of the homogeneous Scots pine stands, 2/3rd has an understorey and natural seedlings. The most common species in the understoreys and among the seedlings are rowan (*Sorbus aucuparia*), black cherry (*Prunus serotina*), birch (*Betula pendula* and *B. pubescens*), (alder) buckthorn (*Frangula alnus*), pedunculate oak (*Quercus robur*), red oak (*Quercus rubra*) and seedlings of both pine species themselves.

The main stand parameters of Scots and Corsican pine stands are shown for private and public forests in Table 1-1. From the higher stem number in private forests for a comparable age distribution (in general older forest stands tend to have less trees), the lower intensity (or the absence) of thinning measures is revealed. This also explains the higher amount of standing dead wood in private forests, because when no trees are removed in dense forest stands, suppressed trees die naturally.

Table 1-1: General stand parameters of homogeneous Scots pine and Corsican pine stands in Flanders.

		Scots pine		Corsican pine	
		Private	Public	Private	Public
Stem number	/ha	759	583	1272	1120
Basal area	m²/ha	29	24	41	34
Stem volume	m³/ha	231	197	329	258
Standing stock	1000m³	4402	2801	1748	1813
Standing dead wood	m³/ha	4.1	2.3	7.2	2.3

Norway spruce forest statistics in Wallonia (Le Comte et al 1999)

During the 1980's, the area covered by Norway spruce reached a maximum of nearly 200,000 ha, *i.e.* 37 % of forested area (545,000 ha) in Wallonia. Afterwards, concerns about the environmental impact of conifer monocultures have slowed down the extension of Norway spruce plantations. A potential degradation of soil fertility and a change in the hydrological balance were mentioned as negative consequences of conifer forestry. Other negative aspects of Norway spruce stands are their sensitivity to storm and pest outbreaks. Moreover, dense conifer monocultures are sometimes perceived as 'ecological deserts', inconsistent with a multifunctional forest management. These potential negative impats of Norway spruce plantations, the dieback symptoms observed since the 1980's and the storm events of 1990 in Belgium are responsible for the present reduction of Norway spruce stands in Wallonia. The decrease of young Norway spruce stands (less than 20 yrs old) is even more pronounced.

In 1999, homogeneous stands of Norway spruce ("pessières") occupied 172,400 ha (36% of the total forest area) in the Walloon Region. Within this area, 1600 ha of stand openings and 11,700 ha of clear cuts are included. Of the homogeneous Norway spruce stands 58% is owned by private owners. 90% of these stands are in the Ardenne ecoregion, where they occupy 52% of the forests (see Table 1-2). The standing volume increased by 11% as compared to 1984. The distribution of Norway spruce in Wallonia is obviously linked to altitude (Table 1-3).

Table 1-2: Distribution of homogeneous Norway spruce stands in the ecoregions of Wallonia

Ecoregion	**Area**			**Standing volume**
	(ha)	**(%)**	**(% within ecoregion)**	**(m^3 x 1.000)**
Sandy loam region	0	0.0	0.0	0
Löss region	700	0.4	2.5	128
Condroz	4,600	2.7	7.4	1,333
Famenne	5,400	3.1	10.2	955
Ardenne	155,400	90.1	52.0	42,470
Jurassic region	6,300	3.7	20.9	1,372
Total Wallonia	172,400	100	36.1	46,258

Table 1-3: Distribution of homogeneous Norway spruce stands in Wallonia over altitude layers

Altitude (m)	**(%)**
under 200	2.3
200-299	8.8
300-399	25.3
400-499	36.8
over 500	26.7

Only 8% of the homogeneous Norway spruce stands are over 70 years old. One third of the stands are younger than 30 years. The age distribution of stands shows two waves of plantation in private forests: the first after World War II and especially in the 1960's, and the second in the 1990's on wind throw sites (Figure 1-2). The age distribution of homogeneous Norway spruce stands in public forests is more even, although stands over 70 years are rare, with the exception of some thousand hectares of spruce stands over 100 years.

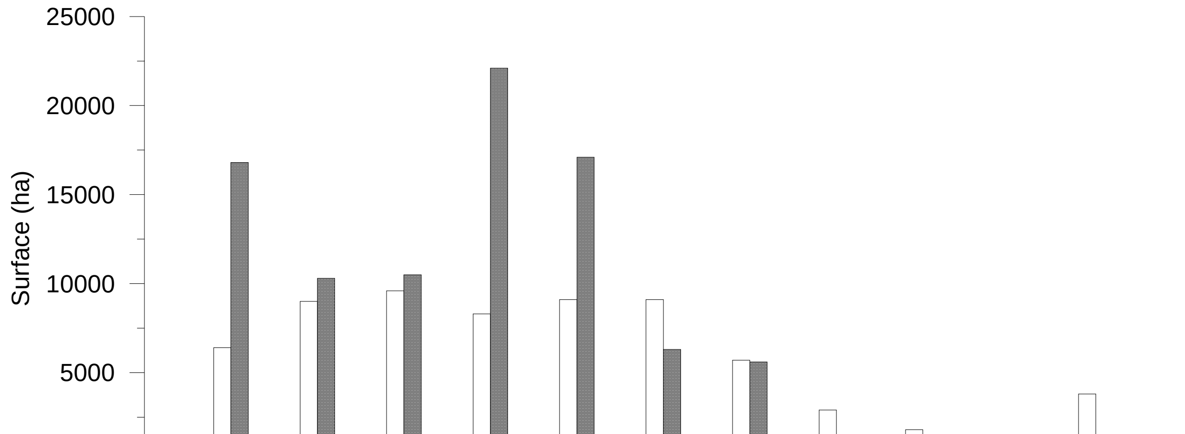

Figure 1-2: Age distribution of homogeneous Norway spruce stands in Wallonia for private (grey) and public (white bars) owners.

Stand management differs between private and public spruce forests. Especially after age 40, the stem number is clearly higher in private forests and the mean diameter is lower (Figure 1-3). Stand rotation (age of clear cut) is on average 56 years in private forests and 72 years in public forests. Clear cuts are on average larger in private than in public forests: 4.2 ha as compared to 3 ha.

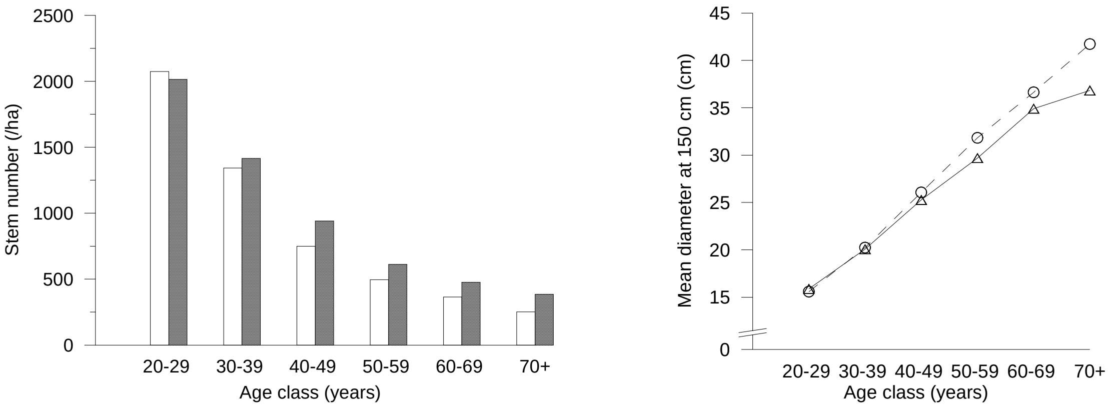

Figure 1-3: Evolution of stem number per ha and mean diameter (at 150 cm) in private (grey bars, triangles) and public (white bars, circles) homogeneous Norway spruce stands

43% of the homogeneous Norway spruce stands over 50 years have natural regeneration (under the canopy of the mature stand). This natural regeneration covers over 2/3rd of the stand in 30% of these stands and under 1/3rd of the stand in 50% of these stands.
Planting is only performed in clear cuts of Norway spruce (16,000 ha). 59% of this surface was replanted with Norway spruce, 19% with broadleaved species and 15% with mixed conifers (larch, Douglas). In private forests replanting with Norway spruce is slightly more common than in public forests.

Douglas (*Pseudotsuga menziesii*), larch (*Larix sp.*) and pine are the other main coniferous species in Wallonia. They constitute about 7.2% of all stands. Since 1984 mixed conifer stands show an increase with an actual area of 20,000 ha. This progression mainly reflects the success of Norway spruce stands in mixture with Douglas fir (Colson *et al* 2002b).

1.4 Forest owner situation in Belgium

Approximately 70% of the Flemish forest area is privately owned (100,000 ha). The number of private Flemish forest owners is roughly estimated at around 100,000, the mean property area being 1 ha. Of the homogeneous Scots pine stands 57% is owned by private persons, 20% by municipalities, 17% by the Flemish or federal government and 5% by other public owners. The ownership of the homogeneous Corsican pine stands is 43% privately owned, 30% municipal forest, 20% regional or federal forest and 7% other public forest.

Of the Walloon forest 290,000 ha (53%) is privately owned. Based on a national statistical survey of 1970, the number of private owners is estimated at 100,000. This is comparable to Flanders but the mean property would be about 2.5 ha.

1.5 History of secondary conifer plantations in Belgium

The primary European temperate forests have undergone many changes since the development of human activities. Dynamic, structure and composition of forest ecosystems are concerned with these modifications. In Belgium, the forested area has increased since 1850, in parallel to the decrease of open landscapes resulting from traditional agricultural practices (Noirfalise & Vanesse 1975). Robust and easily growing tree species were used to restore forest cover on these poor soils under rigorous climatic conditions (Weissen 1995). The main characteristic of this plantation campaign was to use coniferous species planted on large area. Initially, these conifers were imported from other regions of Europe (Norway spruce, Scots pine, Corsican pine) and from North America afterwards (Sitka spruce *Picea sitchensis*, Douglas) (Augusto *et al* 2002). The forest area in Belgium increased from 485,000 ha in 1846 to 625,000 in 1959. While in 1846 only 35,000 ha was coniferous forest, in 1959 conifers covered 262,852 ha (Van Miegroet 1970).

1.5.1 Scots and Corsican pine plantations in Flanders

Sandy soils cover the Vlaamse Zandstreek and the Kempen in Flanders and the Netherlands. Between 1250 and 1850 the prevailing farming system on sandy soils was more or less intensive plaggen management (Bastiaens & Verbruggen 1996, Spek *et al* 2004). The vegetation and organic topsoil were periodically removed from large areas of heathlands and degraded woodlands. This biomass was mixed with animal manure and applied to fields. Additionally large sheep herds were grazing the heathlands. This resulted in strong podsolisation and loss of soil fertility on the heathlands. The according landscape image can be seen in the ordnance survey maps of count de Ferraris from around 1775. From the 17th century on, small Scots pine stands were planted on both heathlands and marginal fields. In the second half of the 19th century, industrial development paralleled agricultural crises. Plaggen management declined and Scots pine plantation on heathland as well as on marginal fields was a profitable alternative. Pitwood was in high demand by the coal mining industry. Vast areas were reclaimed. From 1850 on, the forest area increased steadily to a maximum around 1900. This is conforming to the description of forest history in the Netherlands (van Tol *et al* 1998) and the study of historical maps of Flanders by De Keersmaeker *et al* (2001). These authors stress that only 9,000 out of 80,000 ha of the forests on poor sandy soils have been permanently forested between 1775 and 2000.

The main management system in the pine plantations was clear cut and reforestation with Scots pine or (from the 1930's) Corsican pine in a typical rotation period of about 40-50 years. At the time of clear cut, litter was removed and even stumps were thorn out. Soil was mostly ploughed before reforestation. From the 1970's the mining industry declined and timber prices stagnated. Many (private and public) owners lost sylvicultural interest in the pine stands. In public pine forests thinning operations proceeded, but clear cuts and expensive stand renewal were generally avoided. Only 3% of Scots pine stands was younger than 21 years in 1999 (Afdeling Bos & Groen 2001a). Stand age increased and many stands grew out of the pole and young tree stages into the tree stage. In the ageing pine stands forest succession proceeds and structural diversity increases (Kint 2000).

1.5.2 Norway spruce plantations in Wallonia

Similar to the evolution described above, many of the Norway spruce stands in the Ardenne in Wallonia were planted after 1850 through afforestation of mires, bogs, heathland and poor grasslands ("fagnes, bruyères, landes"). As in flanders, at first Scots pine was planted, but Norway spruce, showing high potential on poor soils and good wood qualities, rapidly extended all over the Ardenne even at lower altitudes. In the 20th century many ancient coppice with standards broadleaved forests and marginal grasslands and fields were transformed to Norway spruce plantations (Noirfalise 1985).

1.6 Conversion needs

A great majority of forest managers agrees that a sylvicultural system based on even aged, 50-70-year-rotation pine monocultures is no longer appropriate in Flanders. Some exceptional views confirm this general rule (Dufrane 2005a & b) (but see Section 5.4). Article 18 of the Flemish Forest Law (Bosdecreet 1990) states: "The care of the conservation, development or restoration of the ecological function of the forests consists among other things of:

1. encouraging autochthonous tree and shrub species;
2. stimulating spontaneous processes;
3. promoting a varied forest structure by striving for an uneven age distribution, for dissimilarity and for sufficient amounts of dead trees and dead wood."

In Flanders, all homogeneous Scots and Corsican pine stands are prone to conversion (Afdeling Bos & Groen 2001b; Criteria Sustainable Forest Management). The alternative forest type to aim for is however still quite vaguely defined as "a mixed forest dominated by native broadleaved species, vertically structured in several stories, horizontally structured in small- and medium-scale patches, with a broad spectrum of ages" (Afdeling Bos & Groen 2001b: public forests) and "a stand with 90% of mixed indigenous tree species" (Criteria Sustainable Forest Management: all forests within VEN). Nevertheless, Scots pine stands over 70 years of age that have an understorey of indigenous broadleaved tree species can be granted with a subsidy for ecological function (see section 1.6). Scots pine is considered to be a native species in itself, but homogeneous Scots pine stands are undesirable.

Contrasting to the policy principle in Flanders, where all stands of non-native conifers are candidates for conversion to broadleaved forest, in Wallonia there is a shared judgment. On sites where a sustained timber production can be expected, even pure coniferous stands are considered to be on their rightful place, if the manager respects some ecological considerations (e.g. distance to streams or wet sites) (Claessens 2001 for Norway spruce, Pauwels & Rondeux 2000 for larch, Colson *et al* 2002a for a mixture Norway spruce - Douglas). Even in protected areas like forests in the Natura 2000 Network, conversion into native broadleaved stands is not an absolute dogma (Mohimont 2004). For the Ardenne region, the suitability of sites currently under pure Norway spruce stands was investigated using GIS (Geographical Information System) (Claessens *et al* 2001). Infomation was combined to determine the suitability of sites for certain forest types and according tree species (Claessens *et al* 2002). From the regional forest inventories of 1980 and 1999 (partial) (Lecomte *et al* 1999) plots were under pure Norway spruce stands were identified. Based on criteria of climate and soil and criteria of patrimonial value (biodiversity, landscape, history), distinction was made between (1) sites unsuitable for spruce and (2) sites rather unsuitable for spruce.

Of the pure Norway spruce stands in the Ardenne region, 27% was incompatible with the site, 21% was rather incompatible. Table 1-4 and Table 1-5 give a description of the sites with incompatible Norway spruce forest.

Table 1-4: Description of the unsuitable sites for Norway spruce in the Ardenne region

Sites unsuitable for Norway spruce	Area (ha)	%
xerocline sites at low altitude (<350 m)	8,090	16
alluvial sites	9,024	18
pseudogley soils on clay substrate ("Argile blanches")	17,922	36
other: ground water influenced sites, podsols, peat soils, stony calcareous soils, superficial soils, altitude<150 m, ...	15,060	30
total Ardenne	50,096	100

The 17,000 ha of pure Norway spruce forest outside the Ardenne region (10% see Table 1-4) can all be considered to be incompatible with the site (<150 m altitude).

Table 1-5: Description of the rather unsuitable sites for Norway spruce in the Ardenne region

Sites rather unsuitable for Norway spruce	Area (ha)	%
sites at low altitude (150-350 m)	24,150	62
hydromorphous sites	6,050	16
superficial soils	4,100	10
xerocline sites	2,700	7
Jurassic region	1,050	3
other	750	2
total Ardenne	38,800	100

In the German state of Baden-Württemberg, where forest conversion has already been adopted in management for 20 years, it has been observed that the effect of storms on the share of broadleaves was very positive. Storm events like those of 1990 seem to hasten the adoption of conversion management (Baumgarten *et al* 2005). However, Claessens *et al* (2001) observed that young plantations of Norway spruce (after 1980) are still being planted on unsuitable sites, e.g. at open areas where Norway spruce was blown down in 1990 (see Figure 1-2). However, that the share of spruce is decreasing at lower altitudes of the Ardenne region, and that in general the Norway spruce forest area decreased since 1980 (Lecomte *et al* 1999).

In Belgium the conversion of pure pine and (rather) unsuitable Norway spruce stands comprises 144,000 ha. In Baden-Württemberg for example, one of the most forested federal states in Germany, 112,600 ha of (mixed) Norway spruce forests need conversion management (Baumgarten *et al* 2005).

1.7 Forest conversion management: goals and scenarios

There are two steps in the management decision process: (i) definition of goals and priorities, (2) choice of the management scenarios to evolve the current situation towards the goal.

1.7.1 Definition of goals and priorities

The conversion needs of pine and Norway spruce plantations in Belgium were clarified in the Section 1.6. The types of conifer stands over which forest policy agrees on conversion have been defined and quantified. The goals are however not defined in terms of (i) shares of specific indigenous tree species in the future stands (e.g. beech versus oak in Wallonia, birch versus oak in Flanders), (ii) desired age class distribution, (iii) the future timber quality and quantity in view, (iv) a priority map with a conversion urgency score for each conifer forest/stand, or (v) milestones (e.g. % of conifer plantations to be converted by a certain year).

Which conifer stands should be converted within what time period following environmental sustainability, biodiversity and socio-economic criteria? To be sustainable and effective the goals should be quantitatively defined giving priority rules and minimal, optimal and maximal figures within a specified time and spatial frame (space: regional, forest complex and stand level, time: short term = one planning execution period of 20 years, mid term: 2 planning periods = 40 years, long term: 4 planning periods = 80 years). Priority should be given to sites with a high risk for conifer stands and a high suitability to broadleaf tree species (Kazda & Englisch 2005). Good examples are Norway spruce stands on hydromorphous, peaty soils in the Ardennes (Section 1.6). They are highly unstable and these sites are very suitable to black alder or downy birch (Claessens *et al* 2001). Another example are pine stands on loamy sandy soils that are not yet completely acidified (pH > 4) and where good potentials for plant diversity exist, e.g. at or near ancient forest sites (Section 3.1.2).

What is the forest type (stand structure, tree species composition at different scales) we aim at? Mostly reference is made to (ancient) broadleaved stands that indeed display many of the positive ecological and sylvicultural characteristics (biodiversity: e.g. highly specialised forest organisms, biogeochemistry: less acidified forest soil, quality timber: large dimensions of noble species) associated with the aims of conversion (Kint 2005). However, such stands are quite rare on the typical sites of undesired coniferous stands (see Section 1.5) and moreover their stand structure and tree species composition results from a management history (e.g. coppice with standards) completely irrelevant to the starting situation of a homogeneous conifer stand. A possible workaround is modelling the expected evolutions based on ecological characteristics of the tree species at hand (Kint *et al* 2004) and validating them with the few conversion examples that evolved accidentally or as an experiment a long time ago (e.g. the Mortzfeldt group cuttings: Bilke 2004, or the forest reserve Mattenburg: Kint 2003). Nevertheless care should be taken when extrapolating these very specific examples to the large areas of secondary pine and Norway spruce forests in Belgium.

1.7.2 Choice of management scenarios: from the current situation towards the goal

To be sustainable and effective at low cost a scenario should be a motivated, well planned management regime that conducts the natural processes (based on forest succession and disturbance regimes). At set time intervals the stand and forest characteristics should be assessed and evaluated to be able to adjust the conversion management.

Forest conversion scenarios in pine forests in Flanders

For the sandy soils in Flanders, the long-term goal is a mixed stand dominated by native broadleaved species (90% or with a share of old Scots pines in the overstorey), vertically structured in several stories, horizontally structured in small- and medium-scale patches, with a broad spectrum of ages. The natural forest types on these soils are birch-oak forests and on the long term (undisturbed succession) poor and typical oak-beech forests. At the forest complex level, 80% of public forests should be composed of such stands in the long term. Of private forests in ecologically sensitive areas, 20% should be composed of such stands within the next 20 years (see Section 1.6).

In general, two conversion scenarios for homogeneous pine stands seem plausible: **continuous stand cover (thinning)** and **group cutting**. Of course, in practice a combination of both is possible, where the remaining forest stand in between the groups is being thinned. These reasonable scenarios can be contrasted to two extreme scenarios: **no intervention** and complete **clear cut**. Sylvicultural considerations (practical and ecological) about these four conversion management scenarios are given in the Appendix Forest Conversion Scenarios.

In Germany, a justified timing between onset of the broadleaved regeneration (natural or seeding/planting) and final cut of the main part of the current conifer stand is 20-60 years, unless in the case of clear cut. Concerning the expected speed of conversion (= percentage converted of the original area of secondary conifer plantations after a certain time period), Figure 1-4 gives a general scheme of reasoning.

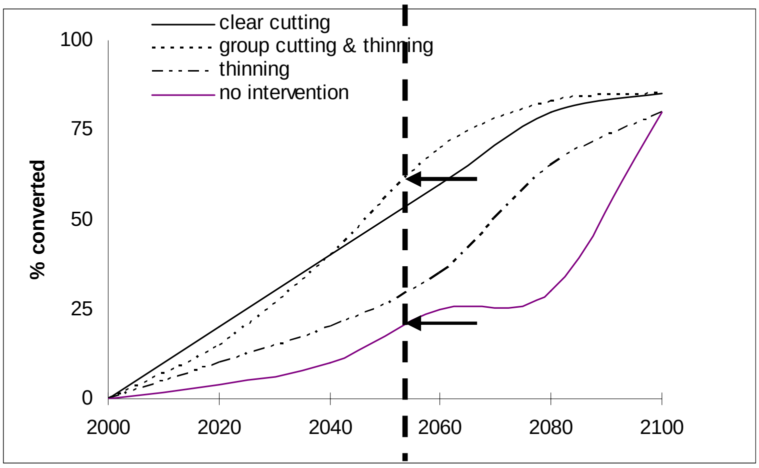

Figure 1-4: Expected conversion rate under four different conversion management scenarios over the 21st century

- All scenarios consider about 20% of the pine stands that will be managed (and regenerated) as conifer stands and will not be converted into broadleaved forest, e.g. outside ecologically sensitive areas at sites with a poor potential for broadleaved tree species, or in areas where pine forests are considered as relevant to the traditional landscape image.
- Any sensible clear cut scenario will strive for a balanced age distribution of the future stands and cut a more or less constant area each year. Because a rotation period of 120-140 years is actually considered reasonable for Scots pine stands from a sylvicultural point of view (but see Section 5.4 on TORP) and the average pine stand age is actually between 40 and 60 years (see Section 1.3), the clear cut program would have converted 80 % within about 80 years.
- A scenario based on continuous thinning within the aging pine stands will keep the pine canopy for a long period and % converted will be realised as an increased share of broadleaves within all the pine stands. After about 50 to 60 years, the broadleaved understorey will grow through the pine canopy and start outcompeting the remaining pines. From that stage the percentage converted will increase at a faster rate.
- When adding group cuts in an otherwise normally thinned pine forest, the percentage converted will initially increase strongly while in the long term the conversion speed will decrease. This is because the group cuttings are spread over time to create a balanced age distribution in the future forest and the remainder of the pine stand in between the groups is taken away with a certain delay after the creation of the groups.
- No intervention leaves the pine stands to natural thinning processes (pines dying of competition with other pines). Even in such stands broadleaved species colonise the understorey and will eventually grow into the canopy. The onset of broadleaves reaching the canopy is delayed, but these pine stands are probably more prone to large scale natural disturbances (storm events, insect attacks). This can induce "jumps" in the percentage converted.

The main difference between the different scenarios is (i) the percentage converted in the mid-term (2050) (Figure 1-4) and (ii) the species composition of the broadleaved generation. Given a starting point of closed Scots or Corsican pine plantations on poor sandy soils in western Europe, the conventional wisdom is that the balance between *Betula*, *Quercus* and *Fagus* in succession will depend on how fast the canopy opens and what seed sources are available, and furthermore that stand development may be short-circuited or deflected by unpredictable disturbances (Kint *et al* 2004). Fast and large scale removal of the pine canopy promotes birch (and pine), while long conversion periods promote beech. Oak takes an intermediary position.

Bilke (2004) investigated pedunculate oak groups that were installed following the ideas of forest manager Mortzfeldt in the late 19th century in North-eastern Germany, among others in pure pine forests. The intended complete pine stand renewal through extension of the oak groups and gradual removal of the remaining pine stands, had however not taken place. He noticed a strong contradiction. On the one hand there was a general contempt of the quality of the oak trees in the rather small groups and of the manageability of the stand mosaic. On the other hand the forestry guidelines in this region encourage conversion into a small-scale mixed forest (as is the case in Flanders) and what's more, many foresters recognise the oak groups as a stabilising factor in the surrounding pure pine forests. Research has been done on the ecological impacts of introducing broadleaves in pure conifer stands (see Chapter 2 and Chapter 3), but much fewer research has been performed and few experience is available concerning the sylvicultural consequences of different conversion management scenarios (future timber quality, feasibility of practical stand management) (e.g. Peters & Bilke 2004). Such information is especially lacking in pine forests on sandy soils, e.g. in Flanders, the Netherlands and Northern Germany (Bilke 2004).

Forest conversion scenarios in Norway spruce forests in Wallonia

Depending on the expected stability of the Norway spruce stand, Baar (2005) proposes two major scenarios for conversion of Norway spruce stands.

1. Advance planting of beech in small cells of 25-50 plants under canopy gaps in the Norway spruce stand, with a maximum of 30-40 cells per ha. Each of the cells will produce one crop tree in the final stand. Normal thinnings and harvest in the Norway spruce stand continue.
2. Small clear cuts or bandwise cuttings. After 5-15 years of spontaneous development in these clear cuts regeneration of Norway spruce, birch, rowan, black alder and other species is expected. Within this young mixed stand beech or oak is planted in small cells, while good elements in the spontaneous stand can be promoted to become future crop trees.

In France, the conversion scenarios for homogeneous Norway spruce stands also include (i) clear cut and replanting or natural regeneration, (ii) advance planting and promotion of broadleaved species admixture in Norway spruce stand and gradual removal of the spruces (Di Placido 2002, Di Placido *et al* 2002).

Baar (2005) and Neruda (2000) draw much attention to any spontaneous regeneration, of secondary broadleaved species and of Norway spruce, which develops during the conversion process.

1.8 Current forest policy towards private owners in Flanders

Because of the expected complexity of the forest owner situation, we restricted the sociological and economic research to Flanders. Meanwhile, attention was paid to research in the Walloon situation (Feremans 2004, Colson *et al* 2002b). In this section, the important policy currently available for Flemish forest owners is addressed. The lack of systematic data on the ownership of private forests in Flanders (and Wallonia) makes the targeting of forest policy a tricky affair. In pine forests on sandy soils, a large part of the private forest owners doesn't perform any effective forest management. Natural processes induce a spontaneous development towards a more mixed forest with an increasing share of broadleaves, be it with a considerable share of the exotic species black cherry and red oak. In this respect, forest conversion is the effort to speed up and direct this transformation process towards well-structured native broadleaved forests.

In Flanders, a myriad of government institutions exist that execute, and formulate forest policy. There are also different organs which advice the government on forest policy. In addition, there are several influential non-governmental organisations, which criticise government policy or carry out their own specific programs. Inevitably in such a context, coherence and continuity in forest policy can be improved. For example, the need for forest conversion was stressed in the Beheervisie voor Openbare Bossen and in the Criteria Sustainable Forest Management. But a recent advice by the Hoge Bosraad does not even mention the subject (Bossenverklaring, Van Langenhove & Spaas 2003).

Afdeling Bos & Groen (Forest & Green Areas Division) of the Ministry of the Flemish Community (www.bosengroen.be) administers all public forests, but it is also responsible for stimulating suitable management of private forests. Official foresters have to combine inspectorate of private forests with the practical management of public forests. The Cel Bosbeleid (Forest Policy Cell within Afdeling Bos & Groen) coordinates, prepares and supports the forest policy initiatives in Flanders. The MiNa Raad (Environment and Nature Council) provides advice to the Flemish government and since 1999 also to the parliament (www.minaraad.be). It has been given wide powers, and it pronounces itself on diverging themes like, sustainable development, urban planning, energy, infrastructure, use of natural resources, etc. The Vlaamse Hoge Bosraad (High Forest Council) exists since 1991. It can provide unsolicited advice. It consists of 29 members, of which at least half are (larger) forest owners. The others are stakeholders' representatives. This council provides policy advice on long-term execution plans, propositions for new laws. The Vlaamse Hoge Raad voor Natuurbehoud (High Nature Conservation Council) is composed of independent experts, who provide advice on forest policy questions only when requested.

The current Flemish forest policy is mainly based on three pillars: forest area conservation, forest area enlargement, multifunctional forest management. Forest conversion in private forests falls under the latter. Instruments for private forest owners are legislative, informative and financial (Vedung 1998). An important recent instrument towards private owners is the forest group ("bosgroep"). It's a voluntary cooperation between different forest owners in a working area from 4,000 to 15,000 ha forest. The management freedom of the owner is a central issue. Forest groups take a neutral position between government, owners and forest users. It receives a yearly fixed subsidy, for the salary of one coordinator and a secretary and an additional subsidy per ha under management. Furthermore, a project based subsidy can be paid out for specific improvement projects, there is also money for training activities and in cooperation with regional and provincial governments there are teams of workers to do urgent, but unprofitable forest management activities.

There exists a rather complicated set of subsidies for private and public owners, parts of which are conditional on an extensive forest management plan. Meanwhile, there are four types of subsidies for all private forest owners:

a) *a one-time planting or replanting subsidy.* Plantations of more than 0.5 ha are subsidised depending on the tree species. It varies between €1,500 and €3,200 per ha.
b) *a yearly public access subsidy as a compensation for management costs.* This subsidy of maximum €50 per ha has been given to only a few owners, who seem hesitant to officially throw their estates open to the public.
c) *a yearly subsidy for ecological function.* This is granted if specific preconditions of habitat quality and natural species composition are met in a forest management plan. It varies between €50 and €125 per ha.
d) *a subsidy for the draw-up of an extensive forest management plan.* Once every 20 years a public or private owner can apply for a €200 basis subsidy when the management plan is approved. To stimulate cooperation, the amount is raised with €20 to €50 per ha subsidy if five or more owners cooperate.

Although this concerns public information, the records of how much has been paid out for these subsidies have not been converted to usable information for outside analysis. Because of this complicated subsidy structure, it is hard to estimate how much a forest owners receives on average when she/he decides to move towards more sustainable management and for instance starts converting a pine forest stand. Expert opinion estimates about €150 per ha will be received yearly when entering on a conversion path (see Section 5.4).

The forest legislation of Flanders is based on the Forest Decree ("Bosdecreet") of 1990 which has been reviewed in 1999.This base text has been completed by decrees of the Flemish government. Some important issues with regard to conversion are the selection of VEN (Vlaams Ecologisch Netwerk, Flemish ecological network)-areas by the Flemish government in July 2002, areas were a special forest management plan has to been written for. The Decree of the Flemish government of 27 June 2003 regulates the procedure for submitting and approving extensive forest management plans. For public forest an extensive forest management plan is always necessary, for private forests it's only necessary for forests more than 5 ha. Inside the VEN, this must be an extensive forest management plan. Also important is the Decree of 9 May 2003 about the exemption of inheritance tax to avoid the parcellation of forest estates.

According to the "Beheervisie voor Openbare Bossen", the main management policy document for public forest (Afdeling Bos & Groen 2001b), 30% of the basal area in homogeneous stands of Corsican pine should be indigenous broadleaved trees and at least 80% of the area of a public forest should be covered with stands of indigenous tree species. Furthermore, there is a strict stand-still principle in both private and public forests: stands of indigenous trees species mustn't be replaced by non-native species. The Criteria

Sustainable Forest Management are the legal standard in private forests within the VEN. They demand that 20% of the forest area should be indigenous forest within 20 years, the common implementation period of management plans.