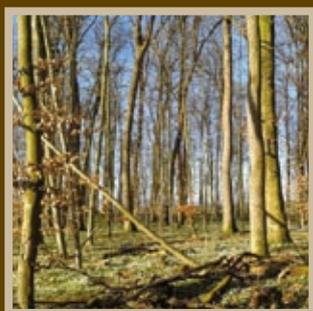


# Integration of Nature Protection in Forest Policy in Baden-Württemberg (Germany)

INTEGRATE Country Report



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## Summary

This report describes the current state of forest and nature protection in Germany, with a special focus on the federal state of Baden-Württemberg.

Under natural conditions, the majority of the German territory would be covered mainly by European beech (*Fagus sylvatica* L.) and mixed beech forests. Due to socio-economic, ecological and political requirements at the beginning of the 19<sup>th</sup> century (wood scarcity and deforestation), coniferous tree species were favoured. Broadleaved stands were converted to coniferous stands and this has created a landscape pattern with uniform and relatively young stands of predominantly Norway spruce (*Picea abies* (L.) Karst.), with negative effects on stand stability and biodiversity. Today, efforts intend to partially reverse this development and to increase the proportion of broadleaved, site-adapted forest stands. The ratio between coniferous and broadleaved forest is currently approximately 60:40.

In the course of restoration of forests during the 19<sup>th</sup> century, arose the need for forest planning in order to ensure sustainability of timber production. Forest science emerged and the first scientifically based concepts for forest management were created. Monocultures developed and artificial regeneration was introduced. Instead of clearcutting, different **silvicultural methods** were developed, like shelterwood cutting, and in Prussia the “permanent forest” (*Dauerwald*) movement evolved, which endorsed mixed forest and uneven-aged stands. Close-to-nature forestry in Germany strongly roots back to this movement.

In the federal state of Baden-Württemberg, the forest area is 1.3 million hectares representing 38,1% of total landmass. Municipal forest is the prevailing form of ownership with 39,7%. Private forests account for 36,2%, and 24,1% are state forests.

The predominant tree species is spruce, particularly in the mountainous Black Forest region. Current policy intentions are directed towards increasing the proportion of broadleaved species in stand composition, in particular of beech. The second forest inventory revealed a trend of about 7% towards an increasing share of broadleaved species. The area of mixed stands (at least 3 species) was about 2/3 of the forest area in the year 2004 while the share of pure stands decreased to 21%. Mainly pure stands of spruce and pine have diminished. Besides, an increase of older stands could be observed.

The average **standing volume** is very high in Baden-Württemberg with 367 m<sup>3</sup>/ha. At present, annual fellings account for 13,1 m<sup>3</sup>/ha, and are slightly lower than the volume increment of 13,8 m<sup>3</sup>/ha. Compared to other economic sectors, forestry is of minor importance and its contribution to the national income is modest. In Baden-Württemberg, forestry accounts only for 0,2-0,3% of the overall gross domestic product (GDP).

The tree species composition in Baden-Württemberg exhibits a high degree of **naturalness**. 48,5% of the forests fall into the categories ‘very near-natural’ and ‘near-natural’, 28,9% are ‘relatively near-natural’ and only 22,6% are considered as ‘strongly cultural’ or ‘cultural’. The **dead wood** volume exposes values noticeably above previous estimations. The average volume of dead

wood of all categories is 19,1 m<sup>3</sup>/ha, while previously the amount of dead wood was assumed to be around 7,7 m<sup>3</sup>/ha in commercial forests. Certainly the devastating storm in 1999 led to an increase of dead woods in the forests.

Designated **protected areas**, in which forestry use is either forbidden or clearly restricted and imposed with specific requirements, entail about 11% of the total forest area.

The legally defined **forest functions** are described in the Forest Act, and can be classified as either “use”, “protection” or “recreation”. The forest function recognized by **forest function mapping** are water protection forest, forests for soil and coast protection, climate protection forests, immission protection forests, noise protection forests, visual protection forests, recreation forests, nature and landscape conservation, gene resources, and game protection areas. Forest functions that are not recognized by forest function mapping are use (Wood, NTFPs), hunting, and forests as carbon sinks.

Nature protection generally features a low conflict potential with other forest functions. However, nature protection goals and timber production oriented forest management are often not congruent and result in trade-offs.

Since Germany has a federal structure, political power is allocated at three different levels, namely at the municipalities, the 16 federal states (*Länder*) and the federation (*Bund*). Many legislative and also most of the executive competences are allocated at federal state level. The **legal framework** is generally dominated by the dualism of both, the forest law and the nature conservation law. Other laws for the protection of certain aspects of ecosystem management, such as soil protection, may interfere with this legal complex.

The **Federal Forest Act** of Germany (FFA) constitutes the framework of the basic legal standards for the German forests. Due to the strong position of the federal states and the restricted competences of the federal government in the field of forest policy, the Act preliminary sets general guidelines and framework regulations. The federal states can complement and further specify the rules at federal state level.

As “multifunctionality” is the core principle of the Forest Act of Baden Württemberg (FABW), it is an obligatory standard to all forest owners. However, state, municipal and private forest owners have slightly different obligations. In Baden-Württemberg the concept of close-to-nature silviculture (“*Naturnahe Waldwirtschaft*”) is very common. This means allowing natural processes work for purposes of human in terms of efficiency and risk minimization, while including ecological aspects as well.

After the adoption of the new FFA in 1976, a nature conservation act was additionally established in the following year. In the 1990s, the outcomes of the Convention on Biological Diversity (CBD) and other conservation-related processes and European Law were implemented as amendments. Another fundamental amendment occurred in 2002 as an implementation of objectives of the National Sustainability Strategy.

Other relevant acts and guidelines exist on water protection, soil protection, environmental damage, reproductive material, plant protection, forest development types, and tending young stands.

Further, Baden-Württemberg developed four concepts to guarantee the maintenance of species in forests: the old and deadwood concept (AuT), species fact sheets, Natura 2000 management plans, and the species protection programme. These concepts should complement each other and provide a flexible, comprehensive instrument for the protection of the specific habitat and structure requirements of certain species in forests.

**Strategies and action plans** include the Natural Biodiversity Strategy, and as a contribution to that the sectoral strategy “Forestry and biological diversity”. Besides, some of the federal states of Germany have voluntarily developed own biodiversity strategies. Baden-Württemberg does not follow a formally adopted strategy, but applies a number of coordinated tools, which follow the same purpose referring to the “action plan on biological diversity”. Further, a program for the conservation of genetic resources and a national forest program (dialogue process) exist. Lastly, the Federal Ministry of Food, Agriculture and Consumer Protection is developing an “Overall Forest Strategy 2020” (Gesamtstrategie Wald 2020) to find a balance between the increasing demands on forest and its service capability.

Germany’s federal structure subdivides also the public finance system into the Federal Government and the federal state level. There exist direct instruments as well as several tax concessions and taxation rules. Relevant in the context of supporting nature conservation in forestry are mainly the direct instruments. These are on the federal level the Act on the Joint Task for the “Improvement of Agricultural Structures and Coastal Protection” (GAK) and on the state level five guidelines plus one tax instrument, which are described below.

The core funding instrument for the safeguarding of forest functions is the ‘**Guideline on Sustainable Forest Management** (RL NWW)’. The guideline’s principal aim is to support sustainable forest management to secure the different functions of forests. Forest owners receive financial aid for measures in the frame of close-to-nature forestry, which warrant the sustainable development of forest functions. Measures must be conducted according to approved forest principles and have to fulfill specific silvicultural requirements as listed in the guideline.

The **environment compensation program** (UZW) focuses on the support of the conservational and recreational functions of forests. Through financial support of private forest owners sustainable, multifunctional forestry shall be adhered. In particular the program shall compensate additional costs and income losses of private forest owners that arise due to voluntary limitations in forest use in the frame of Natura 2000 or due to voluntary obligations in the frame of forest environmental measures.

To compensate income losses of forest owners after afforestation of agricultural areas, the ‘Guideline of the Ministry for Food and Rural Areas on the Grant of an **Income Loss Premium** (EVP)’ was developed.

The regulation of the Ministry of Rural Areas of the granting of **compensation payments to nature parks** in Baden-Württemberg supports the implementation of landscape management measures, public relations work or the development of a recreational worth through private citizens, communities and administrative districts in the areas of nature parks.

The **ecological account** aims to build a preventive pool providing compensation measures and areas that can be used to compensate future impacts on nature and landscape in an appropriate functional, spatial and temporal correlation to the interventions.

The **forest maintenance tax** is not a subsidy for forest owners, but a provision for compensating impacts of conversions of forestland into other land uses. In case it is not possible to compensate the impact of forest conversions, a duty has to be paid.

**Education** related to forestry exists in Germany at three different levels. The profession of a *Forstwirt* is achievable after a three-year practical training. A Bachelor of Science degree is obtainable at five universities of applied sciences within four years. Further, four forestry universities exist, where you can obtain a Master of Science degree.

In Baden-Württemberg two **certification** schemes are significant: PEFC (Programme for the Endorsement of Forest Certification Schemes) and FSC (Forest Stewardship Council). 82% of the forest area is certified according to PEFC, while FSC has yet certified only 3%, which is almost entirely communal forest. However, in 2013 the complete state forest of Baden-Württemberg will be additionally certified according to FSC standards.

The **National Forest Inventory** (NFI) is carried out every ten years on a regular grid basis (4 x 4 km) with permanent sample points. The first inventory was conducted 1986-1989 in the old federal states; the second in 2001-2002 included also the new federal states. The next inventory is currently prepared for 2011-2013. Next to parameters assessing the sustainability of the forest management (e.g. forest area, occurrence of tree species, growing stock), the second NFI incorporated new parameters that are relevant to nature protection (e.g. amount of dead wood, length of forest edges).

Regarding **planning**, both nature conservation and forestry have a detailed planning system. Significant in forestry are the forest framework planning and the forest management plans. The aims of this (non-mandatory) forest framework planning are the improvement of the forest structure for the maintenance of forest functions, integrating objectives of spatial and landscape planning. Forest biotope mapping and forest site mapping are important elements for the implementation of nature protection goals in forests.

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## List of Abbreviations

BMELV	Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz
BMU	Bundesumweltministerium
CBD	Convention on Biological Diversity
FFA	Federal Forest Act (Bundeswaldgesetz)
FFH	Forest in Natura 2000 areas
FNCA	Forest and Nature Conservation Act
FSC	Forest Stewardship Council
GAK	Gesetz über die Gemeinschaftsaufgabe Verbesserung der Agrarstruktur und des Küstenschutzes
GDP	Gross Domestic Product
GDR	German Democratic Republic
LUBW	Landesanstalt für Umwelt, Messungen und Naturschutz
MCPFE	Ministerial Conference on the Protection of Forests in Europe
MLR	Ministerium für Ländlichen Raum und Verbraucherschutz
FABW	Forest Act of Baden Württemberg (Landeswaldgesetz)
NFA	National Forest Act
NFI	National Forest Inventory
NFP	National Forest Programme
NTFP	Non-Timber Forest Products
PEFC	Programme for the Endorsement of Forest Certification
UZW	Umweltzulage Wald (environment compensation program)
WFD	Water Framework Directive



## 1 Introduction

The protection of forests has received increasing attention both at national and international level. Many international processes and commitments such as the Ministerial Conference on the Protection of Forest in Europe (MCPFE), the Convention on Climate Change (CBD), the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol prove this fact. Although the status of forest protection has been addressed within many international processes and commitments such as the Ministerial Conference on the Protection of Forest in Europe (MCPFE) and its Criteria and Indicator data collection, the knowledge on the fulfilment of different forest functions in Europe is low, fragmented or not well communicated.

Not only quantitative but also qualitative aspects are important in this respect: besides the preservation or extension of the area of forest (within and outside protected areas) is important, it is also essential to ensure a high quality of multiple forest functions for all ownership classes. This accounts in particular as forests are confronted with new requirements such as the mitigation of climate change and the increasing demand for bio-energy.

For many decades the integration of ecological parameters into multifunctional forest management and their possible impacts have been a controversial topic in many discussions and investigations in Germany (Ammer & Puettmann, 2009; Riegert et al., 2009; Thoroë et al., 2003; Winkel, 2007; Winkel et al., 2005). Disputes on the right strategy to implement nature protection in forests as well as the legal determination of sound practices in forestry still arise on the political agenda. This study intends to provide an overview of the present forest policy situation and the requirements of both nature conservation and forest legislation in which forest management is embedded, in order to show the requirements that forestry has to fulfil today. Furthermore, the report should provide a basis to develop recommendations for strengthening integrative nature protection in forests. Because major operational regulations are decided on federal state level due to Germany's federal structure, Baden-Württemberg is examined as a case study example.

The structure of this report is as follows. Chapter 2 provides information on the historical development of forest management and facts and figures about forests (e.g. main tree species, amount of dead wood) and protected areas. Chapter 3 describes the major forest functions and potential conflicts between nature protection and other functions. In Chapter 4, the legal framework with relevant acts, regulations, strategies and action plans are described. Chapter 5 gives an overview about the financial instruments, and in Chapter 6, educational institutes and advisory services are being addressed. Then, Chapter 7 is on forest certification and Chapter 8 on monitoring and planning tools.

## 2 Forests, forest management and nature conservation

### 2.1 Historical developments in German forests

#### 2.1.1 Change of natural tree species composition

Forests and their silvicultural and biological characteristics reflect the times in which they were established. Many of them date back to times when overutilization and forest devastation was still noticeable. Under natural conditions, the majority of the German territory (66,5%) would be covered by European beech (*Fagus sylvatica* L.) and mixed beech forests (Bohn, 2001). While at the beginning of a significant change of forest composition due to anthropogenic influences, the ratio of broadleaved to coniferous species was approximately 70:30 (Spiecker et al., 2004), whereas the ratio today is approximately 60:40 (NFI II, 2002). Beech accounts for only 15,2% and old beech forests (> 160 years) cover only 0,16% of Germany's territory (Knapp et al., 2007).

Although the conversion of natural forests towards coniferous stands is widely recognised, the historical background that has led to the present situation is not well known (Spiecker et al., 2004). However, since conversions had been often unintended until the late 18<sup>th</sup> century, this has changed since the beginning of the 19<sup>th</sup> century when forest conversions became a clear aim of forestry due to socio-economic, ecological and political requirements (Spiecker et al., 2004). Heavy forest devastations at that time and a huge demand for wood (mainly as an energy source and construction material) led to a need for quick restoration of forest resources and to the cultivation of fast growing coniferous tree species, namely Norway spruce (*Picea abies* (L.) Karst.) and Scots pine (*Pinus sylvestris* L.) (von Teuffel et al., 2005). The process was further endorsed by the introduction of the economic principle of *Bodenreinertrag/Waldreinertrag* into forestry in the middle of the 19<sup>th</sup> century, an idea which vanished in the first half of the 20<sup>th</sup> century (Mantel, 1990). Additionally, the need for agricultural land decreased and afforestations of the abandoned land were carried out with conifers, which promised to be more effective. Other driving forces of the recent past are ownership structure, population density, global trade and the consequences of the two world wars (Spiecker et al., 2004). In effect, the ratio between coniferous to broadleaved species in forests has switched to 70:30 until 1913 (Spiecker et al., 2004). Apart from the general trend of converting broadleaved forests into coniferous forests, tree species composition has changed due to the introduction of alien tree species like black locust (*Robinia pseudoacacia* L.) (since 1601), eastern white pine (*Pinus strobus* L.) (1784), Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) (1880) or northern red oak (*Quercus rubra* L.) (Hasel and Schwartz, 2002). Some of these alien species like black cherry (*Prunus serotina* Ehrh.) have invasive character (Reinhardt et al., 2003).

The conversion process has created a landscape pattern with uniform and relatively young stands of predominantly Norway spruce but also caused negative side effects on stability (and consequently yield) as well as on biodiversity (von Teuffel et al., 2005). Today, efforts intend to partially reverse this development and to increase the proportion of broadleaved, site-adapted forest stands. The focus has moved towards a conversion of existing forests composed of one or few species with low structural diversity (often even-aged coniferous monocultures) towards uneven-aged mixed stands. This policy was declared a goal of most public forest administrations in Germany (von Teuffel et al., 2005).

While the human impact on forests on the one hand resulted in – from a today's point of view – often unfavourable structures and a large destruction of certain habitats, some ecologically valuable habitats were created as a side effect of land use. Certain “biotopes” like coppice or forest pastures offer very particular ecological conditions and are today protected by law in many of the federal states (MLR, 2000).

### 2.1.2 Silvicultural practices in the past

Manifold silvicultural practices were developed in the last centuries to meet the needs of the society and to make the best use of the forest resources. Thus, forests and their silvicultural and biological characteristics reflect the changing demands on forests and the times in which they were established. Many of them date back to periods when overutilization and forest devastation questioned the current forest utilization practices and required a rethinking of forestry.

Historical forms of silviculture and forestry in Germany are selective cutting systems (*Plenterwald*), coppice for fire wood, special oak tan-bark coppice, coppice with standards and wood pastures.

At the beginning of the 19<sup>th</sup> century, in the course of restoration of forests to overcome wood scarcity and to reforest large devastated areas, arose the need for forest planning in order to ensure sustainability of timber production. Forest science emerged and first scientifically based concepts for forest management were created. Even-aged high forests and forest stands composed of one single tree species (monocultures) developed. This and the need for afforestation led to the introduction of artificial regeneration, which enabled the cultivation of non-native or non-site adapted species, and ultimately brought heavy changes to the overall tree species composition. Although clear cutting was often regarded as a not avoidable consequence of even-aged forest stands, science in Central Europe developed contrasting silvicultural methods. Shelterwood cutting is the earliest of these developments based on stored coppice systems or selective cutting; based on a broad evolution in the 19<sup>th</sup> century and after a diversification process in the first half of the 20<sup>th</sup> century, especially in today's Baden-Württemberg. Another movement radically rejecting clear cutting evolved roughly at the same time in Prussia: the “permanent forest”

(*Dauerwald*) movement, which endorsed mixed forest and uneven-aged stands (Mann, 1920; Möller, 1920). Close-to-nature forestry in Germany strongly roots back to this movement (Hasel & Schwartz, 2002). Another root of this silvicultural philosophy is *Romanticism*, a sentimental perspective on nature and forests, which evolved at the turn of the 18<sup>th</sup> to the 19<sup>th</sup> century and resulted in a demand for landscape conservation and recreation on forests (Mantel, 1990). The view on nature and the idea of the ‘German forest’ in the Age of Romanticism influenced the identity of the German people and were the seed for today’s public interest in the preservation of forests not only for ecological and socio-economic but also for emotional reasons (Welzholz et al., 2005).

In the early 19<sup>th</sup> century the development of laws has strengthened protective forest functions as a result of the obvious negative impacts of deforestation with respect to erosion, flooding and other damages (Hasel & Schwartz, 2002).

## 2.2 Facts and figures about forests and biodiversity

The forest area in Baden-Württemberg is 1.3 million hectares, which represents 38,1% of total landmass of the federal state, making it to one of the federal states with the highest share of forests in Germany (Hanewinkel, 2006). More than 70% of the forest area is designated as protected areas according to the different protection categories delineated in the forest law and nature protection law (see section 2.2.3).

### 2.2.1 Forest sector

Municipal forest is the prevailing form of ownership with 39,7%. Private forests account for 36,2%, and 24,1% are state forests owned by the federal state of Baden-Württemberg (Fig. 1). In average the municipalities hold approximately 500 ha forest. The second share on the total forest area belongs to 260.000 private forest owners, of which 38% are small-scale forest owners possessing an area up to 5 ha. The average area of private forest owners is 1,3 ha. A large number of forest federations support about 29.500 private and municipal forest owners to manage their forests.

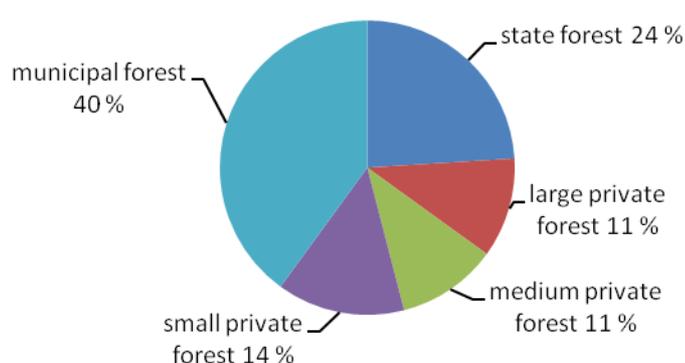


Figure 1: Forest ownership structure in Baden-Württemberg

The predominant species is spruce, particularly in the mountainous Black Forest region. Current policy intentions are directed towards increasing the proportion of broadleaved species in stand composition, in particular of beech. The second forest inventory revealed a positive tendency of about 7% towards an increasing share of broadleaved species (Fig. 2). Nowadays forests in Baden-Württemberg are composed of 48% broadleaved species and 52% coniferous species. With regard to conifers, spruce is still the most common and economically the most important tree species. However, the area of spruce decreased markedly, approximately 6% to a share of the forest area of 37,7%, due to the hurricanes in 1990 and 1999 and the damages in the aftermath, which severely affected spruce stands. Silver fir (*Abies alba* Mill.) and pine cover each 8% of the forest area, Douglas-fir and European larch (*Larix decidua* Mill.) 4%. The predominant broadleaved species is beech with 19%. Oak (*Quercus* spp.) accounts for 6% and other deciduous tree species such as maple (*Acer platanoides* L.) and ash (*Fraxinus excelsior* L.) play an important role as well, making up 10% of the area. The ongoing change in tree species composition has been observed throughout all kind of forest ownership but with different intensity. Spruce is still the characteristic species in private forests, where its proportion diminished from 53 to 48%, whereas the share in municipal forest achieved 30% (1987: 36%).

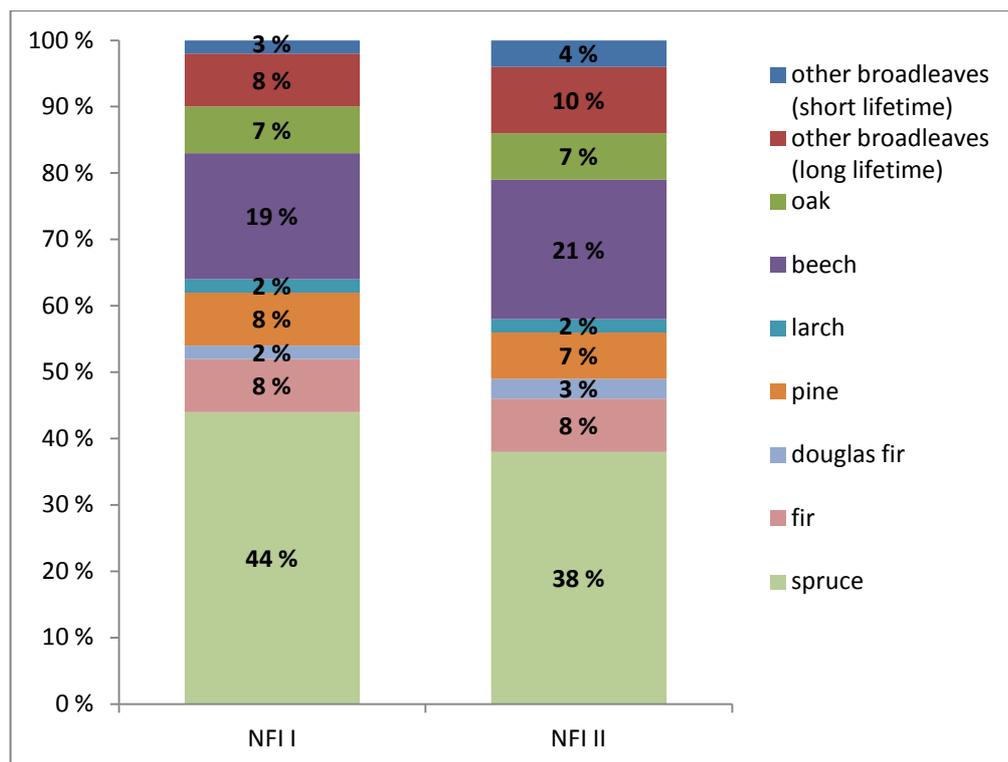


Figure 2: Development of the proportion of tree species in 1987 (left) and 2002 (right) in the total forest area of Baden-Württemberg

The area of mixed stands (at least 3 species) was about 2/3 of the forest area in the year 2004 while the share of pure stands decreased to 21%. Mainly pure stands of spruce and pine have diminished. Slight changes in the age structure of the forest stands towards an increase of stand ages could also be observed (Fig. 3).

The average standing volume is very high in Baden-Württemberg with 367 m<sup>3</sup>/ha. An increase in the volume of growing stock is very evident in the small and medium-sized private forest holdings, where small-scale management and so-called single tree management is the prevailing silvicultural method (Hanewinkel, 2006). In contrary, in the state-owned forests and in the large private forests with the predominantly large-scale management (partial cutting and, recently, also clearcutting on areas < 1 ha), a clear decline in volume has been noticed (Hanewinkel, 2006). In general, the dominating silvicultural system in Baden-Württemberg is the even-age class forest systems. About 3,5% are managed by the so-called 'Plenterwald' (single tree use), and 0,4% is managed as coppice or coppice with standards forest as relicts of formerly widely applied forest management systems.

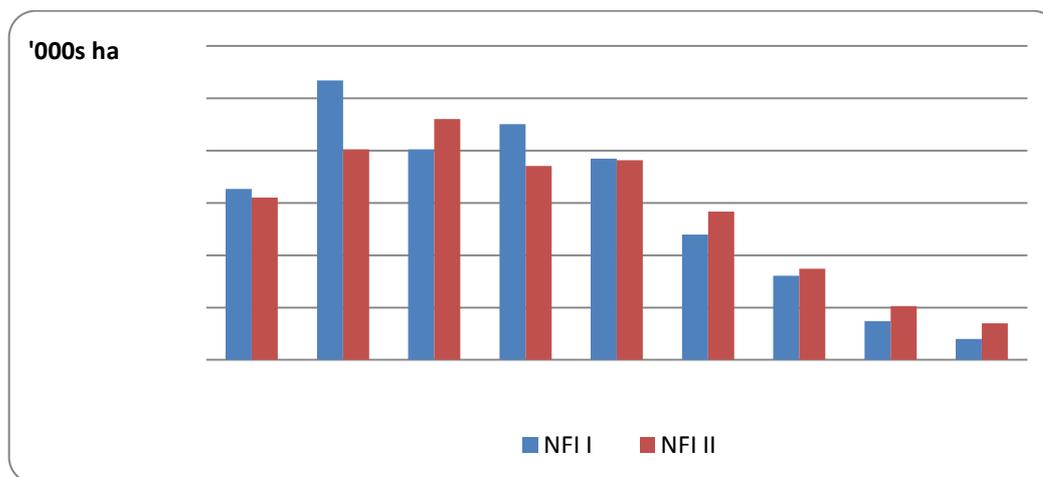


Figure 3: Age class structure in the Baden-Württemberg forests (NFI I, 1987; NFI II, 2002)

At present, annual fellings account for 13,1 m<sup>3</sup>/ha, and are slightly lower than the volume increment of 13,8 m<sup>3</sup>/ha. In spruce and pine stands, it exceeds increment. The ratio of harvest to increment varies also in different ownership categories (Fig. 4).

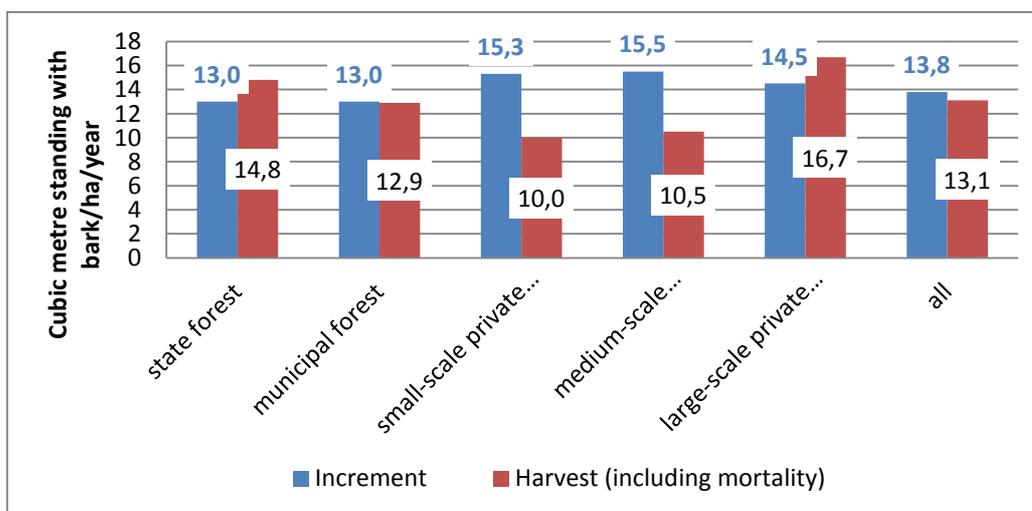


Figure 4: Wood increment and harvest (including deadwood) in Baden-Württemberg by ownership category (NFI II, 2002)

Compared to other economic sectors, forestry is of minor importance and its contribution to the national income is modest. In Baden-Württemberg, forestry accounts only for 0,2-0,3% of the overall gross domestic product (GDP) (Ziegenspeck, 2002). In 2007 the total use of roundwood of spruce and fir was 4.5 million m<sup>3</sup>. Spruce remains the dominant species in the assortment mix of the total cut (Fig. 5). Wood for energy use from forest and the saw and timber industry accounted for approximately 2.5 million m<sup>3</sup>.

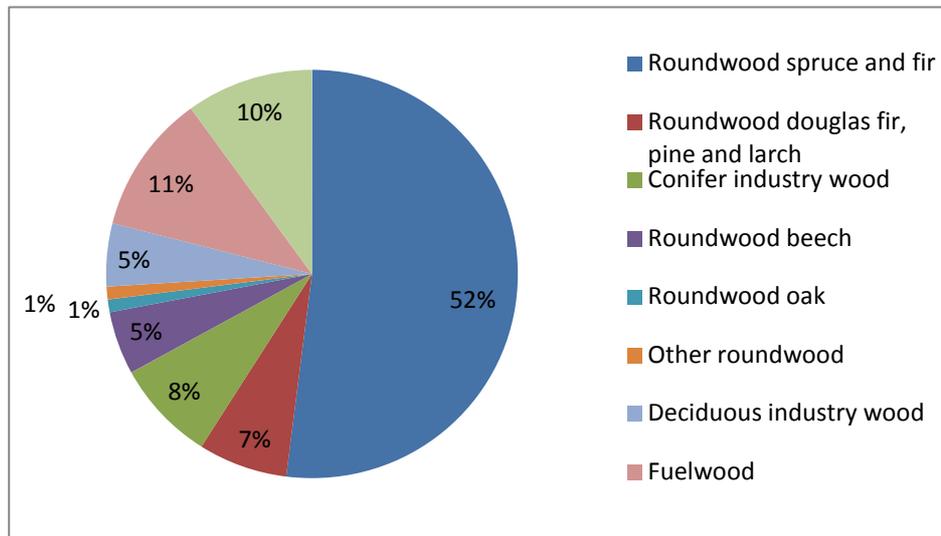


Figure 5: Assortment mix of cuts in the total forest of Baden-Württemberg (MLR, 2009)

### 2.2.3 Diversity and naturalness of forest ecosystems

The second National Forest Inventory (NFI II) in 2002 collected additionally data on structural and biotope traits of the forests and the naturalness of the forest stand such as diversity of tree species, mixture of tree species, living form of plants, diversity of forest communities, amount of dead wood and degree of naturalness. In total, 53 tree species were recorded. Features of the diversity of tree species and the distribution of mixed and pure stands were described in section 2.2.2 already.

Concerning the living form of plants, 10 categories were established: lichens, mosses, ferns, herbs, grasses, dwarf-shrubs, half-shrubs, lianas, shrubs and trees. Most prevalent were forests with 6-9 plant groups (ca. 65%). 3-5 plant groups were also frequently found in forest stands (ca. 30%). Seldom were 1-2 plant groups (only 5%). Whereas soil lichens occurred only on 6% of the area, grasses, herbs and mosses appeared on 89%, 87% and 90%, respectively. Shrubs were observed on 51% of the examined forest areas.

To determine the natural diversity of forest communities, the NFI defined 40 forest communities. 29 are represented in Baden-Württemberg, of which the beech forest communities (3 types) clearly dominate the forest sites (82%) (Fig. 6). Far ahead follow fir forest communities (4 types) on 10%, and riparian and mesic forest communities (9 types) on 6% of the forest area.

For the assessment of the naturalness only the tree species composition was considered to be an appropriate criterion to reveal significant conclusions on the hemeroby of forests. Other criteria (e.g. vertical structure, dead wood or mixture form) could not be examined since these are lacking adequate references.

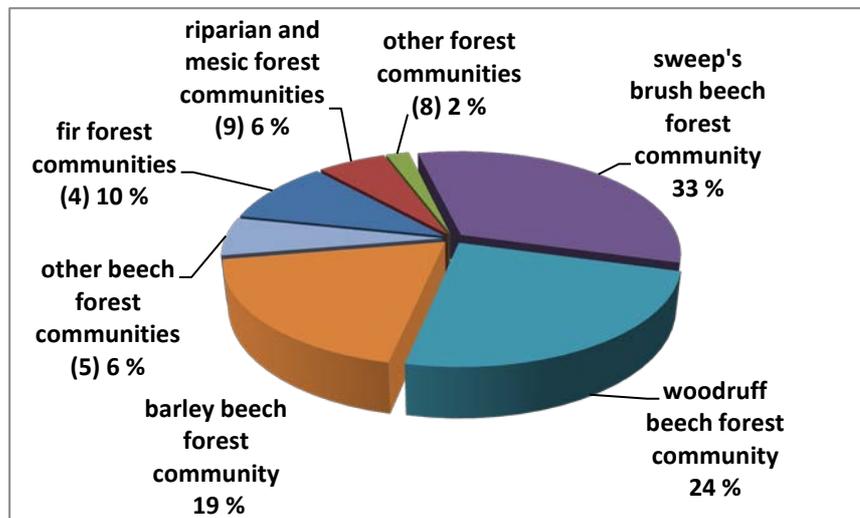


Figure 6: Proportion of the potentially natural forest communities

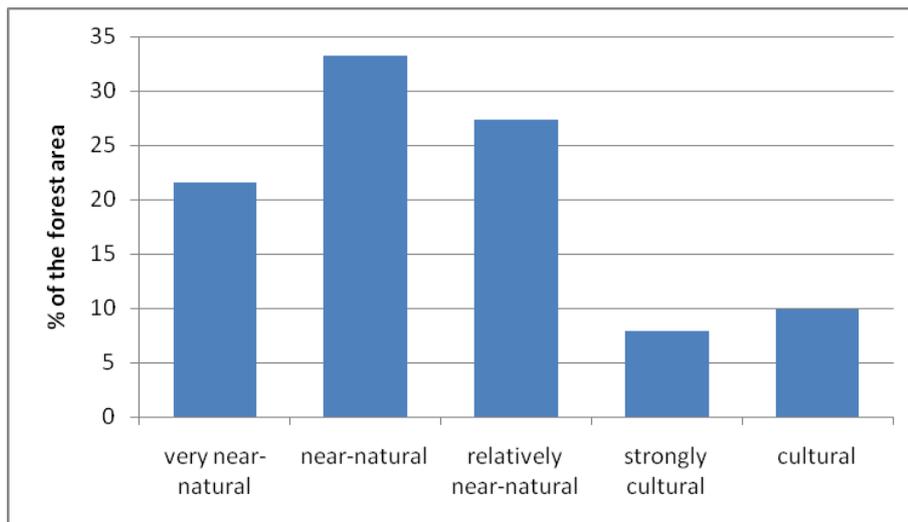
In the light of permanently and rapidly changing environments and altering patterns of competition between species, the criterion naturalness is regarded as not sufficiently embracing the aims of nature conservation (Reif & Walentowski, 2008). Other criteria, particularly originality (= original naturalness) and restorability should be given more importance and the criterion naturalness itself must include not only the percentages of tree species in a stand but also integrate structural criteria and dynamic forest models at the landscape level (Reif & Walentowski, 2008). An extensive analysis of the NFI II in terms of its value for nature protection considers naturalness of the tree species composition and its indicators as one of the most disputed data of the NFI II (Reif et al., 2005). Main critics are to conclude from the naturalness of the tree species composition on the naturalness of the forests on the whole and their ecological stability. Further the categorization of tree species is in some cases critical as on many sites tree species are classified as native because they dominate and regenerate naturally in commercial forests although these species could not persist in the competition of the tree species in the long term (Reif et al., 2005).

The degree of naturalness was derived from a comparison of the actual tree species composition with the tree species of the reconstructed present-natural forest community. The degree of human influence is reflected in the deviation from the present-natural potential vegetation. A graduated scale with five categories expressing the degree of naturalness was established (Table 1).

**Table 1: Categories of naturalness in the NFI II (2002)**

Degree of naturalness	Indicator
very near-natural	All dominant tree species which are native on the site occur; stocking of all of them >50% Share of the tree species of the natural forest vegetation >90% Share of the exotic tree species <10%
near-natural	Share of the sum of all dominant tree species which are native on the site between 10 and 50% of the stock Share of the tree species which are native on the site >75% Share of the exotic tree species <30%
relatively near-natural	Share of the tree species which are native on the site between >50 and 75%
strongly cultural ("kulturbetont")	Share of the tree species which are native on the site between >25 and 50%
cultural	Share of the tree species which are native on the site <25%

The inventory exposed a high degree of naturalness of the tree species composition of Baden-Württemberg, which shows also a high level in comparison with the nationwide results. While 48,5% of the forests fall into the categories 'very near-natural' and 'near-natural', 28,9% are 'relatively near-natural' and only 22,6% are 'strongly cultural' or 'cultural' (Fig. 7).

**Figure 7: Distribution of the different categories of naturalness in percent of forest area (NFI II, 2002)**

For the first time, the NFI II assessed the volume of dead wood, differentiated in five classes: lying dead wood, standing dead wood (whole trees), standing dead wood (broken pieces), rootstocks, residues of wood removal. The latter accounted only for 0,17 m<sup>3</sup>/ha and is therefore not included in Fig. 8.

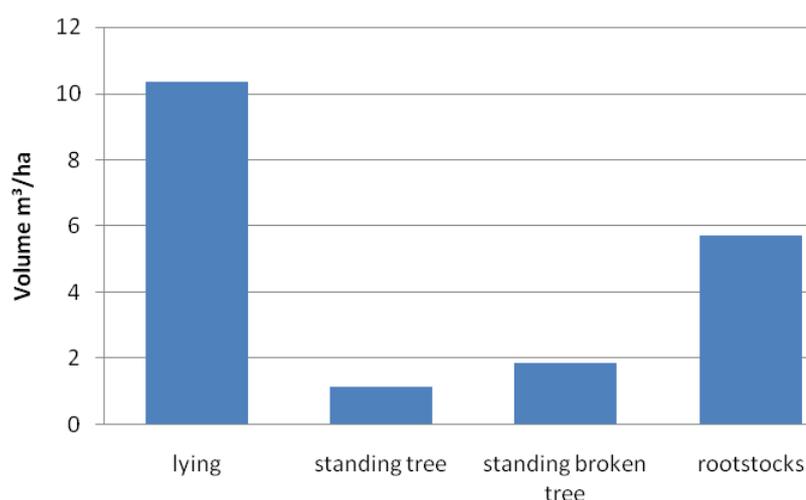


Figure 8: Volume of dead wood of the total forest area, including storm affected areas (NFI II, 2002)

The evaluation of the dead wood volume exposed values noticeably above previous estimations. The average volume of dead wood of all categories is 19,1 m<sup>3</sup>/ha, while previously the amount of dead wood was assumed to be around 7,7 m<sup>3</sup>/ha in commercial forests. Certainly the devastating storm in 1999 led to an increase of dead woods in the forests. A distinct evaluation of dead wood in storm affected areas and non-affected areas delivers values in the dimension of previous presumptions, for instance 8,5 m<sup>3</sup>/ha of lying and standing dead wood in the total forest area. On areas hit by storms the value is 35,8 m<sup>3</sup>/ha.

### 2.2.3 Protected areas in Baden-Württemberg

During the past few decades, forest protection and biodiversity in managed forests have received special attention. Numerous protection programmes and decisions have contributed to a markedly increase in the area of protected forests. Designated protected areas, in which forestry use is either forbidden or clearly restricted and imposed with specific requirements, entail about 11% (strict forest reserves, designed management forest, nature protection areas, protected forest biotopes) (Table 2).

Table 2: Protected areas and areas important for nature protection in 2008 (MLR, 2009)

Protection category		Hectare	% of total forest
Forest protection area according to FABW § 32	Strict Forest Reserve (Bannwald)	6.661	0,5
	Designed Management Forest (Schonwald)	17.660	1,3
	Forest in core areas of biosphere reserves	2.645	0,2
Forest in nature protection areas according to the LNA	Forest in nature protection areas	45.742	3,3
	Forest in landscape protection areas	454.264	32,8
	Forest in Nature Parks	660.070	47,6
Forest biotopes	Forest biotopes according to NFA § 32	40.006	2,9
	Forest biotopes according to FABW § 30a	19.295	1,4

	Other rare biotopes	22.646	1,6
Forest in Natura 2000 areas	FFH areas	384.996	27,8
Forest areas important for nature protection (overlaps adjusted)		1.044.805	75,4
<b>Total forest area</b>		<b>1.386.200</b>	<b>100</b>

FFH areas in forests comprise about 28% and build the emphasis of nature protection in Baden-Württemberg. 14 of the forest habitat types defined in Annex I of the FFH directive can be found in Germany (Table 3).

**Table 3: FFH forest habitat types occurring in Baden-Württemberg (Sippel, 2005)**

EU-Code	Name	Total area
9110	<i>Luzulo-Fagetum</i> beech forests	40.000 ha
9120	Atlantic acidophilous beech forests with <i>Ilex</i> and sometimes also <i>Taxus</i> in the shrublayer ( <i>Quercion roboripetraeae</i> or <i>Ilici-Fagenion</i> )	0 ha
9130	<i>Asperulo-Fagetum</i> beech forests	120.000 ha
9140	Medio-European subalpine beech woods with <i>Acer</i> and <i>Rumex arifolius</i>	300 ha
9150	Medio-European limestone beech forests of the <i>Cephalanthero-Fagion</i>	2.200 ha
9160	Sub-Atlantic and medio-European oak or oak-hornbeam forests of the <i>Carpinion betuli</i>	3.200 ha
9170	<i>Galio-Carpinetum</i> oak-hornbeam forests	1.200 ha
9180	<i>Tilio-Acerion</i> forests of slopes, screes and ravines	3.600 ha
9190	Old acidophilous oak woods with <i>Quercus robur</i> on sandy plains	250 ha
91D0	Bog woodland	2.400 ha
9.1E0	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> ( <i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i> )	8.000 ha
91F0	Riparian mixed forests of <i>Quercus robur</i> , <i>Ulmus laevis</i> and <i>Ulmus minor</i> , <i>Fraxinus excelsior</i> or <i>Fraxinus angustifolia</i> , along the great rivers ( <i>Ulmenion minoris</i> )	430 ha
91G0	Pannonic woods with <i>Quercus petraea</i> and <i>Carpinus betulus</i>	0 ha
9410	Acidophilous <i>Picea</i> forests of the montane to alpine levels ( <i>Vaccinio-Piceetea</i> )	1.200 ha

#### 2.2.4 Biodiversity in Germany

Germany inhabits approximately 9.500 plant species, 14.400 fungi species and 48.000 animal species (around 4% of the world population of known living fauna) (BMU, 2007). Many species were extinct during the ice age, others only in the recent past, especially mammals. The destruction of habitats, the impoverishment of nature and countryside entail major threats to the survival of species (BMU, 2007). Germany has one of the highest threat levels of extinction for its endemic species in Europe. 26% of the endemic plant species, 36% of the endemic animal species and 72,5% of the habitats are endangered (BMU, 2007). The driving forces behind these figures are destruction and fragmentation of habitats by constructions for settlements, transport (roads, high speed railways, water roads) and industry as well as many other activities such as hydrological engineering, fishery, discharge of pollutants, eutrophication, climate change, etc. Intensification of agricultural land use contributes to the threat and sportive and leisure activities also put increasing pressure on nature conservation aims.

Recently, invasive species tend to have negative effects on the site-typical natural or culturally formed biocoenoses.

Local deficits in forest management, e.g. very low proportion of ageing and decay phases, lack of old trees and dead wood components, excessive homogenization of stand structures, use of non-site-adequate tree species, and inadequate forestry and logging techniques are listed in the “National Strategy on Biodiversity” to jeopardize forest biodiversity (BMU, 2007).

### 3 Forest functions in Baden-Württemberg and policy instruments for their consideration

#### 3.1 Legal basis for forest functions

The legally defined forest functions are described in the forest acts. They can be classified as either “use”, “protection” or “recreation”, and represent a systematic of the mid 1970s. Other functions can be indirectly derived from miscellaneous acts (nature conservation, carbon balance) as well as plans and strategies developed by the government or by other institutions, processes etc., which have legally non-binding outcome. Other functions have no legal basis at all and are defined in order to pay respect to de facto conditions that legislations has not de jure recognized: recreational forest not based on the Forest Act of Baden-Württemberg (FABW) is widely designated to forests but not on the basis of the FABW; carbon storage can be defined as a forest function after the Kyoto protocol came into force but this is not reflected by an amendment of the Federal Forest Act of Germany (FFA) nor FABW. The conservation of biodiversity is a provision of the Forest and Nature Conservation Act (FNCA, § 1), which has only recently been added to the aims of this act.

According to § 7 of the FABW the functions have to be mapped and adjusted in a forest function map (see chapter 8.2.2). The map includes the following protected areas defined in the FABW:

- § 30 Soil protection forest
- § 30a Biotope protection forest
- § 31 Protective forests against harmful environmental impacts (“Schutzwald gegen schädliche Umwelteinwirkungen“)
- § 32 Forest protection areas: (strict forest reserve (*Bannwald*) and designed management forest (*Schonwald*))
- § 33 Recreational forest

In addition, there are protected areas derived from the act for nature conservation and landscape protection: § 32 (special protected biotopes in forests). Forest areas protected according to forest and nature conservation law are presented in Table 2 (section 2.2.3). Some biotopes that are not legally assigned but considered worthy of protection are marked on an area of 22.646 ha. These can include old forest sites or historical valuable forest stands, often of small size but of high value for species and habitat conservation. Table 4 presents the actual results of the forest function mapping, including all recreational and protective functions that have to be mapped according to the ‘Guideline on forest function mapping’ (Volk & Schirmer, 2003; further description see below). Not recognized by forest function mapping are the functions use (wood, NTFP), hunting, and carbon sinks.

Protected sites in accordance with other laws (game reserves, road protection forest, cultural monuments, mining protection forest) are not designated in Baden-Württemberg's forests. Some forest functions are assigned based on internal decrees of administrations or voluntary self-commitments of forest owners.

**Table 4: Protection and recreation forest according to the forest function mapping in 2009 (FVA, 2010)**

Protection category	Forest area (ha)	Percent of total forest area (%)
Legal soil protection forest	248.799	17,85
Legal environment protective forest	461	0,03
Legal water protection forest	378.370	28,60
Other water protection forest	120.871	8,67
Climate protection forest	177.799	12,75
Immission protection forest	114.224	8,19
Sight protection forest	4.095	0,29
Legal recreation forest	10.185	0,73
Other recreation forest	373.441	27,50
Legal game protection areas	20.360	1,57

Some general remarks about forest functions and their interlinks (Volk & Schirmer, 2003):

- Integrative approach: protection (and protective) and recreation functions cannot be separated. All forest areas fulfill functions of protection and recreation.
- Knowledge about the regional functions of forests is important especially for decisions about forest maintenance.
- Forest Function Mapping can be important for the application of financial instruments aiming at private forest owners.
- Forest areas do not fulfill protection- and recreational functions in the same manner and intensity.
- Statements and demands of all policy fields that have an impact on forest functions have to be collected and evaluated.
- Many functions can be fulfilled on the same area. But in the case of conflicts, they are taken into consideration for the mapping process and forest planning.

An overview of forest functions classified for the forests in Germany is given in the table below.

**Table 5: Forest functions for Germany according to the 'Guideline for forest function mapping' elaborated by Volk & Schirmer (2003)**

Function	Specification
<b>PROTECTION FUNCTION</b>	
<b>Water protection</b>	1) Legally binding <ul style="list-style-type: none"> <li>• Water protection</li> <li>• Spa protection</li> <li>• Flood land</li> </ul>

	2) Non legally binding <ul style="list-style-type: none"> <li>• Areas worthy as water catchment</li> <li>• Factual flood land</li> </ul>
<b>Soil and coast protection</b>	<ul style="list-style-type: none"> <li>• Erosion by wind or water</li> <li>• Land slides</li> <li>• Water logging</li> <li>• Erosion on hill tops and slopes</li> </ul>
<b>Avalanche protection</b>	
<b>Climate protection</b>	Regional & Local
<b>Immission protection</b>	1) Legally binding 2) Non legally binding
<b>Noise protection</b>	
<b>Visual protection</b>	
<b>Forests with particular function for nature and landscape protection</b>	1) Legally binding according to Nature conservation law: <ul style="list-style-type: none"> <li>• National parks</li> <li>• Biosphere reserves</li> <li>• Nature parks</li> <li>• Nature protection areas</li> <li>• Landscape protection areas</li> <li>• Natural monuments</li> <li>• Protected landscape components</li> <li>• Protected biotopes</li> <li>• Species protection areas / biotope connectivity areas</li> </ul> Forest law: <ul style="list-style-type: none"> <li>• Forest protection areas</li> <li>• Biotope protection forests</li> </ul> Hunting law: <ul style="list-style-type: none"> <li>• Game protection areas</li> </ul> 2) Non legally binding <ul style="list-style-type: none"> <li>• Valuable biotopes</li> <li>• Geological nature formations</li> <li>• Forest stands significant for the landscape</li> <li>• Ecological important forest areas</li> <li>• Forest areas with particular significance for the overall ecology</li> <li>• Forest on renaturation areas</li> <li>• Other areas worthy of protection</li> </ul> 3) Natura 2000
<b>Forest with particular function for research, culture and gene resources</b>	1) Legally binding <ul style="list-style-type: none"> <li>• Cultural monuments</li> <li>• Parks, arboretum</li> <li>• Areas for forest reproductive material for certain legally regulated tree species</li> </ul> 2) Non legally binding <ul style="list-style-type: none"> <li>• Certified sites and seed plantations for tree species not regulated by law</li> <li>• Forest research areas</li> <li>• Forest gene resources</li> </ul>
<b>RECREATION FUNCTION</b>	
<b>Recreation forest</b>	1) Legally binding 2) Non legally binding

### 3.2 Forest functions recognized by forest function mapping

*Water protection forest.* As a rule, water stream systems inside forests are less disturbed than in other environments, as they are not regulated and as their banks are often stocked with natural tree and shrub species. This aspect is of

particular importance due to the role of river streams as a connecting element between habitats.

Recommendations for the application of specific measures or their omission for the management of water protection forests are described in guidelines (like the “guidelines for potable water protection areas”, which is applied to a certain category of water protection area in some of the federal states of Germany), while such guidelines are not developed for other subcategories, especially in case of areas reserved to guarantee a certain quantity of water production.

Generally, human actions with an impact on vegetation and soils may have an impact on water protection. The first priority within this function is the quality of water; the second is a steady supply.

*Water quality:* forest stand structure and forest treatment have to maintain soil conditions with a high mechanical and biological detergency. Recommendations include:

- Omission of sudden decomposition of a rich humus cover, which otherwise may result in an accumulation of nitrates in the ground water (clear cuts have to be avoided)
- Omission of fertilization
- Omission of application of pesticides; the application of approved pesticides may be bound to further regulations
- Application of biodegradable lubricants in forest machines

*Water production quantity:* broadleaved and mixed forest stands have smaller interception values (especially in winter) and are thus favourable to coniferous forests. Certain tree species with intensive and deep root growth are suitable for groundwater recharge, tending and thinning measures can contribute to this goal as well. These aspects are of special relevance in regions with low precipitation and in the context of forest conversion. Mixed forests and vertical structures contribute to the prevention of flooding. Clear cuts have to be avoided.

The conditions for forestry measures in flooding areas are different, depending on the aims of flooding management in a given area. For purposes of decreasing water flow rates, forests should be vertically structured and stocked with site-adapted native species such as ash, oak, elm, black cherry, dogwood and snowball bush. If on the other hand the aim is to guarantee a fast outflow of water, ice and flotsam, forests should be open and single-layered. Site-adapted species are preferable with respect to economic aims as well.

Afforestations are principally welcomed in the context of water supply management (special preparation measures may be required, though) but may negatively affect areas where a fast outflow of flooding water is the aim.

Regulative instruments applied to water protection forests: In water protection category I areas, forestry is obligated not to apply fertilizer and pesticides, and

to omit clear cuts and stump extraction. Afforestations in all categories of water protection zones are restricted to site adapted tree species if the area is not ploughed (SchALVO, 2001).

*Forests for soil and coast protection.* In Germany, site protection forests include soil protection and coast protection forests. Soil protection forests are assigned to prevent erosion by wind and water (there is practically no net erosion in forests). Soils have a key function as a reserve for water, carbon, as a production factor and for biodiversity maintenance, as well as it may serve as a chemical buffer. Coast protection forests protect human infrastructure in coastal areas.

Litter plays a crucial role in this context as it weakens the erosive force of rain and for its capacity for water accumulation together with the mineral soil component. Tree roots fix the soil and help prevent small and large scale erosion (effectively preventing landslides). A rich vertical structure has positive impacts as well, as winds are slowed down above the surface, and water flows beneath it. In mountain areas, erosion may result in rock fall, directly threatening human lives and infrastructure.

Soil protection forests are delineated on the basis of various criteria (like geological conditions, characteristics of the soil, steepness of slopes and other features, climate, precipitation, water regime and land use) and may be formally assigned in accordance with forest acts of the federal states.

Site protection forests should be stocked constantly with site-adapted tree and shrub species with deep and intensive root growth. A rich vertical structure should be aimed at. Silvicultural measures include single-tree utilization and selective cuttings, clear cuts have to be avoided, game stocks have to be kept at a corresponding size. Artificial regeneration should be avoided (due to the impact on the soil structure) as well as soil compaction in the context of other silvicultural measures, especially skidding. Special requirements have to be taken into consideration for

- Forests on very steep terrain (non-regular management!)
- Risks for rock fall (high stem density, with a high proportion of broad leaved species, young trees and shrubs)
- Coppice or similar management forms are suitable for sites threatened by land slides
- Afforestations are always positive

Regulative provisions in soil protection forests are described in chapter 4.2.2.

*Climate protection forests.* This category of protection forest fulfills local and regional functions (for the mesoclimate; the global protection function as a carbon sink is not considered in this context!). The term “local” in this context refers to very small sites (recreational facilities, agricultural areas and similar structures. “Regional” describes a larger scale. The positive effects on the climate are a result of typical forest characteristics, including radiation, temperature, humidity,

and wind conditions. Such protection forests are often found on steep slopes, above wine yards and other agricultural valuable sites etc. As a rule, such forests are not legally bound, although the law offers such an option.

The main challenge for management of such forests is maintenance. Clear cuts should be avoided, and stands should not be too dense as such structures may negatively influence air turbulences.

Afforestations can have a negative effect under certain conditions (when causing cold air flows or preventing cold air from flowing away from the areas requiring protection).

*Immission protection forest.* This protection category refers to the filter function inherent to forests, thus contributing to the protection of human health.

*Noise protection forest.* Depending on the individual perception and intensity, sound may have disturbing character for people and animals. Sources of sound are facilities (a punctual source) and sources along a line, like a road. The intensity of a sound depends on the source and environmental factors, such as topography, weather, but also land use (e.g. open land, constructions, forests). Forests have an oppressive impact on sound intensity, because soil cover, branches and leaves absorb, reflect and disperse sound to a certain degree. The effect subjectively increases along with sight blocking effects. In order to fulfill this function, some landscape management aspects have to be taken under advisement that may overrule measures applied on stand level (sound spreads in a very particular way). Silviculture can contribute with permanent coniferous stockings, vertically closed stand structure, high stem density and a staged closed forest edge.

*Visual protection forest.* Some human objects disturb the landscape (mines, dumpsites etc). Forests can cover the view on such objects. This applies to densely populated regions with high demands on recreation.

A minimal requirement for such forests is a width of at least 30 meters. Conifers (not larch) are more suitable than broad-leaved species; a rich vertical structure is advantageous, shrubs should be cultivated at the forest edges. The geometry should follow the requirements provided by the objects that need to be covered. The understory should permanently remain.

*Recreation forest.* The forest's value for recreation is an effect of its characteristic internal climate, filtering functions, emission of ethereal substances and the oppression of noise pollution. Overlapping demands for recreation and nature conservation are a main domain of conflict in the context of forest functions with respect to nature conservation. These conflicts between leisure activities and nature conservation were examined as case studies with different species, for example grouse. Leisure was identified as the most important factor within a complex maze of interactions (Klaus & Augst, 1994). Although many interactions are not clear yet, there is large consensus that leisure activities lead to

disturbances of wildlife in several ways, including punctual effects on individual animals, as well as the disturbance of spatial patterns.

Leisure may spread over a wide range of activities with a varying impact on nature conservation. More traditional forms include walking, hiking or non-commercial collecting of non-timber forest products. In the recent past, biking has become more popular and some forests even serve for climbing.

Legislation has been aware of the public demand on forests towards recreation since a long time. First restrictions to forest use for the purpose of providing recreational space in urbanized regions have been released by the King of Prussia in 1720 in the framework of forest and hunting law (Mantel, 2002). The current FFA also provides a public accession right for the purpose of recreation in all classes of ownership (§ 14 (1)). As the paragraph further describes, this accession right may be restricted for various reasons by the provinces (§ 14 (2)), especially for specific recreational activities like riding. It is not allowed to use motorized vehicles in forests off public non-forest roads. Collecting non-timber forest products is considered a recreational activity, as long as the amount of products is limited to personal use.

Recreational forest can be assigned without being bound to a certain legal act, or may be legally binding, too (in accordance to the FFA (§ 13) and subsequent forest acts and decrees of the federal states. These decrees describe regulations in more detail. Recreational forest is mainly assigned in urban areas, and in the sphere of health resorts and spas. Forests without a legal basis may be assigned if the number of visitors exceeds defined figures. Regardless of such delimitations, forests may be frequented to a considerable extent.

Forests managed for recreation have special requirements. The main objective is (optical) diversity. This concerns the different forms of uniform high forests as well as close-to-nature silviculture. Recommendations include an interesting tree species composition, long rotation periods (for selected stands where applicable), omission of large scale clear cuts, preference of natural regeneration, promotion of two layered or multilayered structures, maintenance and promotion of secondary species and shrubs, conservation of old and remarkable individual trees, maintenance of historical forms of forest management, omission of strict geometric formations, maintenance and creation of viewpoints, increase tree species richness and forms and colours, development and tending of forest edges; the application of pesticides should be avoided in order to avoid conflicts. Visitor direction plays a key role in order to avoid conflicts with nature conservation goals.

A main conflict potential and financial efforts result not from aesthetic constraints, but from the property owner's duty of care in accordance with the German Civil Code § 823. The legal conditions for a forests owners obligation to prevent danger to forest visitors and his liability are comparably difficult to describe not only due to vague conditions such as "reasonability", but also due to certain exceptions in protected areas. The recent amendment of the FFA intended to

create more clarity and changed the respective article in the law by adding that the forest owner is not liable for typical threats in forests (§ 14 (1)).

*Nature and landscape conservation.* Forests have to fulfill a number of very different tasks of nature and landscape conservation (see MCPFE, 2005). The conservation of the cultural landscape considered as beautiful or valuable and represents a primary idea of nature conservation in the first place (Zucchi, 2003). The size of single sites with special importance for nature and landscape protection varies from several square kilometers to “punctual habitats” of only a few square meters. In the contrast to many others, this forest function can be found as a coherent structure on a large area as well as strongly dispersed over the whole forest area.

“Nature conservation” includes the protection of habitats and species. “Landscape conservation” describes the ecosystem and the landscape. Taken cultural aspects into consideration, landscape conservation usually means the conservation of the cultivated landscape. Many forest areas with assigned special importance for nature and landscape conservation fulfill to a high extent other forest functions as well, first of all recreation. A lot of the larger areas serve for a broad scale of specific goals of landscape planning.

Forest function mapping takes 2 main legal sources for the delineation of areas assigned to fulfill functions of nature and biodiversity conservation into account: nature conservation law, resulting in protected (forest) areas, and forest law, providing basically 2 types of protected areas. The distinction is relevant due to the responsibilities of different state authorities.

A comprehensive description of all types of areas assigned to fulfill nature and landscape conservation and/or biodiversity maintenance functions has been delivered in the framework of COST Action E27 (Welzholz et al., 2005).

In sparsely wooded regions, afforestations increase the value for the conservation of species. However, if afforestations destroy open land habitats for rare species, the overall effect for nature conservation and biodiversity aims is negative. Afforestations therefore need to be approved by authorities. The exact definition of what afforestations are depends on the provincial law (for example cultures of Christmas trees) as well as on responsibility of authorities<sup>1</sup>. Afforestations can be denied in the framework set by the provisions of federal law regarding landscape planning<sup>2</sup> by means of certain criteria (typical characteristics of a given landscape) and the critical threshold of the particular afforestation measure.

*Gene resources.* The delineation and identification of forest stands, groups or individuals with particular function for gene resources are usually carried out by state forest research institutes. Main criteria are autochthony, abundance on special sites with special ecological conditions, rare species, valuable

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<sup>1</sup> Klose & Orf (1998), p. 436

<sup>2</sup> Klose & Orf (1998), p. 453

proveniences of introduced species, populations on the edge of their natural abundance area, noticeable characteristics. The identified objects may be displayed in forest function mapping. The abundance of rare tree and shrub species may lead to the delineation of “forest areas with special function for nature and landscape protection”.<sup>3</sup>

Recommendations for in situ measures in forest areas for the preservation of forest genetic resources and reproductive material are (BMELF, 1998):

- The long term maintenance of these objects
- Coordination with the responsible institutions of the federal states
- Isolation of sites for the preservation of reproductive material
- There are special provisions for comparison tests, seed plantations, base material for clones and mixtures of clones

Objects preserved for the maintenance of genes are generally managed as usual, i.e. preference of natural regeneration, involving old trees as many as possible, a “gentle” way of tending (meaning the omission of drastic reduction of stand density, no exclusive removal of only the worst or best phenotypes). These forest stands require special protection from biotic and abiotic threats as well as the omission of repair planting with genetic material outside of the forest stand.

*Game protection areas.*<sup>4</sup> The majority of the game protection areas were delineated in the eighties. All areas except one are located in the Black Forest, predominantly in state forests, and in 95 % of the cases to protect capercaillie. Most of the areas are marked according to the FABW (§ 38 (1)), only a few according to the Hunting Act of Baden Württemberg (Landesjagdgesetz) (§ 24). All areas are congruent with nature protection areas.

Forestry is officially not restricted in these areas but forest operations are usually carried out off the rest times. Access is not allowed by decree during 1<sup>st</sup> of November until 15<sup>th</sup> of July. However, many of the areas are not distinguishable anymore and thus suspend the legal effect of the access prohibition. Therefore a legal basis, developed in a participatory approach including broad publicity, is necessary to restrict the access in certain forest areas.

### 3.3 Forest functions not recognized by forest function mapping

*Use.* The use function in a narrow sense of the word implies economic utilization, i.e. the utilization of natural resources encompassing wood (e.g. fuelwood, timber), game (hunting) and other products such as Christmas trees, decorative brushwood, berries, and mushrooms (Häusler & Scherer-Lorenzen, 2001). Given a share of 90%, the use of wood is the predominant and economically the most significant use function of forests.

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<sup>3</sup> Leitfaden zur WFK p.57

<sup>4</sup> Information based on personal communication with R. Suchant, FVA, 6 October 2010

*Hunting.* Hunting in Central Europe today combines demands on production/use of meat as a non-timber forest product, leisure and to a certain degree aspects of nature conservation.

Neither the FFA nor the FABW define hunting as a forest function. It is however undisputed that hunting as one of the oldest forms of human use of natural goods represents a demand on forests. It has a considerable relevance for nature conservation through acoustical and optical disturbance, hunting of predators and non-adapted game stocks, resulting in indirect promotion of certain animal and plants species (Plachter, 1991). In particular if natural regeneration is enforced in forest management adequate game stocks are an “indispensable requirement for close-to-nature forestry” (FED, 2002).

The right to hunt according to the Federal Hunting Act in Germany is bound to territory property. A minimum size of 75 ha is required for the permission to carry out hunting right on the same ground (§ 7). Otherwise, hunting right has to be leased to other persons. Hunting leaseholders do not count as forest owners if they have no other utilization rights (FFA § 4); effectively, forest owners and hunters with respect to a given area are often not the same individuals.

The Federal Hunting Act (*Bundesjagdgesetz*) § 21 (1) prescribes killing plans (effectively game stock management plans), which have to take demands of forestry into account but also those of landscape and nature conservation. The paragraph emphasizes especially the contribution of game management to the protection of endangered animal species.

The Hunting Law of Baden-Württemberg regulates that game management plans have to consider the physical constitution of the game and primarily the condition of the vegetation. Browsing reports, which inform about the proportion of browsed seedlings of defined tree species as indicators, are an important monitoring tool for browsing and deliver a sound basis to assess and adapt the game management plans.

*Forests as carbon sinks.* Approximately 6% of the Land's carbon dioxide emissions were bound by forests and forest products between 1987 and 2002. The substitution of fossil fuel by wood bioenergy prevented an increase of additional 5,5% emissions (18.4 million tons CO<sub>2</sub>) (Pistorius & Zell, 2005).

### 3.4 Conflict potential between nature protection goals and other forest functions

The spatial coincidence of different forest functions is often free of conflicts, but there are exceptions. In these cases, however, frequently only partial aspects are concerned, which is why an analysis of the given case is inevitable. The resolution of such a conflict has to take into account the general importance and the particular weight assigned to the forest functions identified for an area, including

economic and silvicultural aims as well as provisions of spatial planning and urban land use planning<sup>5</sup>.

A detailed analysis shows that there is conflict potential between all possible pairings of forest function goals, sometimes even within a single aim. For example, measures of nature and landscape conservation have to consider the protection of natural processes as well as certain goals of protection of species or within species protection.

Nature protection features a low conflict potential with other forest functions. However, nature protection goals and timber production oriented forest management are often not congruent and result in trade-offs (Table 6). Occurring conflicts when more than 2 forest functions overlap, which is frequently the case, are often complicated to resolve. Some of the measures required in the context of other forest functions may have a positive synergy effect on the achievement of nature protection goals.

**Table 6: Exemplary trade-offs between nature protection and timber production oriented forest management (Winkel et al., 2009)**

<b>Nature protection goals</b>	<b>Rationale</b>	<b>Correlation with timber production</b>
<b>Allow natural differentiation processes</b>	Enabling of evolutionary processes, creation of “special” habitats (biodiversity, aesthetics)	Conflicts and synergies – “biological automation” vs. necessity of silvicultural regulation to improve, e.g., timber quality and forest productivity
<b>Raise quality and quantity of dead wood</b>	Habitat for endangered species, naturalness of forests (limited dynamics), conservation/creation of species-rich and close to nature landscape	Potential antagonism, especially if more and thicker dead wood is required (loss of sales revenues, occupational health and safety, risk of pests and diseases); partial synergies exist (related to timber prices and efficiency)
<b>Creation/conservation of site-adapted native forests</b>	Central criteria of nature protection in forests, closeness to nature as a basis for natural biodiversity, characteristic and beauty of Central European forest landscape	Difficult to generalize, partly considerable potentials of conflict (productive, non-site adapted coniferous woods), partly synergies – basically one of the most essential conflicts between nature protection and timber production oriented forestry
<b>Creation/conservation of species-rich mixed forests</b>	Basis for biodiversity, characteristic and beauty of European forest landscapes	Difficult to generalize, potential for conflict existent, mixed forests stands are a challenge for mechanized timber harvest/logistics; but also synergies (stability, diversification, etc.)
<b>Creation of rich structured forest stands (horizontal/vertical)</b>	Basis for biodiversity (abundance of borderlines), characteristic and beauty of forest	Heterogeneous correlation, structured forest stands are partly contradictory to possibilities of optimization of timber harvest
<b>Conservation of site-diversity</b>	Sites (soil) as basis of diverse forest ecosystems	Potential conflict, if melioration/fertilization is profitable

<sup>5</sup> “Bauleitplanung”

## 4 Legal framework for forest management in Baden-Württemberg

The legal sphere of nature and biodiversity conservation in multifunctional forests includes an impressive number of potentially relevant legal acts on national and Land level (see for example LUBW, 2006). Since Germany has a federal structure, political power is allocated at three different levels, namely at the municipalities, the 16 federal states (*Länder*) and the federation (Bund). Many legislative and also most of the executive competences are allocated at federal state level (GC, Art. 70-75; Art. 83 ff.). In the area of forestry the federal state is responsible for some national framework regulations and legislations, the federal states can establish their own regulations and legislations in addition to this frame.

The legal framework is generally dominated by the dualism of both the forest law and nature conservation law. Other laws for the protection of certain aspects of ecosystem management, such as soil protection, may interfere with this legal complex.

### 4.1 Development of forest legislation after the Second World War

The legal framework for forestry as it is today reflects the development of forestry after the Second World War; developments of forest(-ry) regulations reflect not only socio-economic demands on forests but also technical requirements for forestry, events and scientific knowledge as well. The history of forest law in the recent past and in the framework of its meaning for society in (West) Germany<sup>6</sup> can be divided into three phases:

- A chaotic phase of uncontrolled use (until 1952)

After the destructions of the Second World War, great amounts of wood were required, mainly for reconstruction and energy. Additionally, the allied occupants exploited forests, and a bark beetle disease occurred. As a result, legal prescriptions were not adhered at all (Hasel & Schwartz, 2002), and forests were heavily overused during the first years after the war. The situation improved after 1952, when the allied economic policy was abolished (Hasel & Schwartz, 2002) and international trade was re-established.

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<sup>6</sup> East Germany as a socialist state developed differently. Not only forest ownership was concerned; the general legal conditions were different, too: Various regulations set rules for forest use, but new demands on forests were not reflected in any comprehensive national forest code. The West German Federal Forest Act entered into force on the territory of the former German Democratic Republic (GDR) in 1990 in the course of the reunification, which from a legal point of view meant an accession of the respective territory to West Germany and its law as well, and allowed the newly founded Lands to adopt forest acts as well (Hasel & Schwartz, 2002).

- Forests as a reserve for area (until 1975)

As soon as the wood market returned to normal conditions, forests were restored, rationally planned forestry was re-established, and the forest law was reformed on large scale.

During reconstruction and an increasingly prosperous economical development, the demand for building sites increased. Forest area consumption between 1949 and 1960 accounted for 7.000 ha annually and reached up to 26.000 ha per year after 1960, especially in urban areas. As a result, the forest area per capita in urban areas decreased stronger than for the whole country. While the average value for forest area per capita is approximately 1000 m<sup>2</sup>, it is only 100 – 200 m<sup>2</sup> in urban areas. This is crucial, as various demands on forests become more complex in such an environment (recreation, protection functions).

In rural areas, however, the contrary occurred. As the agricultural yield steadily decreased, many farmers decided to convert rather unprofitable sites into forestland. Until the end of the century, these afforestations accounted for approximately 300.000 ha. The trend still persists.

- Forests as an environmental factor (~1970 onwards)

It is hardly possible to determine exactly when new demands on forests were firstly articulated. It is sure that a change in the perception of forests and forestry occurred as environmental issues gained more importance. There was a clear political impact, which was obvious at the latest when the Chancellor Brandt declared environmental issues as a focus of his government in 1969. The political impact could be observed in legislation, when West Germany adopted a Federal Forest Act (FFA) in 1975. The amendments changed the former “forestry law” to a “forest law”, which by setting a framework for Forest Acts of the *Laender* effectively marked a second wave of amendments after the war (Klose & Orf, 1998). New demands on forests such as recreation (right of public access) and environmental protection were articulated, thus emphasising its nature as an environmental factor and as an important element of landscape and nature conservation. Finally, the new forest act reflected a request from forestry towards financial support (§ 41) and other economic regulations targeting structural challenges (§§ 15 – 40) as a result of decreasing wood process and increasing (labour) costs, thus establishing first financial instruments (Hasel & Schwartz, 2002).

## 4.2 Forest legislation

### 4.2.1 Federal level

The Federal Forest Act constitutes the framework of the basic legal standards for the German forests. Due to the strong position of the federal states and the restricted competences of the federal government in the field of forest policy, the Act preliminary sets general guidelines and framework regulations. The federal

states can complement and further specify the rules at federal state level (FFA §5). While the legislation is competitive concerning forestry monitoring, the federal government is only allowed to draft a framework for legislation both on nature conservation and landscape management as well as environmental planning and water management (Klose & Orf, 1998). Despite several attempts to reform the Federal Forest Act and to adapt it to international requirements only slight amendments have been achieved. The Act thus reflects the national sectoral forest policy debate of the early 1970s and provides rather vague rules for forest management (Hauber et al., 2009).

The aim of the Forest Act is *to conserve and increase the countries forests due to their economic, environmental and recreational functions and secure their proper management; to advance forestry; and to balance the interests of the general public with those of forest owners* (FFA §1).

The content of this paragraph is the basis for the terminology inherent to German forest law:

- Sustainability (maintenance of the mentioned forest functions on a long/indefinite term)
- “Forest function” and “multifunctionality” (fulfilling use, protective/protection and recreational functions alike)
- Proper forestry

While sustainability and proper forestry remain vague concepts, the FFA provides comparatively clear explanations of forest functions. However, they have no valuation or ranking. This idea is clearly reflected in the very first paragraph (Klose & Orf, 1998).

On the federal level “multifunctional forestry” is a provision of the FFA § 1, according to which the main provisions are a) “proper” and b) “sustainable” forest management. The term “proper forestry” (“ordnungsgemäße Forstwirtschaft”) stands for the legally defined minimum requirements of (ecological but also economic) performance in forestry. “Sustainable” forest management, although being the most elementary requirement for forestry, is not clearly defined, but interpreted<sup>7</sup>. Proper forestry is further explained in § 11, but not down to the operational level. The minimal requirements for the management of forests prescribed in the paragraph mainly aim at the maintenance of forests, namely reforestation of cleared areas or thinned out forest stands. Further legal restrictions are possible through the application of the §§ 12 (introducing protected/protective forests) and 13 (recreational forest).

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<sup>7</sup> According to Klose & Orf (1998), the traditional concept of sustainability is focussed on the economic aspects of forestry, referring to wood production and yield, it was later extended to a broader definition describing the compliance of all forest functions (§ 11). Heutige Begriffswandlung: Drei Säulen Modell Ökologie – Ökonomie – Soziales. See also Orf (2005).

#### 4.2.2 Federal state level

The definition of standards for the management of forests lies with the responsibility of the federal states. The Forest Act of Baden-Württemberg restricts and defines proper forestry under the following categories as “sustainable” (§ 13), “tending” (§§ 14 – 19, “pfleglich”), “planned” (§ 20, “planmäßig”) and “qualified” (§ 21, “sachkundig”), taking into account precautionary action in the field of environmental protection (§ 22, “Umweltvorsorge”).

In addition to the requirement of the FFA, the FABW requires (§ 14)

- The conservation of soil and its fertility (addressed in the FNCA)
- The conservation or establishment of a biologically vital forest
- To carry out the measures necessary for forest maintenance
- To prevent damages by natural hazards including biological agents
- The priority of biological pest management
- The obligation to open up forests, but taking into account demands of landscape, soil and natural environment

Harvesting of immature forest stands is forbidden in § 16 (coniferous forests are immature <50 years, broadleaved: <70 years). The provision that forestry has to be “planned” (§ 20) means that state and communal forests have to develop periodical and annual management plans. Private forests are concerned by this regulation if their size equals 100 ha and more. Plans equaling forest management plans (“Betriebsgutachten”) have to be conducted by private forest owners (30 – 100 ha).

“Qualified“ in the sense of FABW § 21 means that all forest owners have to manage their forests in line with “accepted principles“ (1); skilled state forest officers are responsible not only for the management of state, but also communal forests. Private forest owners can consult forest officials for advice (see Privatwaldverordnung, 1999). This paragraph is the basis for the application of official guidelines for forest management in all classes of forest ownership.

Finally, § 22 specially emphasizes the need to take into account the maintenance of environment and natural goods (1), the “diversity and natural characteristics of the landscape”<sup>8</sup>, the establishment and tending of forest edges, the conservation of habitats for native plant and animal species, and the requirements of a vital and adequate game stock.

The FABW also addresses conversion (§§ 9 – 11), setting high restrictions and clarifying exception.

The act also introduces different categories of protected and protective forest areas (§ 29), which have their counterparts in the FFA, namely for the protection

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<sup>8</sup> “die Vielfalt und natürliche Eigenart der Landschaft”

of soils (§ 30), biotopes (§ 30 a), and against harmful environmental impacts like noise, emissions etc. (§ 31), and finally for recreation (§ 33). Restrictions for clear cuts are higher in these forests.

#### 4.2.3 “Multifunctional forestry” and “close-to-nature forestry”

FABW § 45 provides the aims of forest management in state forests, which are explicitly multifunctional: Aims of forestry are a “sustainable maximal production of valuable wood while fulfilling and sustainably ensuring protective and recreational functions”.

As “multifunctionality” is the core principle of the FABW, it is an obligatory standard to all forest owners. However, state, municipal and private forest owners have slightly different obligations:

- State forests fulfill a highlighted role: According to § 45, they notably serve the common welfare (1), but have to be managed in line with economic principles (2); state forests also serve the purpose of carrying out tasks exceeding the capacities of other forest owners (3), and notably serve research (4). The paragraph specifies exceptions for certain measures usually requiring official permission (6).
- The FABW § 8 provides with particular regulations for communal forests with respect to forest functions, which have to be considered in “planning, measures and miscellaneous projects” of planning authorities. Coordination with forest authorities is required.
- Private forest ownership is often dealt with in dependency of its size. A minimum size of 30 ha brings obligations for example for forest planning, while other thresholds disallow financial support.

Baden-Württemberg is one of the federal states picked up another term as a key conception for its understanding of integrated forest management: Close-to-nature silviculture (“Naturnahe Waldwirtschaft”). This means allowing natural processes work for purposes of man in terms of efficiency and risk minimization, which includes ecological aspects as well (von Teuffel et al., 2005).

The Land Ministry responsible for forests issued an administrative order on forest planning (“Forsteinrichtungsdienstanweisung”, briefly “FED 2000”) in state forests, defining “close-to-nature” as the core conception (MLR, 2002). The implementation of this concept is obligatory in state forests and recommended for communal forest owners. It includes the following elements:

1. Formation and tending of stable forest ecosystems on the basis of forest site mapping, and to a certain degree the integration of natural disturbances for the protection of succession processes.
2. Naturalness in tree species selection, i.e. native main tree species mixed with typical accompanying species

3. Mixed stands are principally aspired and multilayered forest structures in forests that allow single-tree forest management (continuous forestry)
4. Natural regeneration (general omission of clear cuts; clear cuts larger than 1 ha are restricted to exceptional cases)
5. Tending measures is restricted where possible on steering interventions of natural processes
6. Regulation of game stocks allowing natural regeneration without additional protection measures
7. Integrated pest management avoiding the application of biocides
8. Sound forest operations avoiding soil and forest stand damages
9. Integration of nature conservation and landscape protection, including a “sufficient” amount of lying and standing dead wood, the integration of natural processes into planning, forest biotope mapping, and the consideration of specific requirements of individual sites

Factually, “close-to-nature” forestry, as described in the FED 2002, is the concrete interpretation of multifunctional sustainable forestry as provided by the FABW. The principal aim is the restoration of conditions close to those of natural forests. In many cases, this means the conversion of coniferous stands towards mixed forests and an increase of the proportion of old trees and decay phases in forests, but it does not imply the restoration of forests to their natural condition (von Teuffel et al., 2005) because the demands on forests today are very different from what they were at the beginning of the Middle Age, when tree species composition of forests, their structure and abundance in Germany and Central Europe was not, slightly or only regionally, disturbed by human (Hasel & Schwartz, 2002).

#### 4.3 Nature conservation law and emerging legal competition

After the adoption of the new FFA in 1976, a nature conservation act was additionally established in the following year. The new “Federal Nature Conservation and Landscape Protection Act” (FNCA) did not much interfere with the sphere of forest law at its beginning. This was due to the fact that legislation had created a legal exception for forestry, if it is in line with the Federal Forest Act, having in mind the assumption that forestry practices in accordance with the forest law is not in conflict with nature conservation objectives.

While the FFA had not seen any major amendment since its existence, new provisions imposed by international agreements, European Law, scientific knowledge and other sources of norms were mainly implemented in the Federal Nature Conservation Act. In the 1990s, the outcomes of the Convention on Biological Diversity (CBD) and other conservation-related processes and European Law were implemented as amendments of the Federal Nature Conservation Act in Germany. The FFA had practically remained unchanged regarding conservation aspects.

Another fundamental amendment occurred in 2002, which effectively was an implementation of objectives of the National Sustainability Strategy (Federal Government of Germany 2012a; 2012b). In the course of this general amendment, the legal exception for forestry persisted (and still persists), but “Good Practice” (“Gute fachliche Praxis”) was formulated more concretely, thus establishing a legally binding competing standard to “proper forestry” as provided by the (Federal) Forest Act. Good Practice implies to pursue the goal to build natural forests and to manage these sustainably without clearcuts (§ 5(3))<sup>9</sup>. A sufficient proportion of “site-native forest plants” is to be maintained (§ 5(3)). Moreover § 5 provides that forestry (along with agriculture and fishery) fulfills an exceptional role for the conservation of the cultural and recreational landscape. Nevertheless, the provisions are still rather vague. Winkel & Volz (2003) developed a set of 17 criteria for “good practice in forestry”, which provoked a controversial debate between nature conservationists and forest owners. Due to these persisting discrepancies an amendment of the FFA has not been achieved.

#### 4.4 Other relevant acts and guidelines

##### 4.4.1 Water protection

The Federal Water Act was profoundly amended in 2010 with the aim to improve the implementation of the Water Act through common standards and rules and to facilitate the enforcement of the European Water Framework Directive (WFD). Objective of the law is to protect water as a part of the environment, as livelihood of humans, as habitat for animals and plants as well as useable good through sustainable water management. For the management of surface and coastal waters and ground waters the Federal Government determined nationwide uniform requirements. The regulations on the management of surface waters are supplemented with provisions concerning minimum water flow, passability, use of hydropower and riparian zones. These provisions intend to achieve a balance between the use and the protection of water bodies. For instance, riparian forests are set under protection in flood plain areas and conversion of riparian forests into other land-uses is forbidden. In riparian zones it is further not allowed to remove site-indigenous trees and bushes. Compensations are guaranteed for restrictions in forest management due to orders resulting from the Federal Water Act.

The Water Act for Baden-Württemberg regulates the implementation of the federally formulated requirements, including the WFD. Particularly the WFD and its water protection goals affect a wide array of the forestry work in the area of streambanks, wetlands or the whole river basin of streams and water catchment.

The Forest Research Institute of Baden-Württemberg has developed a ‘Handbook Forest and Water’ (Adler et al., 2008) which contains inter alia 35 potential

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<sup>9</sup> “(3) Bei der forstlichen Nutzung des Waldes ist das Ziel zu verfolgen, naturnahe Wälder aufzubauen und diese ohne Kahlschläge nachhaltig zu bewirtschaften. Ein hinreichender Anteil standortheimischer Forstpflanzen ist einzuhalten.“

measures that comply with the WFD. The necessity of implementing the ascertained measures can only be assessed in correlation with local activity programs, which have been issued by the Regional Administrative Authority (Adler, 2008). The remedial measures are separated into 20 groups and each measure is described in an information sheet, including effects, estimated costs, ecological significance etc. Many of the measures can be considered to have a positive impact on nature protection in forests, e.g. the creation of wetlands in the forest or maintenance of riparian forests as well as silvicultural activities aiming to increase the share of deciduous trees or to transform non site-native tree stands.

#### 4.4.2 Soil protection

Like for the other laws, the Federal Soil Protection Act provides framework regulations that are complemented by the federal states. It aims to sustainably safeguard or to restore the functions of the soil by avoiding damaging soil changes and preventing detrimental impacts on the soil. Concerning impacts of forest management on soils, both the federal and the Land Soil Protection Act point to specific regulations in the forest acts on federal and Land level. The Soil Protection Act of Baden-Württemberg refers to the articles 14 and 30 of the Forest Act of Baden Württemberg that prescribe a proper forest management maintaining the soil and its fertility, and for the management in soil protection forests site-adequate stocking and its regeneration in time, respectively. In addition, the 'Order on Management Principles in Soil Protection Forests' provides regulations on tree species, clear cuts, harvest and reforestation for the designated forest areas. This means that the forest stands have to be maintained (respectively established) with site-adapted tree species (§ 1); permanent stocking and natural regenerations have to be aimed at (§ 1); clear cuts are only allowed if they have no negative effects on the site (§ 2); and reforestation has to be accomplished within 1 year (§ 4).

The 'Guideline on opening up of skidding tracks' supports the protection of soils by providing a framework for the maintenance, adaptation, optimization and building of skidding tracks taking into account the legal, economic, silvicultural, pedological and technical conditions as well as requirements of landscape, nature and water protection. The guideline is based on the prevention principle and requires the documentation of the skidding track net and its adherence also in calamity situations.

#### 4.4.3 The Environmental Damage Act (Umweltschadensgesetz)

The Environmental Damage Act of 2007 implements Directive 2004/35/EC on environmental liability with regard to the prevention and remedy of environmental damage. It introduces a regulatory instrument for the sanction of ecological damage (biodiversity, functionality of ecosystems).

The concrete impact on forest management through the liability of forest owners and entrepreneurs is not completely clear yet. The act does not define ecological damage, but refers to other established acts such as the Water Liability Act, the Federal Nature Conservation Act or the Federal Soil Protection Act. Environmental damages therefore include an obligation to prevent deterioration of Natura 2000 elements or soil protection functions, but is limited to “water bodies, soil, and habitats” (§ 2 (1)). There is an obligation not only to restore inflicted damage, but also to actively prevent it (Uyanik, 2008). Indeed the goods protected by the act (water, soil and biodiversity) are on the one hand immediately and stronger influenced by economic activities than in other economic branches (Günther-Dieng, 2010). On the other hand, no claims of any kind have yet been brought to justice until the beginning of 2010, which may indicate that the practical implications of the act are rather insignificant. In fact, due to the regulations of § 19 (old: 21a) of the amended FNCA, forestry represents a case of subsidiarity according to the Environmental Damage Act § 1, preventing a change to the common practices. As a result, the Environmental Damage Act is factually applicable only in protected areas including SACs and SPAs in case of considerable impacts according to Federal Nature Conservation Act § 19(5) on the achievement or maintenance of favourable conditions. Outside protected areas, forest owners and entrepreneurs should usually not be liable as long as their actions are in line with “proper forestry” (Güther-Dieng, 2010).

The applicability within SACs raises interesting points, since there are various possible causes for deterioration of conditions. Generally, the damage level is rather low for violations referring to Article 6 of the FFH directive (Uyanik, 2008); for example, an invasion of *Prunus serotina* qualifies as deterioration (Heydeck & Münte, 2008). Also intensified browsing may present a deterioration.

As a result of the introduction of a concrete sanctioning tool for illegal actions on Natura 2000 sites and due to unsolved questions of liability (but also for other reasons), Baden-Württemberg implements its “Programme for dead wood and habitat trees” (AuT-Konzept) in all state forests, effectively preventing the application of the Environmental Damage Law, thus creating legal security (Lorho, 2010).

A new element is the participation of environmental NGOs, which are permitted to hand in applications, for example in case that authorities do not enforce the act against possible originators.

#### 4.4.4 Act on Reproductive Material (Forstvermehrungsgutgesetz)

Objective of the law is to maintain and improve the forest’s genetic diversity and to promote forestry and its productivity by providing high quality and origin secured forest reproductive material. It regulates the admission, production, marketing, import and export, security of provenances and origin of seeds, seedlings and plant components.

#### 4.4.5 Plant Protection Act (Pflanzenschutzgesetz)

The act regulates the use of plant protection means and aims to avoid risks for the health of humans, animals and the natural environment resulting from the application of plant protection measures. Applicants have to follow the rules of good practice and are not allowed to use plant protection agents if they are expected to cause severe disturbances for the conservation status of the local population of a species. Particular caution has to be paid if species of the FFH directive and the Habitat directive are affected.

#### 4.4.6 Guideline on forest development types

Close-to-nature forestry builds the core of forest management for the forest administration of Baden-Württemberg. The Guideline on forest development types (“Waldentwicklungstypen-Richtlinie”) shall operationalize the common principles of close-to-nature forestry. The term ‘forest development type’ is defined as follows: forest development types comprise forest stands with comparable silvicultural initial state and comparable goals. They describe the most purposeful practices and techniques to achieve the goals taking into account the diversity of functions of the forest (use, protection and recreation function).

Forest development types are described as continuous silvicultural development and operation concepts that are subject to changing silvicultural perceptions. The guideline illustrates for each forest development type the overall concept, the initial situation (forest history, site characteristics, state in the succession, ecological situation), goals in terms of species composition, mixture and structure, and silvicultural measures to achieve the goals.

#### 4.4.7 Guideline on tending of young stands

This guideline (“Jungbestandspflegerichtlinie”) describes common principles of tending and provides detailed information about the necessary tending and thinning operations for different tree species in accordance with the top height of the trees.

### 4.5 Species protection measures in forests

Baden-Württemberg developed four concepts to guarantee the maintenance of species in forests: the Old and deadwood concept, the Species fact sheets, the Natura 2000 management plans, and the Species protection programme of the Land. In combination the concepts shall complement each other and provide a flexible, comprehensive instrument for the protection of the specific habitat and structure requirements of certain species in forests.

#### 4.5.1 Old and dead wood concept

In a concerted action involving research, forest institutions, and species experts the Old and deadwood concept (Alt- und Tothholzkonzzept – AuT) was elaborated

in order to sustainably provide old and dead wood in commercial forests and to integrate this feature in the forestry practice. The AuT concept takes into account species requirements, work security, road safety and profitability. Abandonment of the utilization of smaller stands and tree groups builds the basis of the concept. The selected stands and tree groups are excluded from use and left to natural development and aging until the decomposition of the emerging deadwood. Through the combination of varying sizes of the area and groups, centers of very old and decaying trees, rare single tree structures and larger amounts of standing and laying deadwood are distributed over the entire forest area. Areas are selected according to the presence of rare and protected species, still existing very old forests, important habitat structures and other forest and ecological parameters. Depending on extension, distribution and selection criteria three protection elements are differentiated: forest stands (forest sanctuaries), groups of trees (habitat tree groups), and ecologically valuable specially protected single trees (Table 7). Species depending on these requisites are fostered through the protection of these elements. Focus is given to species protected in the Annexes II and IV of the FFH Directive and other species of the Birds Directive (Annex I). These legally special protected species are considered as umbrella species, whose protection is beneficial for many other species.

**Table 7: Protection elements of the AuT concept (Schmalfuß, 2010)**

<p><b>Aerie and cave trees and “reservoir trees”</b>  <b>What?</b> Protected propagation locations are not utilized; legally protected (BNatSchG §44)  <b>Where?</b> Preferably as focal points in habitat tree groups</p>	<p><b>Forest sanctuaries</b>  <b>What?</b> Permanently established parts of stands or small stands above 1 hectare size, that are (cartographically registered) left for their natural development and decay (no forest utilization)  <b>Where?</b> Criteria for selection are:</p> <ul style="list-style-type: none"> <li>• Age (“old forest” is always selected)</li> <li>• Forests with uninterrupted habitat tradition</li> <li>• Management intensity (arB areas, extensive types are selected preferably)</li> <li>• Site (low increment, special sites, bad passage, scarce roading)</li> <li>• Forest biotope mapping, ecological significance (cave centers, known species distribution)</li> <li>• Spatial location (vicinity to old forest)</li> <li>• Road safety and forest protection</li> </ul> <p><b>When?</b> Selection during forest management planning, pre-selection through forest office  <b>How much?</b> Varies in the forest offices depending on local environment with appropriate stands; in total 5% of forest land, including ‘Bannwälder’ and core area of biosphere reserves</p>
<p><b>Habitat tree groups</b>  <b>What?</b> One or more trees with particular habitat structures and the surrounding trees  <b>Where?</b> In main utilization stands, old wood groups and continuous forests (Dauerwald)  <b>When?</b> Selection before felling measures  <b>How many?</b> 1 habitat tree group with about 15 trees for each 3 hectares (can be more or less!)  <b>How long?</b> Until the natural die back of the tree group; dead wood remains in the stand</p>	

The concept is binding for the state forest but can also be applied in other forest ownerships. The concept shall contribute to the aim of the state forest administration ForstBW to take 7% of the state forest area out of use and leave it for natural development by 2020. First rough estimates assume revenues will be reduced by EUR 4 million annually in the final stage of the implementation (Reger, 2010).

#### 4.5.2 Species fact sheets

Information on biology, distribution, conservation status, endangerment and protection measures, including pictures and distribution maps, are compiled for FFH species domestic in Baden-Württemberg in a species fact sheets and published on the website of the Land Institute for Environment, Measurements and Nature Protection Baden-Württemberg (LUBW). The forest owner can use the information to adjust the selection of the protection elements of the AuT concepts to the species with specific requirements or only regional distribution.

#### 4.5.3 Natura 2000 management plans

A management plan (MaP) is worked out for each Natura 2000 area to maintain or restore the selected habitat of the protected species. The distribution of species with particular requirements on the occurrence of old and dead wood are precisely recorded in the area and targeted protection measures determined which are clearly beyond the instruments of the AuT concept, though, MaPs for less demanding species can refer to the AuT concept. Additional measures can be required if the target species are in a critical conservation status.

As not all species rely on old and dead wood structures in the forest, the MaPs in Natura 2000 areas contain also measures detached from the AuT concept and thus complement the protection of species by safeguarding habitats for species dependent on open forest structures and cleared areas. These structures generated through traditional forest management are either simulated through new methods or the old often not profitable forestry practices revived through environmental contracting.

#### 4.5.4 Species protection programme

The species protection programme is targeted on the protection of animal and plant species that are extremely endangered or occur only on few locations. The single species distributions are described by qualified experts and proposals for their protection are made. The Regional Council and the Rural District Offices implement the suggested protection, maintenance and development measures through environmental contracting programmes or direct maintenance measures. Concrete measures related to the location and the populations exist for several species groups in the forests (e.g. butterflies, dragonflies, moss, flowering plants, ferns). They concern about 7200 populations of over 700 species. The exact location and distribution is available for the forest administrations on geographical information systems. This allows for a better consideration of the highly threatened animals and plants in the forest management.

## 4.6 Strategies and Action Plans

### 4.6.1 National Biodiversity Strategy

The federal government adopted a national strategy for biodiversity in November 2007. It features approximately 330 goals and 430 measures applicable in all spheres of relevance (BMU, 2007).

The national strategy provides with a glossary of relevant terms and definitions. Some of these definitions are in line with those set by article 2 of the CBD (for example “ex-situ conservation”), others are not harmonized with this international agreements (like the term “biodiversity”). Some of the terms are, however, not officially defined at all in the framework of the CBD, e.g. the term “biotope”.

The national strategy reflects the ecosystem approach of the CBD, meaning that “the protection and use of biodiversity should always be considered from both an ecological, economic and social viewpoint” (BMU, 2007: p. 9).

The conservation of biodiversity is targeted at species, habitats and ecosystems occurring in Germany or Central Europe. Implementation of the CBD in the country is based on a considerable range of statutory, institutional and organisational instruments.

Also some special programmes were adopted:

- A national programme (1999) for the conservation and sustainable use of genetic resources for food, agriculture, forestry and fishing, comprising a number of specialist programmes on the individual sub-aspects of genetic resources, together with
- a sectoral strategy on “Forestry and biological diversity” (2000), which was implemented and further developed with the involvement of affected parties and
- autonomous programmes by the federal states.

Concerning forest habitats, the national strategy sets the following vision (BMU, 2007: p. 31):

*“By the year 2020, the conditions for typical biotic communities in forests (diversity in structure and momentum) have been further improved. The trees and bushes of the natural forest community have been completely rejuvenated, primarily via natural means. Semi-natural management forms use natural processes to strengthen the ecological functions. Old and dead wood is available in sufficient quantity and quality. By 2020, forests with natural forest development account for 5 % of the wooded area. When establishing new forests, there is a growing trend in favour of using native tree species. The proportion of non-native tree species is being continually reduced. Historical forest usage forms such as coppice-with-standards forest, simple coppice forest and grazing-forest, with their high potential for nature conservation or recreation, will be continued and, where possible, expanded.”*

The strategy further defines a set of measures:

- To conserve extensive, undissected forest areas
- To conserve and develop natural and near-natural forest communities
- To particularly conserve ancient woodlands, and to conserve and – where possible – augment forest areas with conservation-relevant traditional usage forms by 2020
- To promote contract-based nature conservation in 10% of privately-owned forest land
- To develop a guideline strategy between the Federal and Lander Governments to incorporate biodiversity requirements into all publicly-owned forests by 2010, and to implement this strategy by 2020
- To formulate more clearly the legal principles of sustainable forest management by 2010
- To certify 80% of woodland to high ecological standards by 2010
- To achieve a balanced ratio between forest rejuvenation and wildlife by 2020
- To adapt the forests to the challenges of climate change e.g. by cultivating mixed stands with the maximum possible diversity
- To uphold the Governments undertaking not to use genetically modified organisms or propagatable parts thereof which could pose a threat to forests

The strategy explicitly emphasizes the aim of semi-natural forest management in all land used for silvicultural purposes, and states concrete measures on the legislative level: a general amendment of the FFA towards a clear definition of sustainable forest management; on the federal state level a more widespread promotion of traditional and eco- and nature-friendly forms of forestry; the promotion of rare tree and bush varieties; greater education and advice for land users regarding the conservation of biological diversity; forest owners, forest associations and wood associations follow the principles of sustainable and near-natural forest management (BMU, 2007).

#### 4.6.2 Sectoral strategy “Forestry and biological diversity”

Germany adopted the sectoral strategy “Forestry and biological diversity” (2000) as a contribution to the National Biodiversity Strategy. The paper admits to the aim of a profitable “Close-to-nature forest management” (BMVEL, 2002) on the whole managed area as requirement for a “sustainable and multifunctional forestry”.

The strategy is based on the provisions of UNFF’s MYPOW, the MCPFE’s resolutions, the Work Programme for the PEBLDS, identifies 11 focal actions, including a total of 42 measures (BMVEL, 2002). These focal actions are

- Monitoring (harmonisation of information between federal states and the Federal Government, integration of further aspect of biodiversity on the National Forest Inventory)
- Harmful external impacts on forests (continuation of support for immission monitoring)

In order to achieve the goals formulated in the CBD process, Germany should enforce close-to-nature forestry outside state forests through improved instruments and better financial support; reasonable game stocks; improved implementation of scientific knowledge; monetarisation of other performances of forestry with respect to protective functions (Schäffer, 2007).

#### 4.6.3 Biodiversity Action Plan for Baden-Württemberg

Some of the federal states of Germany have voluntarily developed own biodiversity strategies. Baden-Württemberg does not follow a formally adopted strategy, but applies a number of coordinated tools following the same purpose, which is referred to as “action plan on biological diversity”. It consists of four elements:

- the definition of a basket of key species (“111-Arten-Korb”);
- a voluntary model project for municipalities for the evaluation of conditions for the maintenance of biological diversity by means of target species (“Biodiversitäts-Check für Gemeinden”).
- a research programme on the impacts of climate change on biological diversity that resulted in 5 recommendations for the adaption of nature conservation strategies. They include process protection especially in forest ecosystems in order to ensure a large variety of options; the connectivity of habitats; stabilization of aquatic systems, invasive species and informational instruments (communication and information). (MLR, 2009)
- finally, the action plan focuses on parameters of biodiversity in forests (“Biodiversitäts-Parameter im Wald”). One of the main ecological characteristics of managed forests is the lack of old trees and dead wood due to rotation periods preventing forests from entering succession states of maturing and decay. The Land has developed a programme for “old and dead wood and habitat trees in commercial forests” to improve conditions for certain species which rely on old and dead trees (see chapter 4). The concept is obligatory for state forests.

#### 4.6.4 Overall Forest Strategy 2020

The Federal Ministry of Food, Agriculture and Consumer Protection is developing an “Overall Forest Strategy 2020” (Gesamtstrategie Wald 2020) to find a balance between the increasing demands on forest and its service capability (BMELV, 2010). The strategy shall define, develop and safeguard the future forest for coming generations. The discussion process started in 2008 and shall be finalized in 2011 after three symposia involving researchers, politicians and

forest stakeholders. A bundle of measures agreed between the federal state and the *Länder* shall implement the objectives of the strategy with a partial financing through the forest climate fund. Key questions are (1) which are the pillars for the future forest policy, (2) what is done to improve the quality of nature protection, and (3) which additional contribution can forest and wood industry accomplish to CO<sub>2</sub> reduction (Wendisch, 2010).

#### 4.6.5 Programme for the conservation of genetic resources

In 1998, the Federal Ministry in cooperation with the *Länder* started the development of a “Concept for the conservation and sustainable use of genetic resources for food, agriculture and forestry”, which was finished in 2000 (Paul et al., 2000).

This programme focusing on forest plants is one out of four sectoral strategies for the conservation of genetic resources and is based on a similar paper of 1987. The strategy includes several measures for the conservation of genetic resources.

The aims are formulated as

- Conservation of tree and brush species
- Conservation of their genetic diversity
- Sustainable use of these genetic resources
- Restoration of genotypic diversity
- Contribution to the conservation and restoration of diverse forest ecosystems

Diversity of genes in Germany is threatened through deforestation and fragmentation, immission, climate change, water economy, pests and abiotic hazards, historical forms of forest use, use of unsuitable reproductive material, unnaturally high game stocks, and finally through total reservation of forest areas for process protection (valuable rare populations may extinct through succession). The corresponding work programme for the implementation runs in a four-years cycle. It includes a record and evaluation of forest genetic resources, in-situ-measures (natural and artificial regeneration, conservation of forest stands and individuals), ex-situ-measures (genetic banks, evacuation and seed plantations), conservation in the framework of forest use and identification of common research nucleuses. The National Agro-biodiversity strategy (BMELV, 2007), which was developed as a supplement to the National Biodiversity Strategy, renewed the concept and is now the (new) framework for the sectoral programmes on genetic resources.

#### 4.6.6 National Forest Programme

National Forest Programmes (NFP) are considered as an important instrument to implement international decisions and national goals of forest policy through a continuous participative discussion process on the national and sub-national level. After the 1<sup>st</sup> phase 1999-2000, the 2<sup>nd</sup> phase 2001-2003, and a monitoring process 2004-2006, the process of the German NFP is in a third phase since

2006 on the national level. The topics biodiversity, integrative versus segregative nature protection and multifunctional forestry have been addressed several times and recommendations have been approved by the stakeholders. However, the elaborated recommendations have received only low political attention and did not result in legally binding activities. Due to the lack of commitment and willingness to implement the outcomes, some important environmental NGOs stepped back from the NFP and thus the process has lost in significance (Hauber et al., 2009).

On the sub-national level, Baden-Württemberg was the first federal state (even before the federal government) to start a dialogue process on forests and forestry. Since its initiation in 1998 four dialogue phases have been realized. Theme of the first dialogue phase (1998-2000) was forest and climate, the natural resource wood, forest and biodiversity as well as forest and society. In the second dialogue phase (2001/2002) topics on the agenda were forest maintenance and increase, preservation of cultural landscapes, societal demands on forests and the complex forest and wood: promotion of the use of the sustainable resource wood. The third dialogue phase (2003) dealt with climate consequences for the forests and their appraisal and the theme forest and biodiversity. Themes of the fourth dialogue phase (2006) were development of forest organizations and forest legislation in Baden-Württemberg.

While the first dialogue phase discussed the theme forest and biodiversity in relation to the international processes UNFCCC and CBD and in the context of the federal forest policy, focal points of the third dialogue phase resuming this topic were on the one hand climate change and its consequences for forestry and possible adaptation measures and on the other hand the conflict areas 'species protection versus process protection' and 'segregative versus integrative nature protection' (Hauber et al., 2009). After the fourth dialogue phase the forest program process seems to have come to a standstill since predominantly the forest owner association did not support the process anymore (Hauber et al., 2009).

Recommendations for actions resulting from the discussion on 'segregative versus integrative nature protection' in the third dialogue phase of the forest programme in Baden-Württemberg in 2003 (LUBW et al., 2008):

- Segregation and integration have to complement each other by the implementation of nature protection goals; on large areas integrative nature approaches is given priority.
- A general renouncement of defined protected areas is not possible (e.g. due to species protection or process protection).
- On areas worthy of protection exist an interaction between static and dynamic elements. For nature protection in forests dynamic elements play a central role. Dynamic should therefore be principally allowed, if applicable also through a change of the protected areas.
- Acceptance for specific nature protection measures must be achieved by

the forest owners, if applicable through utilization compensation or payment of indemnities.

- Succession shall be dealt with equally as active silviculture (planting) in the subsidy policy.
- Standards for integrative nature protection are to be developed in the target course of biodiversity.

## 5 Financial instruments

Germany's federal structure subdivides also the public finance system into the Federal Government and the federal state level. There exist direct instruments as well as several tax concessions and taxation rules. Relevant in the context of supporting nature conservation in forestry are mainly the direct instruments. These are on the federal level the Act on the Joint Task for the "Improvement of Agricultural Structures and Coastal Protection" (GAK) and on the state level five guidelines plus one tax instrument.

### 5.1 Financial support on federal level

*Act on the Joint Task for the Improvement of Agricultural Structures and Coastal Protection (Gesetz über die Gemeinschaftsaufgabe Verbesserung der Agrarstruktur und des Küstenschutzes - GAK).* Article 91a of the Basic Law of Germany requires the Federal Government and the federal states to handle certain areas considered important for the public in cooperation. Based on these so called 'community tasks' the law on the 'Joint tasks for the improvement of the agricultural structure and of the coast protection' (GAK) was established in 1973. The state and federal governments plan and agree on principles in agriculture and forestry and finance the measures together. On the basis of these principles the federal states elaborate own regulations. In this way, a nation-wide uniformity is achieved which at the same time respects regional particularities of the federal states.

The objective of the GAK is to ensure productive forestry and agriculture adapted to future requirements and to improve their competitiveness on the common European market. The programme shall also strengthen the rural area in Germany. In the framework plan jointly developed by the Federal Government and the federal states for the period of a four years lasting financial plan, the principles of the support measures are formulated. This plan contains the rules governing the prerequisites, type, and intensity of the aid measures as well as the distribution of the available resources within the nation and different states. The responsibility for implementing these measures is with the federal states, which issue their own guidelines. The costs are shared between the Federal Government and the federal states, which pay 60% and 40%, respectively. Since the GAK framework plan is the core instrument to implement the Common Agricultural Policy of the EU, support principles of the GAK are often correlated to the aims of the European Agricultural Fund for Rural Development. This correlation offers the possibility for the federal states to co-finance some measures by the EU.

For forestry the GAK pays investment grants and covers costs up to a (measure specific) percentage. Applicants can be private forest owners, farmers, forestry groupings and rural communities.

The contemporary framework plan for 2010-2013 names four areas in forestry, which each entail several measures. Along with the support of afforestation, close-to-nature forest management, forest federations, and forest infrastructure is under the direction of the forestry support section. Concrete targets concerning the issue biodiversity are not stated, only in general terms referring to the ecological productivity of forests. Table 8 presents the four specific areas, the objectives and the individual measures eligible for support.

**Table 8: Overview forestry measures financed by GAK in 2010-2013**

Measure category	Objective	Individual measure
Afforestation	Increasing the forest area through afforestation or natural forest growth on agricultural resigned or fallow areas taking into consideration interest of nature and landscape protection by investment grants and by compensating income losses after afforestation on former agricultural areas	<ul style="list-style-type: none"> <li>• Preparatory work</li> <li>• Afforestation (investment)</li> <li>• Repair plantings</li> <li>• Follow-up measures</li> <li>• Annual afforestation premium</li> </ul>
Close-to-nature forestry	Increasing the stability and the ecological and economic productivity of forests by paying a one-time subsidy	<ul style="list-style-type: none"> <li>• Conversion</li> <li>• Reforestation</li> <li>• Maintenance</li> <li>• Repair plantings</li> <li>• Structural improvements of young stands</li> <li>• Advance plantings and underplantings</li> <li>• Silvicultural measures</li> <li>• Liming</li> <li>• Insecticide-free pest control</li> <li>• Use of horses</li> </ul>
Forest federations	Overcoming structural disadvantages due to small areas and ownership fragmentation through cooperation in forest federations. Start-up financing forestry groupings and granting first investments in order to improve production, working, and forest market conditions by paying a one-time subsidy	<ul style="list-style-type: none"> <li>• First investments</li> <li>• Administration</li> <li>• Mobilisation premium of wood</li> </ul>
Forest infrastructure	Improving the forest infrastructure in remote areas in order to provide access for a sustainable management, prevention of and coping with damages, and recreation by paying a one-time subsidy	<ul style="list-style-type: none"> <li>• Forest road construction and maintenance</li> <li>• Timber storage facilities</li> </ul>

## 5.2 Financial support in Baden-Württemberg

### 5.2.1 Guideline sustainable forest management

The core funding instrument for the safeguarding of forest functions is the 'Guideline on Sustainable Forest Management (RL NWW)'. The guideline's principal aim is to support sustainable forest management to secure the different functions of forests. Forest owners receive financial aid for measures in the frame

of close-to-nature forestry, which warrant the sustainable development of forest functions. The measures serve in particular the development of a sustainable forest management according to the pan-European criteria.

Beneficiaries are natural persons, juristic persons and forest corporations. The EU, the state government and the Land Baden-Württemberg share the costs. Measures must be conducted according to approved forest principles and have to fulfill specific silvicultural requirements as listed in the guideline. In the case of mixed stands, the mixture must be ensured persistently. Additional requirement is the commitment to the obligations and duties for 10 years.

The guideline includes a wide array of measures ranging from silvicultural measures, such as afforestation or reforestation through soil protection liming and forestry road construction to special aid with exceptional damage incidents, which serve directly or indirectly the maintenance of forest functions (Table 9). All measures related to silviculture evidently contribute to the maintenance and improvement of protective functions (e.g. soil and water protection, erosion protection, climate protection, air pollution prevention). Also an increase of the forest area has generally a positive effect. The principles for afforestation, pre- and under-planting and natural regeneration concerning deciduous tree species foster the diversity of species and hence the stability of forest stands. The support of forest infrastructure serves the objective through better access and thus reduced driving in forest stands. Forest corporations play a vital role in the small sized private forest areas where sustainable management is often neglected and are important means to enable and improve the management of these areas. Maintenance of habitats and biotopes, creation of moist areas and restoration of streams as well as forest environmental measures are some of those measures directly influencing nature protection and biodiversity in forests. Environmental contracting to implement the protection concept of Natura 2000 is also possible within the RL NWW up to seven years on the basis of management plans.

**Table 9: Eligible measures of the guideline NWW**

Category	Measures	Financial support
Part A: Afforestation	<ul style="list-style-type: none"> <li>• Afforestation of former agricultural sites</li> <li>• Afforestation of other sites</li> </ul>	subsidy
Part B: Close-to-nature forestry	<ul style="list-style-type: none"> <li>• Preparatory work, certifications, periodical management plans and operating certifications</li> <li>• Conversion, development, restoration of site-adapted deciduous and mixed stands through reforestation, advanced planting or natural regeneration as well as repair planting</li> <li>• Tending of young stands</li> <li>• Soil protection liming</li> <li>• Building of close-to nature forest edges</li> <li>• Insecticide-free pest control</li> </ul>	Partial financing in form of a subsidy (between 50 and 90% of the costs)
Part C: Forest	<ul style="list-style-type: none"> <li>• First investments (machines and</li> </ul>	Partial financing in form

corporations	<p>devices, investments for the concentration of the timber offer, investigations and market analyses</p> <ul style="list-style-type: none"> <li>• Administration/management</li> <li>• Timber mobilization premium</li> </ul>	of a subsidy (between 40 and 60% of the costs) for investments and administration; fixed amount financing in form of a subsidy (between 1.00 and 2.50 EUR/solid m <sup>3</sup> ) for timber mobilization
Part D: Forest infrastructure	<ul style="list-style-type: none"> <li>• New road constructions</li> <li>• Road maintenance (generally only after a calamity)</li> <li>• Timber storage facilities</li> </ul>	Partial financing in form of a subsidy (between 30 and 70% of the costs)
Part E: Other ecological measures and immediate aids	<ul style="list-style-type: none"> <li>• Maintenance of landscape, biotopes and habitats</li> <li>• Wetlands and streams in forests</li> <li>• Environmental contracting Natura 2000</li> <li>• Forest environmental measures</li> <li>• Timber transportation to storages</li> <li>• Wet storage after natural disasters</li> <li>• Interest reduced loans after natural disasters</li> </ul>	Fixed amount financing

For the period 2007-2013 EUE 47.8 million are planned to be spent for the guideline NWW. EUR 3.5 million from the EU, and EUR 44.3 million from the Land Baden-Württemberg (including means from GAK). The last annual reports of the forest administration reveal that the largest share in terms of both applications and budget goes to reforestation and silvicultural measures, mainly pre- and underplanting and tending (ForstBW, 2008; 2009; 2010a). Liming is another large asset in the support budget. Only about a dozen applications are registered for maintenance of habitats and streams in forests. Figures for measures in Natura 2000 areas were not available.

### 5.2.2 The environment compensation program (Umweltzulage Wald)

The environment compensation program (UZW) focuses on the support of the conservational and recreational functions of forests. Originally enacted in 1991 to fund forest management in forestry disadvantaged areas, the program shifted clearly towards support for the preservation of certain protection and ecological functions in the forest in the year 2000. This direction was further pursued in the last revision in 2008, in which also the name from forest compensation payment changed to environment compensation payment. Since then extensive management in Natura 2000 forest areas can be compensated. The actual guideline for the period 2007-2010 is now entitled 'Guideline of the Ministry for Food and Rural Areas for the Financial Support of Forest Environmental Measures and NATURA-2000 Areas in Forest'.

Its objectives are to maintain forests with certain protection and ecological functions and to secure the sustainable implementation of these functions. Through

financial support of private forest owners sustainable, multifunctional forestry shall be adhered. In particular the program shall compensate additional costs and income losses of private forest owners that arise due to voluntary limitations in forest use in the frame of Natura 2000 or due to voluntary obligations in the frame of forest environmental measures. Private forest owners and certain cooperatives (“Realgenossenschaften”) can apply for the financial support, which is provided by the state of Baden-Württemberg and the European Union.

The amount of the payment is dependent upon whether the forest property contains a soil protection, recreation or water protection forest or FFH areas. Additional precondition for the environment compensation payment is the compliance with certain obligations. The forest areas must be managed according to the principles of proper, close-to-nature forest management. The applicant is also obliged to a series of measures, which preserve protective and ecological functions of the forest (Table 10), to be followed over a period of five to seven years.

**Table 10: Obligatory measures to be fulfilled by the forest owner to receive financial support**

Category	Obligatory measures	Financial support
Environment compensation B	<ul style="list-style-type: none"> <li>Abandonment of extensive driving during harvest</li> <li>harvest and skidding methods with low impact on soil</li> </ul>	40 EUR/ha
Environment compensation E	<ul style="list-style-type: none"> <li>Forest management taking into account requirements of recreation forests (i.e. increased safety standards and permanent access to forests)</li> </ul>	20 EUR/ha
Environment compensation W	<ul style="list-style-type: none"> <li>Abandonment of the use of pesticides on timber stored on piling sites in water protection areas</li> <li>Alternative: transport and storage of timber outside the water protection area</li> </ul>	20 EUR/ha
Environment compensation N	<ul style="list-style-type: none"> <li>Maintenance of the FFH forest habitat types in terms of species richness and habitat structures in their characteristic, quality and spatial extension</li> <li>Maximal 25% non-endemic tree species</li> </ul>	50 EUR/ha

Previously from 2000 to 2006 more than 10.000 applicants received EUR 43.68 million to manage 152.000 hectares. For the period 2007-2013 in total EUR 41 million are foreseen, annually approx. EUR 5.86 million.

### 5.2.3 Income loss premium

To compensate income losses of forest owners after afforestation of agricultural areas, the ‘Guideline of the Ministry for Food and Rural Areas on the Grant of an Income Loss Premium (EVP)’ was passed firstly in 2002. The actual version of the guideline was amended in 2008.

Natural and juristic persons as well as forest corporations can apply for the support, which is jointly financed by the Land Baden-Württemberg, the state government and the EU. Allocated means for the period 2007-2013 amount to EUR 7.3 million.

First-time, site-adapted afforestation of agricultural areas with deciduous tree species or mixed stands with at least 40% broadleaves are subject of the financial support. Afforested areas have to be managed properly. The premium is paid annually as fixed amount up to 15 years and spans between EUR 300 and maximum EUR 700 per hectare for arable land, and up to EUR 300 per hectare for grassland. Mixed stands receive a reduced amount (85%) of the premium.

During the last support period from 2000 to 2006, 720 ha of agricultural areas were afforested with deciduous or mixed stands with a financial contribution of EUR 5.7 million. Although agricultural areas will be continuously abandoned in the future, the area potential is relatively low. However, it can be assumed that the EVP contributes to improve the protection function of forests and influences positively forest owners in their choice for certain tree species and thus serves biodiversity in forests.

#### 5.2.4 Support of nature parks

The regulation of the Ministry of Rural Areas of the granting of compensation payments to nature parks in Baden-Württemberg supports the implementation of landscape management measures, public relations work or the development of a recreational worth through private citizens, communities and administrative districts in the areas of nature parks. It aims to maintain the diversity and beauty of nature and landscape in nature parks, to develop nature parks as exemplary recreation landscapes, and to achieve sustainable tourism and environmentally sound land use, which serve the diverse use and the diversity of species and biotopes. Support is granted for measures whose objectives are compatible with those of the nature parks.

The EU, the state government and the Land Baden-Württemberg pay the financial support, which is set at EUR 10.5 million for 2007-2013. Support is given as partial financing of the eligible measures (Table 11). Investments for the maintenance of the natural heritage and the development of competences and public relations work receive up to 70% of the eligible costs. The other two categories are covered by 50% of the eligible costs.

**Table 11: Eligible measures for the support in nature parks**

Category	Measure
Natural heritage	Investments for the maintenance, restauration and improvement of the natural heritage and cultural landscapes
Development of competences and public relations work	Studies for the implementation of concrete measures, provision of information on the nature park, development of competences for the implementation of the nature park plan, marketing of regional products

Development of the recreational value	Investments in infrastructure for integrated, environmentally adapted and sustainable recreation and visitor direction
Cultural heritage	Investments and studies with regard to the maintenance, restoration and improvement of the cultural heritage

### 5.2.5 The ecological account (Ökokonto)

The provision on the acceptance and crediting of previously implemented measures for the compensation of impacts resulting from interventions (ecological account) belongs to the rubric 'impact regulation' under nature protection law and has been approved by the land government in 2010. The ecological account aims to build a preventive pool providing compensation measures and areas that can be used to compensate future impacts on nature and landscape in an appropriate functional, spatial and temporal correlation to the interventions. Advantages of the ecological account are seen in that measures for future interventions can be implemented in advance (temporal decoupling) and independently of the location of the intervention (spatial decoupling). Compensation measures to be accepted in the ecological account have to generate a sustainable and ecological added value, i.e. development instead of maintenance measures. Measures which are either obligatory by law or funded with public means are not acknowledged. The provision specifies the conditions for accountability: The measures have to be carried out with approval of the nature conservation authorities, the positive effect has to be acknowledged, and the occupation of the area for purposes of nature conservation has to be guaranteed. The trade with areas with points on the ecological account or with the eco-points as such is allowed.

### 5.2.6 Forest maintenance tax (Walderhaltungsabgabe)

The forest maintenance tax is not a subsidy for forest owners. Instead it is a provision in accordance with the FABW § 9 (4) for compensating impacts of conversions of forestland into other land uses. The FABW specifies compensatory measures such as afforestation of appropriate areas nearby or the maintenance of a protective stands in order to compensate the negative effects of forest conversion on the protection and recreation function of forests. In case it is not possible to compensate the impact of forest conversions, a duty has to be paid. Its amount depends on the severity of disturbance on these functions, the value or benefit for the causer and the economic reasonableness. The provision explains these criteria in detail. The minimum payment is 0,60 EUR per m<sup>2</sup>, the maximum 10% of the land value after conversion but can exceed this maximum twofold if designated protection or recreation forests are converted.

## 6 Informational instruments

### 6.1 Education

In Germany, it is possible to work in the forestry sector with several professions. The most basic professional level is that of *Forstwirt* and the practical training takes three years.

Further, five universities of applied sciences (*Fachhochschule*) provide education on engineer level. They are located in Hildesheim-Holzwinden (Göttingen; Lower Saxony), Eberswalde (Brandenburg), Weihenstephan-Triesdorf (Freising; Bavaria), Rottenburg (Baden-Württemberg) and Erfurt (Thuringia). The study takes 4 years and results in a Bachelor of Science (BSc) degree, which is needed to become a forester.

At the university you can reach next to a Bachelor of Science (3-4 years), also a Master of Science (MSc) degree in forestry (4-6 years in total). The four forestry universities are located in Freiburg (Baden-Württemberg), Göttingen (Lower Saxony), München (Freising; Bavaria) and Tharandt near Dresden (Saxony). With an MSc degree you can continue with a PhD. But, you can also apply for the referendary (*Referendariat*) or “trainee” (Baden-Württemberg), which is a two-year practical training that prepares for a career as *Beamter* (forest officer) at a state or municipal forest organisation.

### 6.2 Advisory services for private forest owners

Based on § 53(1) 3 and (2) and § 55 (6) of the FABW, the government decreed a legal ordinance on state advisory and extension services for private forest owners (“Privatwaldverordnung”). According to § 1 of the decree, state advisory services have the purpose of helping private forest owners in managing their forests properly, including “ecological issues”. Advisory services (“Beratung”) are free of charge (§ 1 (3)) as long as such consulting is limited to information.

On the other hand, the extension services provide occasional or permanent operational involvement in business actions. Such extended services are charged on the basis of a catalogue developed by the authorities but they are not bound to be commercially profitable for the public forest administration body. They aim at public goals, including the promotion of small privately owned forests and protective and recreational functions or nature conservation goals (Krott, 2005). Extended services include various management issues like administration, sales management and similar activities for forest ownership up to 200 ha (§ 2). Special conditions apply to private forest ownership of more than 200 ha or less than 30 ha. Other services in accordance with § 65 of the FABW (responsibilities of forest authorities) are possible, including the evaluation of the forest’s states for third parties in the framework of forest management planning (§ 3).

## 7 Certification

Forest certification is a voluntary market oriented tool based on principles, criteria and indicators that are perceived to contribute to ecological, social and economic sustainable management of forests. In principal forest holdings pursue management standards that surpass the legal requirements and receive therefore a certification for sustainable utilization. In Baden-Württemberg two certification schemes are significant: PEFC (Programme for the Endorsement of Forest Certification Schemes) and FSC (Forest Stewardship Council). With 82% of certified forest area (PEFC, 2010), the PEFC covers the largest share of area in Baden-Württemberg. While FSC has certified only 3% (FSC, 2010), which is almost entirely communal forest, PEFC attracts more private forest owners (71% of all private forest holders). The complete state forest area and 81% of communal forests in Baden-Württemberg are also certified according to the PEFC criteria. In a further step the complete state forest area of Baden-Württemberg will be certified by FSC, following a ministerial decision in 2012.

The effects of certification on nature protection are controversially discussed. While Thoro et al. (2003) do not see essential differences in the silvicultural consequences of both certificates, other authors indicate severe discrepancies in certification standards and procedures (Klein, 2003; Savcor Indufor, 2005). Häusler & Scherer-Lorenzen (2001) compared criteria that conceivably have a direct or indirect effect on biodiversity (Table 12). The greatest overall effects on the preservation and furtherance of species diversity are seen in the designation of a reference area, strict requirements for biotope conservation and cutting time (Häusler & Scherer-Lorenzen, 2001). In terms of these criteria, FSC makes either stricter provisions or at least aims for an improvement, while PEFC maintains the legal standard or does not determine provisions. However, many criteria are widely comparable and may have similar effects on the forest area.

**Table 12: Comparison of certification systems (Häusler & Scherer-Lorenzen, 2001; PEFC, 2009; FSC, 2010)**

Criterion	FSC	PEFC
<b>Reference area</b>	At least 5% (in publicly owned forests)	No provision made
<b>Use of pesticides</b>	No chemical biocides are used	Permissible as "last resort" within the scope of integrated forest conservation
<b>Manuring (except for liming)</b>	Prohibited only "for the purpose of obtaining increased yield"	Prohibited only "for the purpose of obtaining increased yield"
<b>Soil cultivation</b>	No large-scale cultivation that interferes with the mineral soil	No large-scale cultivation that interferes with the mineral soil
<b>Clear cutting</b>	Not practiced as a general principle (exceptions permissible)	Not practiced as a general principle (exceptions permissible)
<b>Time of cutting</b>	Interventions are to be adapted if endangered species are affected	No provision made

<b>Biotope conservation</b>	Management activities in forests with high protective value ought to preserve or augment their characteristic features	Forest management makes special allowance for protected biotopes
<b>Species composition</b>	Site-adapted forest stands are targeted	Mixed stands with site-adapted species shall be maintained
<b>Cultivation of non-native trees</b>	Permissible, but only as minority share	Permissible
<b>Woody debris strategy</b>	Preservation and enhancement, in average 10 biotope trees per hectare	Ought to be retained to a sufficient extent
<b>Natural regeneration</b>	Is given priority	Is given priority
<b>Natural succession</b>	Allowed	Not mentioned
<b>Genetically modified organisms</b>	Not allowed	Not allowed

## 8 Monitoring and planning tools

### 8.1 National Forest Inventory

The National Forest Inventory (NFI) is carried out on the basis of § 41a (4) FFA every ten years as a large-scale survey of forest status and forest production potential conducted on a random basis with permanent sample points. This inventory is harmonized across all federal states and all forms of ownership and covers the whole forest area, independently of protection status. The first inventory was conducted 1986-1989 in the old federal states; the second in 2001-2002 included also the new federal states. The next inventory is currently prepared for 2011/2012.

The technical details of the previous inventory of 2001 are described in the "Survey instructions for the 2nd National Forest Inventory (2001 – 2002)". Parameters aiming to assess the sustainability of the forest management include forest area, occurrence of tree species, growing stock, timber utilization, and increment. To appraise the ecological stability of forests, the second NFI incorporated new parameters that are relevant to nature protection embracing naturalness of tree species composition, amount of dead wood, length of forest edges, formation of the brush layer and ground vegetation, browsing damage, stratification of forest stands and existence of particular protected biotopes.

An analysis of the inventory methods and the results of the second NFI acknowledge the integration of the new parameters as a substantial improvement but see deficits in the current procedure for a reasonable assessment of the ecological forest condition (Reif et al., 2005). Main deficiencies are identified within the situation of different ownership types (small and large forest owners), the situation in different forest function and protection area types, species composition in the herb and brush layer, differentiated analysis of the forest structure and information on forest textures (Reif et al., 2005). The available data reveal positive trends of the forest development from a nature conservation perspective. However, it is hardly possible to explain whether the improvement is a result of forest and nature conservational policy instruments, exterior effects or an increasing dissemination of close-to-nature silvicultural concepts (Reif et al., 2005).

### 8.2 Forest planning and mapping

Both nature conservation and forestry have a detailed planning system. Core of the nature conservation planning is the landscape planning (§ 13 FNCA), which is often supplemented by other plannings (species and biotope protection planning, Natura 2000 management plans etc.). Significant in forestry are the forest framework planning and the forest management plans. Forest biotope mapping and forest site mapping are important elements for the implementation of nature protection goals in forests.

### 8.2.1 Forest framework planning

The aims of this (non-mandatory) forest framework planning are the improvement of the forest structure for the maintenance of forest functions, integrating objectives of spatial and landscape planning (FABW § 5). The formulation of forest political guidelines above the local and forest unit level for the maintenance, development and management of the forest located in the planning area shall promote and safeguard the use and protection functions of forests. Statements on forest maintenance, afforestation/succession or forest protection areas are relevant for species protection although the planning level allows only for general statements. Usually the forest framework plan is binding for the forest offices but it can also be established as a development plan according to the land planning law (§ 2 (1)). Forest biotope mapping, forest function mapping and forest site mapping are all included in the forest framework planning. By now forest framework plans are not set up for whole Baden-Württemberg.

Direct significance for species protection have the periodical and annual forest management plans (§§ 50, 51 FABW). Periodical forest management plans (“Forsteinrichtung”) are developed for state and communal forest in a ten years cycle. Owners of private forests of a size of 30 – 100 ha may be obliged to prepare plans equaling FMPs (“Betriebsgutachten”), while FMPs are mandatory for private forests exceeding this figure. Periodical FMPs aims to coordinate all operating schedules in order to sustainably safeguard all forest functions. Additionally annual FMPs based on the 10-year-FMP are required for operational management.

The periodical forest management planning presents the universal planning and also controlling tool for the integration of all requirements on forests for forest management on stand level. The planning parameters are precisely defined in a decree (“FED 2002”), and represent the Land’s interpretation of close-to-nature-forestry (see chapter 4.2.3.). They take the results of forest function mapping, forest site mapping, forest biotope mapping as well as protection areas including the Natura 2000 areas into consideration. Moreover, special inventory data is available, which serve mainly for forest use but also include some ecological parameters. Based on this data, and depending on the respective forest stand (its condition, age, species composition etc.), strategic aims of the forest management unit and provisions of higher planning levels, individual objectives and operational measures are prescribed for each stand.

### 8.2.2 Forest mapping

The two instruments for mapping areas relevant for nature and species protection are the forest biotope mapping and the forest function mapping.

Forest biotope mapping covers the two legally protected areas ‘ biotope protection forests’ (FABW § 30) and ‘protected biotopes’ according to the LNCA (§ 32). Furthermore other non-legally protected areas of importance for species conservation are included in the mapping.

The first compilation of the Forest Biotope Mapping was carried out between 1989 and 1998 in all kinds of forest ownership on the entire forest area of Baden-Württemberg, resulting in a mapped biotope area of about 82.000 ha (ForstBW, 2010a; 2010b). As there was no spatially comprehensive sampling grid, the inventory is actually referred to as “selective forest biotope mapping”. The capturing unit is the biotope itself, i.e. the habitats are either located or they are not. Main criteria for the selection are rareness and vulnerability. Forest authorities inform forest owners affected by the biotope mapping and provide recommendations regarding the management of the biotopes. Since 2002 the mapping is adjusted by the forest administration in regular cycles, usually in beforehand of the periodical forest management planning.

The aim of this data collection is to ensure that requirements of nature conservation are taken into consideration in planning processes on both, (1) the level of forest management units (results contribute to forest management plans and to specific measures like amelioration) and (2) spatial and landscape planning of the Land, the regions and communities alike: urban land use and specific planning, financial support for tending measures and connectivity of habitats, and especially the designation of sites for the Natura 2000 network.

(1) Forest management unit:

Results of the Forest biotope mapping are integrated in the ten years periodical and yearly forest management planning. Long-term maintenance of biotopes and the consideration of nature protection issues is thus guaranteed in the forest management.

(2) Spatial and land use planning:

For landscape planning on the Land, regional and local level, results of the forest biotope mapping are essential contributions for the survey and assessment of nature and landscape, the ascertainment of spatial objectives of nature and landscape maintenance as well as the development of landscape management measures. Forest biotopes are also significant for forest policy. They serve as a basis for special nature protection planning (e.g. in nature parks), in the conception of nature preference areas, for biotope network plans or other instruments of nature protection (e.g. intervention regulations).

The forest function mapping comprises all protection/protective and recreational forests and integrates the results of the forest biotope mapping. It includes further the forest protected areas according to § 32 of the FABW (strictly protected forest reserves and designed forest reserves). Mapping has been conducted since 1975 by the Forest Research Institute of Baden-Württemberg on the entire forest area throughout all forest ownership types. Basis for the mapping is the ‘Guideline on forest function mapping’ (Volk & Schirmer, 1998), which is currently revised and adapted to recently emerged demands on forests. Major revisions are expected for recreation and the global climate protection function, which cannot be assigned to specific forests by now.

Forest Function Mapping is crucial for forest planning on different scales. It is not only a helpful tool for forest planning and management but also builds the basis for the forest framework plans and a decision support for spatial planning on federal, regional and landscape level. It has been an important instrument for the maintenance of forest areas.

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