

*Working Papers*  
*International Series*

99/1

*Forest Policy and Forest Economics*  
*Department of Forest Sciences*

***Forests, Forestry and Forest Policy in  
Switzerland***

*Basic Information and Institutional Framework*

Extended Version of the Forestry Case Study Switzerland  
prepared for the Silva Teaching Module "Forestry in  
Changing Societies in Europe"

*Franz Schmithüsen and Willi Zimmermann*

*Zurich 2002*



Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich



This document is the extended version of the Forestry Case Study Switzerland (Arbeitsberichte Internationale Reihe Nr. 99/1, 25p.) which has been prepared as a contribution to the Silva teaching module “Forestry in Changing Societies in Europe”. The purpose of the document is:

- to provide basic information and references on forests, the forest sector and wood processing sector for comparative country studies;
- to present an outline of recent policy developments that have been induced by a wide range of private and public demands as well by the citizens evolving perceptions and attitudes;
- to highlight specific conditions and peculiarities of forestry in Switzerland in order to facilitate comparative analyses with other countries.

Generally the paper should serve the reader and in particular the students to continue with their own investigation on the variety of forest conditions, country specific policy objectives and instruments as they exist in Europe.

We thank Georg Iselin and Thomas Volken, assistants at the chair, for their help in preparing the report.

*F. Schmithüsen  
W. Zimmermann*



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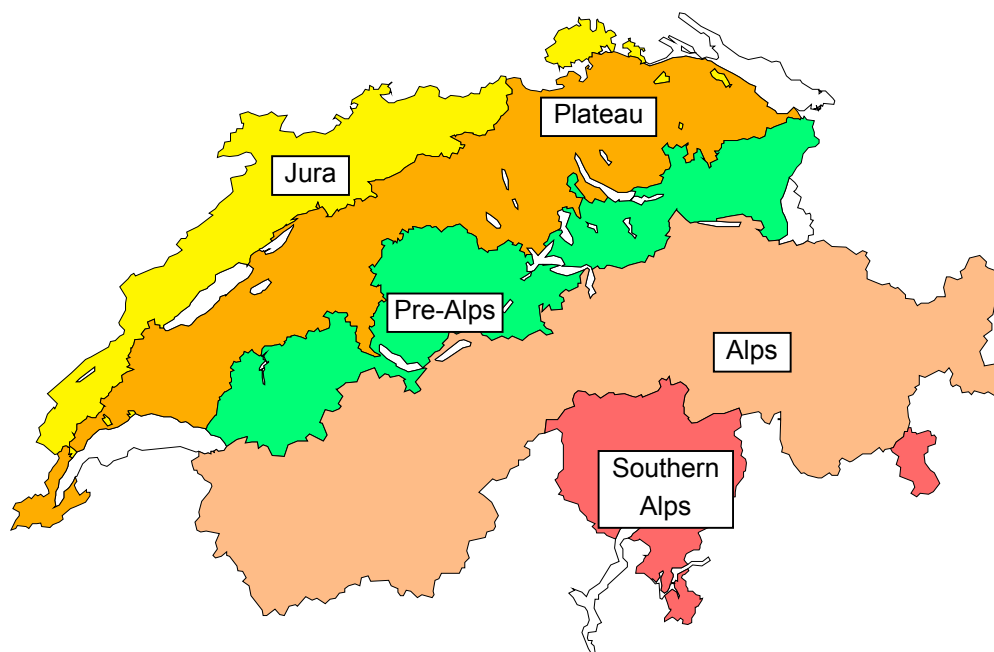
# 1 General Country Information

## 1.1 Natural Conditions

Country Information: Switzerland lies in the central part of the Alps which extend from Southern France to Austria and Slovenia. The Alps and Jura mountains with the central Plateau in between determine the country's broad geographical zonation (Bär 1979; SAEFL 1997). Its surface covers an area of 41,285 square kilometres. The greatest distances of 350 kilometres and 230 kilometres occur from west to east and north to south, respectively.. The highest elevation point is the Dufourspitze in the Monte Rosa massif in the canton of Valais (4,634 metres above sea level) while the lowest is the Lago Maggiore in the canton of Ticino (193 masl). The geological formation was principally determined by the collision of the European and African plates as well as by several periods of glaciation. Four major rivers originate in the Gotthard massif and take their course towards different European regions: The Rhine flows first through the Eastern part of the country into Germany, then into the Netherlands where it ends in the North Sea; the Rhone turns westward into France and ends in the Mediterranean Sea; the Ticino merging with the river Po in Italy; and the Inn through the Engadin into Austria and Germany, merges with the Danube and brings its waters to the Black Sea.

Regional Diversity: Switzerland can be divided into five regions (BRP 1998) with the following percentages of the territory (Fig. 1): Jura (12%), Plateau (23%), Pre-Alps (16%), Alps (40%) and the Southern Alpine slopes (9%). The diversity of climatic and soil conditions ranges from lowlands to alpine elevations. The rapidly changing topography in the Alps and the Jura mountains and the relief determined by the great valleys led to a large variety of landscapes and vegetation forms. Beyond the timber line mosses and lichens are found, and in a short distance a Mediterranean flora with chestnut forests dominates in the southern foothills. In higher elevations conifer forests are common whereas in the central part and in the Jura deciduous and mixed forests are a predominant.

Figure 1: Major Regions of Switzerland



Source: SAEFL, 1997b, p.7.

## 1.2 Social, Economic and Political Aspects

**Population and Language Groups:** The population (1996) amounts to 7.1 million of which 17% are in the age group below 15 years and 15% in the group above 64 years (SFSO 1998, 16-17). 19% of the inhabitants are expatriates. The average population density is 171 persons per square kilometre. However, it varies considerably from region to region with a large concentration in the Central Plateau, the Northern foothills of the Jura Mountains and in the Southern parts of the canton Ticino.

Switzerland is a country with four main language groups, in which people with different cultural habits and historical traditions live together. According to the census of 1990 the main language groups are German (63.7%), French (19.2%), Italian (7.6%) and Romansch (0.5%). 8.9% of the population have indicated another language as means of communication.

**Employment and GDP:** 3.8 million (1996) are regularly employed in full- and part-time positions. 4.7% of the labour force are occupied in the primary sector, 26.5% in the secondary sector and 68.7% in the tertiary sector (SFSO 1998, 16-17). The unemployment rate was 3.7%.

In 1996 the gross domestic product (GDP) per capita was 25,400 US\$ (SFSO 1998, 16-17). It was considerably higher than the average GDP per capita in the EU countries (19,333 US\$) in the same year. However, while the average annual increment in real terms of the EU countries was positive (+1.4%) over the period 1990-1996, the development of the Swiss GDP per capita was slightly negative (-0.1%).

**The Swiss Federal System:** Since 1848 Switzerland is a federal state with a political structure at three levels: the Federation, the Cantons and the local Authorities (Linder 1998; SFC 1998). The Federal Constitution (FC) determines the division of competences between the Federation and the Cantons. Powers which are not constitutionally given to the Federation are original cantonal competences. Any new transfer of powers to the Federation requires a change of the Swiss Constitution (Art. 3 FC).

Since 1978, when the Canton Jura has been created, the country is formed by 23 Cantons, three of them are divided into two half-cantons for historical reasons (Art. 1 FC). Each canton and half-canton has its own constitution, parliament, government and courts.

The cantons are divided into representative political communes in which decisions are made by local councils (ca. 80%) or by the assemblies of all citizens (ca. 20%). The degree of autonomy given to local authorities is determined by the cantonal constitutions and varies widely. At present there are almost 3,000 communes; the number tends to become smaller due to the merging of local units.

**Elements of Direct Democracy:** In addition to the representative elements (election of the members of parliament) the Swiss political system shows two significant elements of direct democracy: the compulsory respectively the optional referendum and the popular initiative. Both instruments are constitutionally founded and currently used in different ways on the three federal levels of the country's political system. In general terms the referendum is an approval or a veto cast by a popular ballot with regard to acts of parliament and/or government. The popular initiative is a political instrument by which citizens may seek constitutional amendments, changes in legislation or the adoption of new legislation. At the federal level only popular initiatives aiming at constitutional amendments are possible (Art. 118ff. FC).

**Political Organisation of the Federal State:** The members of Parliament are elected by some 4.6 million citizens. The Federal Assembly has two Chambers: the National Council with 200 members elected by common rules valid throughout the Federation and the Council of States with 46 representatives elected (2 for a Canton; 1 for a Half-Canton) by the people according to the rules of each Canton (Art. 71ff FC).

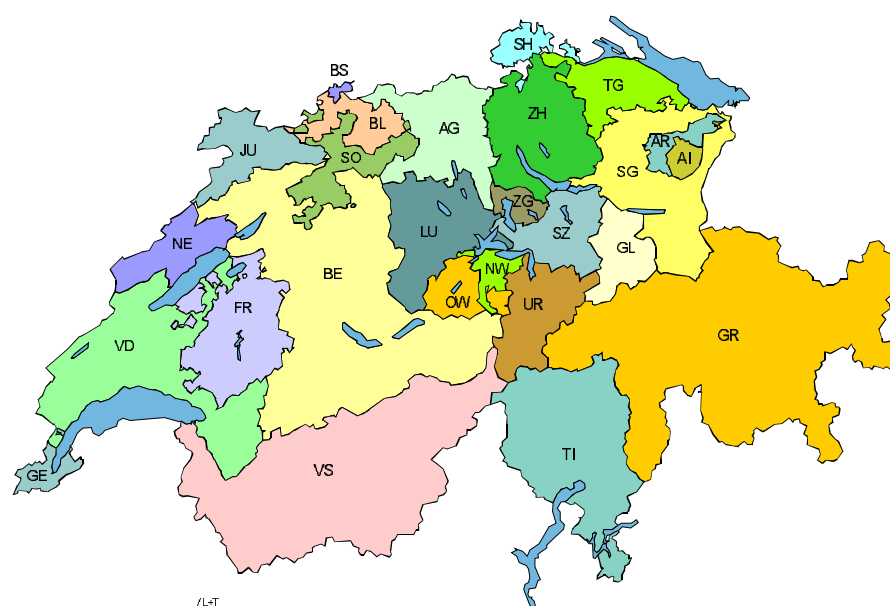
The United Federal Assembly i.e. both Councils together elect the seven members of Government (Federal Council) and the Chancellor in charge of the Federal Chancellery. The 30 members and 30 substitute judges of the Federal Court as well as the 9 members of the Insurance Court are also elected by the United Federal Assembly.

**Federal Government and Administration:** The Government is formed by the Federal Council (Art. 95ff FC). It defines the fundamental goals of state action and determines the necessary resources for their attainments; represents the Federation within the country and abroad; conducts the preparatory procedure leading to new legislation; submits proposals and laws and decisions to the Federal Assembly; enacts regulations as empowered by the Constitution and by federal laws; and makes decisions with regard of important infrastructure other works. The administration is organised in 7 Federal Departments with the following competences: foreign affairs; home affairs; justice and police; defence, protection of the population and sport; finance; economic affairs; environment, transport, energy and communications.

**Referendum and Popular Initiative at the Federal Level:** A popular ballot (referendum) is compulsory for all amendments to the Constitution and on accession to some international organisations (Art. 89 FC). The adoption of a proposal requires a majority of the valid votes cast throughout the country as well as a majority of the Cantons in which the voters have adopted the proposal. The amendments of laws and the promulgation of new laws by Parliament, and certain treaties in international law are subject to an optional referendum. A popular ballot is held if 50,000 citizens request so with their signatures within 100 days of the publication of the legal act. The optional referendum has the effect of a popular approval respectively veto with regard to acts of parliament and certain international treaties.

With the instrument of a popular initiative citizens may seek a popular vote on an amendment to the constitution (Art. 118 FC). The initiative may be formulated as a general proposal or as a precise text, the wording of which cannot be influenced by parliament or government. The federal authorities may respond to the proposal of an initiative by a usually less far reaching counter-proposal. The launching of a popular initiative requires the collection of 100,000 supporting signatures within a time-limit of 18 months.

Figure 2: Cantons in Switzerland



Source: SFC, 1998, p.2.

## **2 Forest Resources and Their Uses**

### **2.1 Forest History**

As in the neighbouring countries the forests of Switzerland have been influenced and partially transformed by long lasting and changing human interventions (Hauser 1972; Schuler 1980). Of particular importance was the medieval colonisation with land clearing in the Central Plateau and the Jura which peaked during the 12th and 13th century. Forests in the vicinity of villages were intensively used for local wood supply, food and other forest products, and as part of the agricultural space in combined production systems. From the 15th century onward large scale forest exploitation for mining, salt production as well as for other artisanal and industrial uses developed. Wood exports mainly by floating to Austria, Germany and Italy were another factor that sped up changes in the forest vegetation. An outstanding example in this context is the Swiss National Park in the Canton of Grison: today many people consider the park to be a typical natural landscape, although large scale clear cuts for local industries and wood floating on the Inn to the salines in Austria were practised over centuries (Parolini 1995).

An interesting aspect in the Swiss forest history are the collective and communal land use systems and the logging bans for forests with important protective functions (Price 1990). They have been common in the Alps and Pre-Alps since the 14th century. In the Alps common resource use systems have been maintained and developed into communal and corporative forest ownership. In other parts of the country forest areas were divided among their owners and became private farm forests.

Already during the 17th and more strongly in the 18th century the reduction of usable forests and the fear of a general shortage of wood induced efforts towards a more sustainable utilisation and management. The physiocratic societies aiming at improvements of land uses and agricultural production played an increasing role in the process of introducing improved forestry practices. During the brief period of the Helvetic Republic (1798-1803) a project for a central forest law was elaborated, but failed to be adopted (Schuler 1998). With the reconstitution of cantonal powers in 1803 such efforts became obsolete and forestry matters remained cantonal competences. The Swiss Constitution of 1848 acknowledged this fact by not referring to forests and forestry at all.

During the 19th century local land slides and large scale flooding occurred in the cantons Grison, Ticino, Valais and Uri in 1834; in the Emmental in 1837; and in the valleys of the Reuss, Rhine, Rhone as well as in those of the Southern Alpine slopes in 1839 (Schuler 1998). They were associated with progressive clear cutting on steep slopes along the valleys. This led to an increasing sensitization of the population and politicians. Personalities such as Karl Kasthofer, Charles Lardy, Xavier Marchand, Elias Landolt and Karl Culmann made valuable contributions and provided information to the public. The Swiss Forestry Society founded in 1843 acted in the same sense. The most important result of this political process was the adoption of Article 24 of the Federal Constitution in 1874 (Bloetzer 1978). It established a federal frame competence for protective measures against the effects of natural calamities, for reforestation and for the preservation of the remaining forests in the Alps. Another result of these efforts was the creation of educational facilities for forest engineers at the newly established Federal Institute of Technology (ETH) in 1855 and subsequently of a Federal Forest Research Institute in 1885.

Based on its constitutional competence (Art 24) the parliament promulgated the first federal forest act in 1876. Since the federal competence was limited to the mountainous areas of the country, the forest law referred to those areas only. In the 1890s of the last century the positive impacts of the federal responsibilities on forests led to a call for an expansion to the whole territory. In 1897 Article 24 of the Constitution was changed, by taking out the reference to mountainous areas, and a second federal forest law was promulgated in 1902 for the country as a whole. It was partly revised at more than 20 occasions during this century. Starting in 1985 a

total revision took place (Zimmermann 1988). As a result a new forest law came into force in 1993.

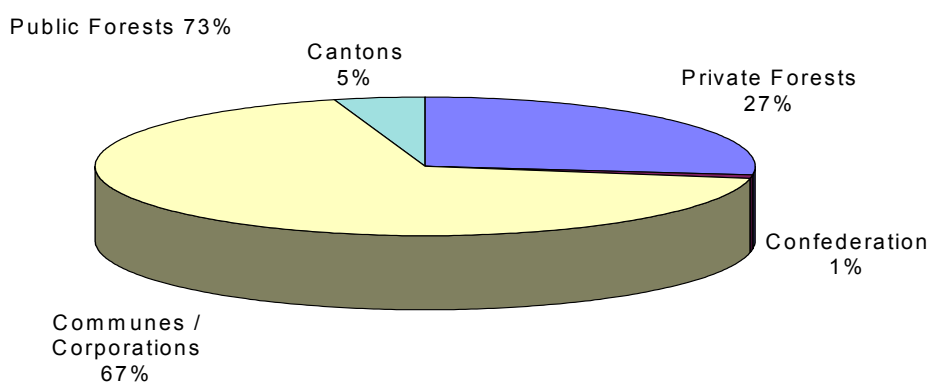
## 2.2 Forest Ownership

From a comparative point of view the case of Switzerland is of interest in two ways. On one hand it is among the European countries with the highest proportion of public forest ownership. On the other the fact that communal and community forest tenure account for most of the public ownership is remarkable relative to other countries, where state ownership is the predominant form of public ownership. Public tenure and small scale holdings are a significant factor for the direct involvement of people in the decision making. It is also a reason for the diversity of forests and forestry problems, which we find within the country's geographical regions

Ownership Pattern: 326,000 ha or one third of the forest area are privately owned. There are approximately 260,000 owners with an average forest area of little more than 1 ha each (BFS/BUWAL 1997). The private forests traditionally belonged to farmers but there is an increasing proportion of owners with professional activities in other sectors. Private forests are frequent in the Pre-Alps (46%) and the Plateau (41%) and of lesser importance in the other regions. No recent data are available on parcelisation which is current in some parts of the country. Public forests cover some 878,000 ha or two thirds of the country's forest surface. Public tenure dominates in the Alps, on the Southern slopes of the Alps and in the Jura mountains, where 70-80% of the forests belong to the public owners. In the Plateau and Pre-Alps public ownership amounts to more than 50%. The average size of holdings is small, with 70% of all public owners having less than 100 ha.

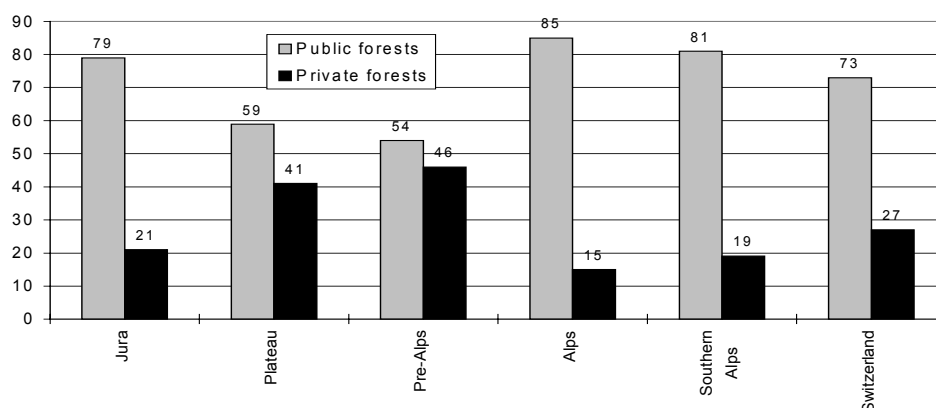
Different Groups of Public Forest Owners: More than 90% of the public forests are owned by local communities (boroughs), municipalities and local corporations. The local communities developed as associations of burghers, whose civic entitlements included the right to share the timber and pasture in certain forests around settlements. During the 19th century the tenurial rights of these associations were recognised by forest legislation as full right ownership. Today 400,000 hectares or 50% of all public forests belong to this category. A second group of owners are political municipalities managing at present 250,000 hectares or 30% of the public forests. Their ownership results from a transfer of local rights to the political entities during the 19th century and from buying forests in recent times. The third group, classified as corporations and cooperatives under the forest law, includes different kinds of associations which own approximately 100,000 hectares.

Figure 3: Forest Area by Ownership



Source: BFS/BUWAL, 1996, p. 69.

Figure 4: Public and Private forests by regions (percentage)



Source: BFS/BUWAL, 1997, p.64.

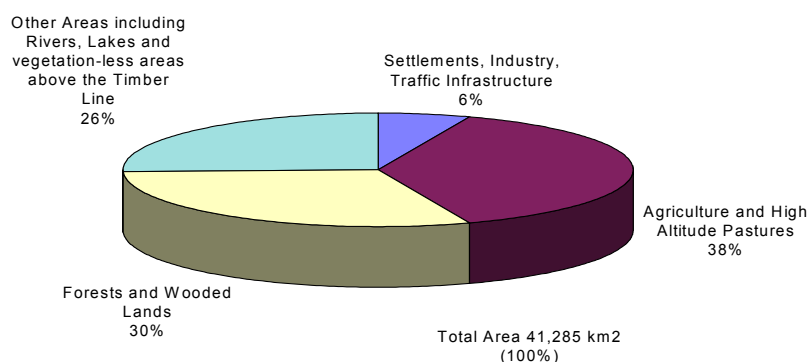
## 2.3 Land Use and Forest Resources

### 2.3.1 Overview on Land Uses

The last available figures on the overall land use pattern in Switzerland date from the 1979/85 areal statistics (BRP 1998, 52). They indicate a settlement area of 5.9% comprising land uses for traffic, industry and actual settlements; 38.3% of agricultural land including arable land and meadows, land for fruit-growing, vineyards and horticulture, and alpine pastures; and a forest area of 26.3% with another 4% of wooded land in different stages of natural succession. Typical for an Alpine country is the considerable proportion of other lands which includes rivers and lakes, vegetation on steep slopes and areas above the timber line. Altogether the figures on the existing land use pattern show that settlement and agricultural areas amount to less than half (44.2%) of the country's surface. This is an indication for the limited space for further land development and confirms the need of appropriate land-use planning and land management.

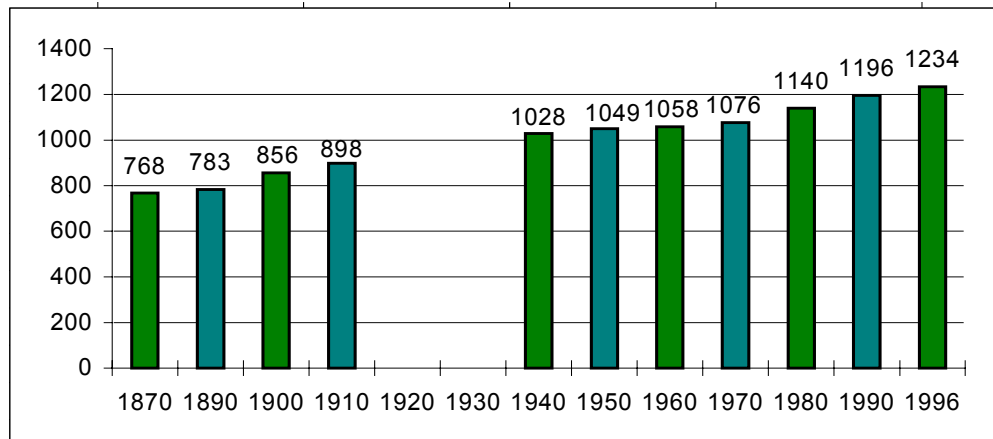
An update of the land-use census between 1992-1997 in 9 cantons in the Western part of the country shows that the actual settlement areas have expanded by 14,000 hectares (BRP 1998, 53). A similar evolution has probably taken place in the other parts of the country. The expansion of such areas usually reduces the productive agricultural lands in the densely populated landscapes. A quite different development can be found with regard to forests and wooded lands, especially if one considers long term trends. Between 1870 and 1996 the country's forest area increased from 770,000 to 1,200,000 hectares or by almost 60% (SAEFL 1997b, 17).

Figure 5: Land Use Pattern in Switzerland



Source: BRP, 1998, p. 53.

Figure 6: Changes in forest area since 1870 (in 1000 ha)



Source: SAEFL, 1997b, p.17.

### 2.3.2 Extent and Distribution of the Forests

The national forest inventory 1993-1995 shows a total forest area of 1,234,000 hectares (Brassel and Brändli 1999). In order to be defined as forest, an area need to meet a set of minimum criteria such as a width of 25-50 metres, a cover of 20% and a height of 3 metres. The forest area extends from 200 m altitude in the southern Ticino to 2,300 m at the timber line in the central valleys. Almost half (42%) of the forest is on slopes with a gradient greater or equal 40% and one fifth on slopes over 60%. Three quarters of the forest is situated in mountainous areas and half at altitudes higher than 1,000 metres above sea level. The distribution in the five main geographical regions of the country is as follows: 34% of the forest area in the Alps, 18% on the Central Plateau, 18% in the Pre-Alps, 16% in the Jura Mountains, and 14% on the southern side of the Alps.

The forest cover amounts to 30% of the Swiss territory, with considerable regional variations. South of the Alps nearly half of the land is covered by forest. In the Central Plateau, which is the country's most densely populated region, forest cover is only 24%. A similar rate of forest cover exists in the Alps (25%), where the high altitude is a natural barrier to tree growth. Regional variations are even more evident if one considers the forest area per inhabitant. A citizen in the densely populated Plateau is surrounded by ten times less forest (6.5 a) than his fellow countryman living in the Alps (63 a).

Relative to the National forest inventory data 1983-1986 the forest area of the country increased by 4% or 47,000 hectares. Regional variations are considerable with a small increase in the Plateau (0.5%), the Jura (1.6%) and the Pre-Alps (2.6%), and a large increase in the Alps (7.6%) and the Southern Alps (5.6%). This regional pattern is the result of changes in land uses, and the long lasting tendency to abandon cultivated lands in mountainous areas on steep terrain followed by natural successions of the vegetation. The process is most advanced on the Southern slopes of the Alps where in several valleys villages and settlements are virtually surrounded by forest.

Table 1: Forest Area by Region

|            | Jura | Plateau | Pre-Alps | Alps | South. Alps | Switzerland |
|------------|------|---------|----------|------|-------------|-------------|
| in 1000 ha | 201  | 227     | 220      | 415  | 171         | 1234        |
| %          | 16.3 | 18.4    | 17.9     | 33.6 | 13.9        | 100         |



Source: WSL/BUWAL (ed.), 1999, p.43.

Table 2: Forest area per capita by region

|                              | Jura  | Plateau | Pre-Alps | Alps | South. Alps | Switzerland |
|------------------------------|-------|---------|----------|------|-------------|-------------|
| Forest area in 1000 ha       | 201   | 227     | 220      | 415  | 171         | 1,234       |
| No. of inhabitants in 1000   | 1,018 | 4,091   | 827      | 643  | 293         | 6,872       |
| Forest area per capita in ha | 0.19  | 0.05    | 0.27     | 0.64 | 0.58        | 0.18        |

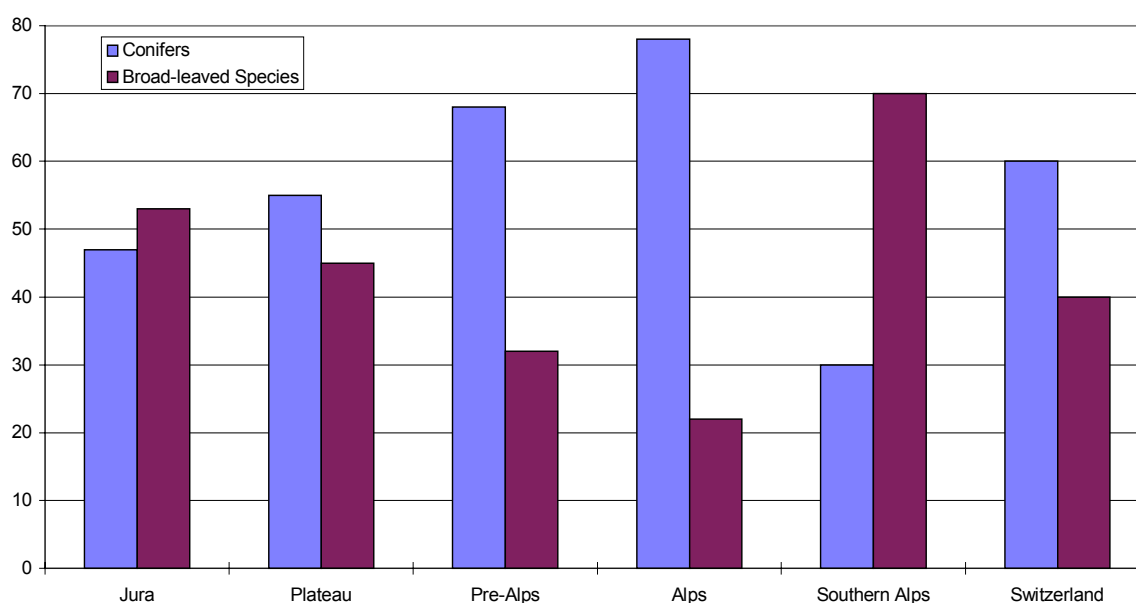
Source: WSL/BUWAL (ed.), 1999, p.43 and 373.

### 2.3.3 Tree Species and Age Class Distribution

**Tree Species:** Due to the natural vegetation zones coniferous species are predominant in the Alps (78%) and Pre-Alps (68%). In the Jura broad-leaved species, in particular beech (*Fagus sylvatica*) prevail, but Norway spruce (*Picea abies*) and silver fir (*Abies alba*) also cover a considerable part of the forest area. This is also true for the Plateau, where the distribution of coniferous and broad-leaved species is almost equal. A particular case are the Southern slopes of the Alps, where the climatic conditions favour a larger range of broad-leaved species, and where land use practices increased the area of sweet chestnut (*Castanea sativa*) over centuries. Generally 60% of all trees in Switzerland are coniferous and 40% deciduous.

The National Forest Inventory sampled around 50 tree species. The most important tree species in Swiss forests are Norway spruce (39%), silver fir (11%) and beech (18%). Other species like Scots pine (*Pinus sylvestris*), maple (*Acer ssp.*), ash (*Fraxinus excelsior*) and oak (*Quercus ssp.*) are fairly common, but do not reach a high percentage in the species composition. Typical alpine species are for instance European larch (*Larix decidua*) and Swiss stone pine (*Pinus cembra*). In the Southern Alps sweet chestnut is very common.

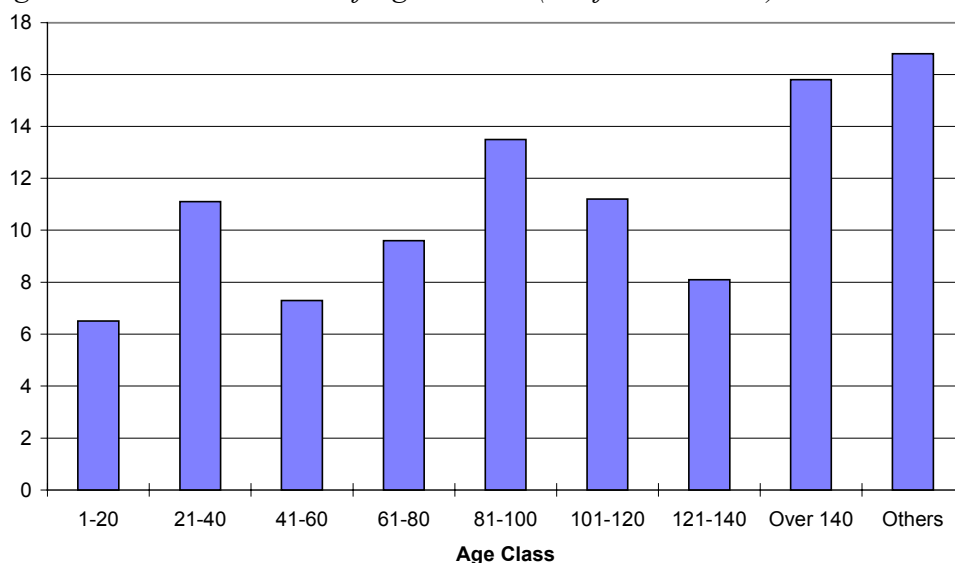
Figure 7: Regional Distribution of Coniferous and Broad-leaved Species



Source: WSL/BUWAL (ed.), 1999, p.105 (modified).

Age Class Distribution: Information on the age class distribution is only available for even-aged stands. Where the age of even-aged stands was estimated in two thirds of the cases based on defined parameters. No inventory information is available for uneven-aged stands, which represent 15.7% of the total forest area. The age class distribution in even-aged stands shows a below average representation of the classes 1-20 and 41-60 years, and an over-representation in the classes between 80 and 120 years as well as over 140 years. According to calculations based among others on the actual species composition and recommended rotation periods the yearly regeneration area should in fact be around 3,700 hectares. Presently it is only around 1,700 hectares per year (Brassel and Brändli 1999).

Figure 8: Distribution of Age Classes (% of Forest Area)



Others: Mixed stands (15.7%) and stands with no information (1.1%)

Source: WSL/BUWAL (ed.), 1999, p.128 (modified).

### 2.3.4 Growing Stock, Growth and Annual Fellings

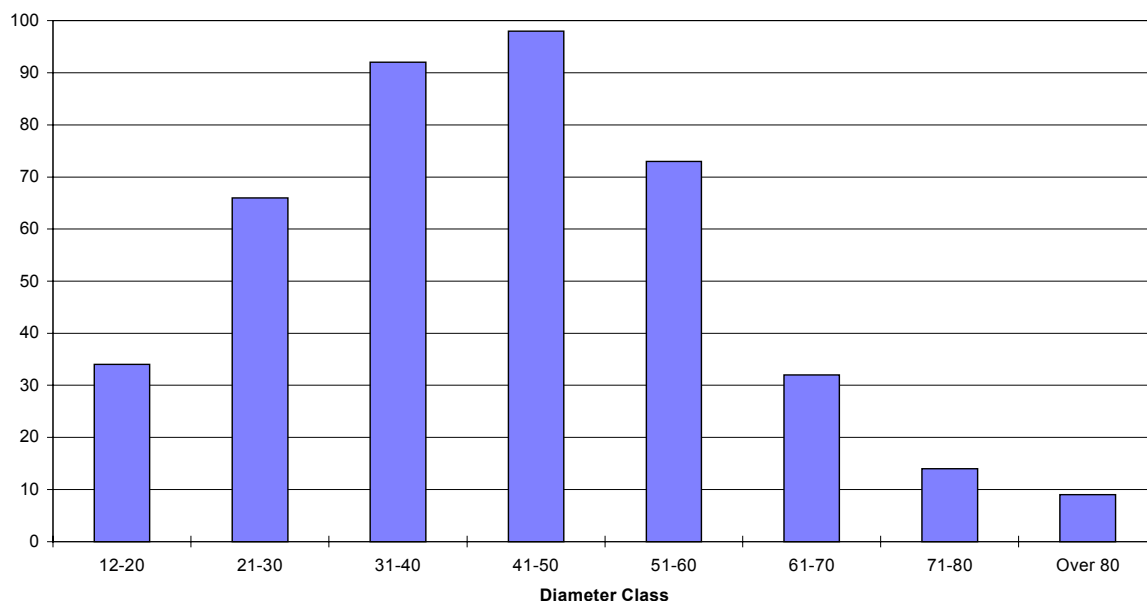
Growing Stock: Between 1986 and 1996 the total growing stock in stemwood with bark increased by 42 million cubic metres to a total of 418 million cubic metres of which two thirds (63%) are in the diameter classes between 30 and 60 cm. The growing stock in stemwood without bark, excluding dead and down trees, is around 388 million cubic metres. In comparison with other European countries the growing stock volume per hectare is exceptionally high. The Swiss average volume per hectare is 362 m<sup>3</sup> with increased by 25 m<sup>3</sup> within the last ten years. The comparison between regions indicates high growing stocks per hectare in the Plateau (433 m<sup>3</sup>) and the Pre-Alps (461 m<sup>3</sup>) whereas the growing stocks in the Alps (309 m<sup>3</sup>) and Southern Alps (215 m<sup>3</sup>) are below average.

Table 3: Mean volume of growing stock by region (Stemwood without bark, diameter > 12 cm)

|  | Jura | Plateau | Pre-Alps | Alps | South. Alps | Switzerland |
|--|------|---------|----------|------|-------------|-------------|
| growing stock* 1986 (m <sup>3</sup> /ha) | 328  | 409     | 417      | 292  | 176         | 333         |
| growing stock* 1996 (m <sup>3</sup> /ha) | 365  | 440     | 469      | 318  | 219         | 367         |

Source: EAFV/BFL, 1988, p.51. ; WSL/BUWAL (ed.), 1999, p.76.

Figure 9: Volume of growing stock by diameter classes in million  $m^3$



Source: SAEFL, 1997b, p.24.

Distribution by Species: Spruce represents almost half or 198 million cubic metres and beech another 17% or 71 million cubic metres of the total volume of growing stock. Altogether, conifer species contribute more than two thirds (72%) to the country's growing stock with as much as 79% and 88% in the Pre-Alps and Alps. Even in the Jura and the Southern Alps, where broad-leaved species are more predominant, the share of conifers in the total growing stock is more than half. The proportion of conifer species decreased by 1% of the total growing stock and by 4% in the Southern Alps during the last 10 years.

Balance between Growth and Wood Removals: The mean annual increment, measured as stemwood with bark at a callipering limit of 12 cm, amounts to 8.3  $m^3/ha$  for the whole of the country. Higher increment rates exist in the Plateau (12.3  $m^3/ha$ ) and the Pre-Alps (10.4  $m^3/ha$ ), while lower rates occur in the Alps (5.7  $m^3/ha$ ) and the Southern Alps (4.2  $m^3/ha$ ). The Increment including ingrowth is higher by an average of one cubic metre per year and hectare.

Table 4: Increment by Regions in  $m^3/ha$  and year (stemwood with bark)

|                            | Jura | Plateau | Pre-Alps | Alps | South. Alps | Switzerland |
|----------------------------|------|---------|----------|------|-------------|-------------|
| Increment without ingrowth | 8.3  | 12.3    | 10.4     | 5.7  | 4.2         | 8.3         |
| Increment with ingrowth    | 9.0  | 13.9    | 11.2     | 6.4  | 5.0         | 9.2         |

Source: WSL/BUWAL (ed.), 1999, p.87.

A comparison on the basis of stemwood with bark shows that the total annual growth volume of the fores in Switzerland of 9.8 million  $m^3$  exceeds the combined volume of removals and natural losses of 7.2 million  $m^3$  by 30%. If the annual growth volume is compared with the yearly removals for commercial use of 5.4 million  $m^3$  (stemwood with bark) the difference amounts to more than 50%. Regional variations are an indication for differences in the profitability of timber harvesting. Whereas for instance in the Plateau and Jura the harvesting rates in relation to growth

volume turn around 60%, they are about half in the Pre-Alps and Alps, and drop to 16% in the Southern Alps (SAEFL 1997b, p 45).

Table 5: *Increment, removals and quantity of wood for commercial use (stemwood with bark)*

|  | Jura | Plateau | Pre-Alps | Alps | South. Alps | Switzerland |
|--|------|---------|----------|------|-------------|-------------|
| Increment with ingrowth million m <sup>3</sup> /year             | 1.7  | 3.2     | 2.3      | 2.0  | 0.6         | 9.9         |
| Removals and natural losses million m <sup>3</sup> /year         | 1.2  | 2.6     | 1.6      | 1.5  | 0.3         | 7.2         |
| Removals of wood for commercial use million m <sup>3</sup> /year | 1.0  | 2.2     | 1.2      | 1.0  | 0.1         | 5.5         |

Source: WSL/BUWAL (ed.), 1999, p.87,93.

### 2.3.5 Forest Threats

Principal Causes: The national forest inventory 1993-95 identified the extent of forest damages over a period of 10 years. Storms (66%), insects (13%) and vitality losses (12%) are the principal causes with a combined effect of more than 90% of all causes. Landslides, snow, forest fires, fungi and avalanches are other agents of mainly local importance. In a period of 10 years the area affected by damages amounted to 235,000 hectares or 20% of all forests. The volume of compulsory harvesting was in the order of 22 million m<sup>3</sup> or almost half of all fellings.

In 1990 as in several other countries the orcan "Vivian" was a major catastrophe with compulsory fellings of 5.0 million m<sup>3</sup> corresponding to more than the mean annual harvesting volume. Major storm events also occurred in 1967 and 1962 with 2.1 respectively 2.4 million m<sup>3</sup> of compulsory fellings. Insect damages largely caused by bark beetles are frequent. A locally specific cause of considerable importance are damages in Larch stands from *Trypodendron lineatum*. The effects of forest fires are a serious danger in the valleys of the Southern Alpine slopes. The frequency of forest fires oscillated between 50 and 150 per year with areas burned ranging between 300 and 1000 hectares.

Table 6: *Area, volume and cause of compulsory fellings within a ten years period*

|          | Area in 1000 ha | Fellings in Million m <sup>3</sup> | Importance in % |
|----------|-----------------|------------------------------------|-----------------|
| Storm    | 124,5           | 14,9                               | 66,4            |
| Insects  | 40,3            | 3,0                                | 13,3            |
| Vitality | 41,4            | 2,6                                | 11,6            |
| Others * | 29,2            | 1,9                                | 8,7             |
| Total    | 235,5           | 22,4                               | 100             |

\*landslides (1,9%), snow (1,6%), forest fires (1,6%), fungi (1,3%), avalanches (0,5%), not identified (2%)

Source: WSL/BUWAL (ed.), 1999, p.222 and 223 (modified).

Physical Damages to Forest Stands: The second national forest inventory recorded that 28% of the sampled trees on the permanent plots had physical damages. 6.1% of all trees were damaged due to timber harvesting and another 2.0% due to other direct human impacts. The regional variations

of direct anthropogenic damages is considerable and related to the intensity of harvesting practices. In the Jura (8.9%), the Plateau (8.4%) and the Pre-Alps (7.3%) it is higher than the national average and in the Alps (4.1%) and the Southern Alps (1.8%) it is considerably lower.

Table 7: *Damaged Stems and Cause of Damage*

|   | Jura   | Plateau | Pre-Alps | Alps    | South. Alps | Switzerland |
|---|--------|---------|----------|---------|-------------|-------------|
| Total number of stems in thousand (100%)                    | 91.076 | 101.292 | 109.303  | 163.662 | 67.456      | 532.789     |
| Damaged trees due to human causes (%)                       | 8,9    | 8,4     | 7,3      | 4,1     | 1,8         | 6,1         |
| Damaged trees by a-biotic factors (fire, weather, rockfall) | 4,3    | 1,4     | 5,8      | 9,7     | 9,9         | 6,4         |
| Damaged trees by diverse biotic factors and erosion         | 2,8    | 2,2     | 3,6      | 2,7     | 5,3         | 3,1         |
| Undefined   | 6,7    | 4,6     | 6,9      | 9,3     | 8,8         | 7,4         |

Source: WSL/BUWAL (ed.), 1999, p.215 (modified).

Damages to Regeneration by Browsing and Grazing: Figures from the national forest inventory indicate that 14% of the young trees are damaged by game and another 4% by other factors. As in the case of other forest damages, one has to consider that regional and local variations are significant. Especially in the mountainous areas the effect of browsing on the success of natural regeneration is important. Grazing is another factor which has an impact on 10% of the country's forests. According to inventory data it is still practised rather intensively on 80,000 ha and extensively on 36,000 ha. Of the total regeneration area of 160,000 ha approximately 20,000 ha (11%) show effects from intensive or extensive grazing practices.

Table 8: *Percentage of Young Trees damaged by Browsing*

|                            | No damage | Damage by Browsing | Other Damage |
|----------------------------|-----------|--------------------|--------------|
| Young growth/thickets      | 81.2      | 14.3               | 4.5          |
| Regeneration under shelter | 82.6      | 13.7               | 3.7          |
| Selection-type forest      | 80.1      | 13.1               | 6.8          |
| Total                      | 81.6      | 14.0               | 4.4          |

Source: WSL/BUWAL (ed.), 1999, p.215 (modified).

Table 9: *Regeneration and Total Forest area in 1000 ha by Intensity and Actuality of Grazing*

|                       | Young growth/thickets | Regeneration under shelter | Selection-type forest | Total regeneration area | Total in % | Total forest area |
|-----------------------|-----------------------|----------------------------|-----------------------|-------------------------|------------|-------------------|
| No grazing            | 69.9                  | 45.6                       | 44.2                  | 159.7                   | 88.5       | 1,007.0           |
| Extensive in the past | 0.6                   | 0.4                        | 0.2                   | 1.2                     | 0.7        | 12.2              |
| Extensive actually    | 2.8                   | 1.8                        | 3.7                   | 8.3                     | 4.6        | 36.1              |
| Intensely in the past | 0                     | 0.2                        | 0.4                   | 0.6                     | 0.3        | 4.2               |

|                    |      |      |      |       |     |         |
|--------------------|------|------|------|-------|-----|---------|
| Intensely actually | 4.4  | 2.8  | 3.5  | 10.7  | 5.9 | 80.4    |
| Total              | 77.7 | 50.8 | 51.9 | 180.4 | 100 | 1,139.9 |

Source: WSL/BUWAL (ed.), 1999, p.206 (modified).

**Environmental Monitoring Systems:** The impact of depositions of air pollutants on the environment is subject to continuing debates and it is still difficult to rely causes and effects (SAEFL 1997a; SAEFL 1997b, p 29). The National Air Pollution Monitoring Network (NABEL) measures trends and current air pollution levels throughout Switzerland. The network has 16 stations measuring air pollutants such as sulphur dioxide, nitric oxide, nitrogen dioxide, ozone, carbon monoxide, total suspended particles and dust fallout. The National Soil Monitoring Network (NABO) monitors the contamination of soils at 105 permanent plots of which one third are situated in forest areas (BUWAL 1993).

**Monitoring of Crown Defoliation:** Since 1983 the state of crown defoliation has been regularly monitored (SAEFL 1997b, p 31; Brang 1998). Until 1992 the annual inventory of forest condition was consistently made on permanent plots on a 4x4 kilometre grid as part of the SANASILVA programme. With progressing work of the national inventory monitoring was subsequently reduced to a 8x8 kilometre grid. Since 1995 these plots have been assessed every three years. Results of 1995 and 1996 differ with those of previous years in as much as they are no longer weighted by the basal area of the monitored trees. These changes in the monitoring approach imply that comparisons over longer time periods need a careful analysis before conclusions can be made.

The measurement of crown defoliation refers to the needle/leaf losses of trees with a diameter greater than 12 cm. Depending on the magnitude of the loss a tree is assigned to one of the following defoliation classes: Class 1 identifies tree crowns with little or no defoliation, class 2 defoliation between 26 and 60%, class 3 and 4 crown defoliation above 60%. Altogether defoliation of classes 2-4 increased from 13% in 1986 to 21% in 1996. There had been a steady rise in class 2 up to 1994 followed by a reduction in the following two years. Defoliation in classes 3 and 4 remained stable for several years but showed an increase in 1995 and 1996.

*Table 10: Changes in Defoliation: All Species*

| Defoliation classes | '86 | '87 | '88 | '89 | '90 | '91 | '92 | '93 | '94  | '95  | '96  |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| 2                   | 11  | 12  | 10  | 9   | 15  | 17  | 14  | 16  | 20   | 17.9 | 13.9 |
| 3 & 4               | 2   | 3   | 2   | 3   | 2   | 2   | 2   | 2   | 2.6  | 6.7  | 6.9  |
| Total 2 to 4        | 13  | 15  | 12  | 12  | 17  | 19  | 16  | 18  | 22.6 | 24.6 | 20.8 |

Source: SAEFL, 1997b, p. 32.

## 2.4 Silviculture

In Switzerland silvicultural concepts and practices close to nature were developed (Leibundgut 1979, 1984; Ott et al. 1997; Schütz 1990, 1994, 1997). Today silviculture close to nature aims in particular at favouring forest biotope diversity and the potential of natural stand development for ecological and economical reasons (Schütz 1998). It comprises a great diversity of silvicultural techniques according to Leibundgut's principle of "free use of cuttings".

The reference for silvicultural considerations is the classification of Swiss forest vegetation with 71 defined communities based on floristical, physiognomical and ecological criteria (Ellenberg and Klötzli 1972; Keller et al.1998)

High forests with even-aged, uneven-aged and selection-type stands cover 80% of the forest area. The remaining area comprises a variety of forest types such as coppice with standards, coppice and chestnut selva, open stands as well as brushwood close to the timberline. Natural regeneration (83%) and mixed regeneration (11%) are predominant, whereas plantations (6%) are of little importance. The proportion of naturally regenerated forest varies between the regions. It is particularly high in the Alps and Jura, however only half in the Plateau region.

*Table 11: Forest Area by Type of Forest*

| Forest type                        | Area in 1000ha | %    |
|------------------------------------|----------------|------|
| Even-aged high forest              | 837.3          | 67.9 |
| Uneven-aged high forest            | 96.3           | 7.8  |
| Selection-type high forest         | 52.4           | 4.2  |
| Other forest types                 | 153.9          | 12.4 |
| Brushwood and inaccessible forests | 94.2           | 7.6  |
| total                              | 1,234.0        | 100  |

Source: WSL/BUWAL (ed.), 1999, p.117 (modified).

*Table 12: Proportion of Natural Regeneration per Region*

|                      | Jura | Plateau | Pre-Alps | Alps | South. Alps | Switzerland |
|----------------------|------|---------|----------|------|-------------|-------------|
| Natural regeneration | 54   | 25      | 62       | 78   | 94          | 60          |

Source: WSL/BUWAL (ed.), 1999, p.176.

*Table 13: Regeneration Stands by Type of Regeneration (percentage)*

|                            | Natural regeneration | Plantation | Mixed |
|----------------------------|----------------------|------------|-------|
| Young growth/thickets      | 60                   | 14         | 26    |
| Regeneration under shelter | 94                   | 1          | 5     |
| Selection-type high forest | 98                   | 0          | 2     |
| Total                      | 83                   | 6          | 11    |

Source: WSL/BUWAL (ed.), 1999, p.176 (modified).



## **2.5 Forest production**

### *2.5.1 Harvesting systems and accessibility*

Based on the data of the National Forest Inventory current harvesting methods combine hand yarding (21%), winches (22%), skidding in forest stands (32%), skidding on roads (30%) and skyline and cable systems (20%). Whereas skidding in forest stands in combination with winches is largely practised in the Jura and the Plateau, cable yarding combined with road skidding are common in the Alpine regions. The forest road density changes with region and elevation. Road density is between 40 and 60 metres per hectare in the Jura and the Plateau, and between 10 and 20 metres per hectare in the Alpine areas. Above 1000 metres elevation the road density is less than half in comparison with the lowlands.

Table 14: *Frequency in use of the different harvesting methods (percentage)*

| Harvesting Methods          | Jura | Plateau | Pre-Alps | Alps | South. Alps | Switzerland |
|-----------------------------|------|---------|----------|------|-------------|-------------|
| Hand yarding                | 6    | 1       | 10       | 13   | 17          | 7           |
| Horse                       | 1    | 1       | 0        | 2    | 0           | 1           |
| Winch                       | 4    | 1       | 3        | 10   | 3           | 4           |
| Skidder in the forest stand | 20   | 18      | 5        | 7    | 0           | 17          |
| Skidder on the road         | 78   | 81      | 70       | 33   | 35          | 66          |
| Skyline                     | 1    | 2       | 13       | 24   | 25          | 10          |
| Trucks                      | 0    | 1       | 2        | 25   | 18          | 7           |
| Helicopter                  | 0    | 0       | 7        | 20   | 19          | 7           |
| Others                      | 1    | 1       | 1        | 2    | 5           | 1           |

(different harvesting methods can be used in combination, therefore the amount can step over 100%)

Source: WSL/BUWAL (ed.), 1999, p.245 (modified).

Table 15: *Forest road density in 1995 differentiated by region and elevation (in m/ha forest area)*

| Elevation (masl) | < 600 | 600 - 1000 | 1000 - 1400 | 1400 - 1800 | > 1800 | Total |
|------------------|-------|------------|-------------|-------------|--------|-------|
| Jura             | 59.2  | 40         | 22.7        | 23.3        | -      | 39.5  |
| Plateau          | 65.7  | 48.6       | 36.1        | 12.0        | -      | 58.1  |
| Pre-Alps         | 34.0  | 20.4       | 15.0        | 5.9         | 0.0    | 16.6  |
| Alps             | 22.8  | 17.9       | 12.9        | 10.7        | 4.1    | 11.6  |
| South. Alps      | 17.3  | 9.1        | 7.6         | 3.0         | 1.9    | 7.8   |
| Switzerland      | 56.9  | 30.9       | 15.0        | 8.8         | 3.7    | 26.2  |

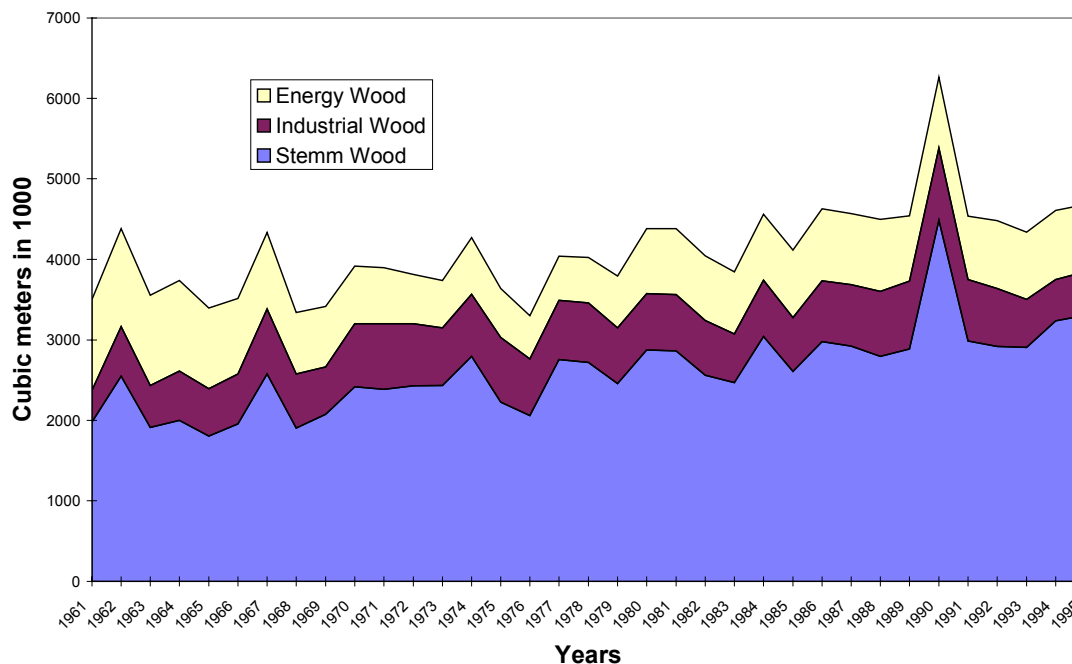
Source: WSL/BUWAL (ed.), 1999, p.236 (modified).

### 2.5.2 Timber uses

Annual Wood Production: Annual wood production (BSF/BUWAL, 1997, 72-73) oscillates since the 80<sup>th</sup> between four and four and a half million cubic meter per year with an exceptional peak of 6.2 million in 1990 due to wind throw. The repartition between saw and veneer logs (63%), wood for other industrial uses (17%) and energy wood (20%) has remained fairly stable over the years. Around three quarters of the annual production is coniferous. A significant aspect is the export of coniferous logs which has risen from 400 000 cubic meters in the 80<sup>th</sup> to the present level of 700 000 m<sup>3</sup>/year. The export of hardwood logs turns around 300 000 m<sup>3</sup>/year.

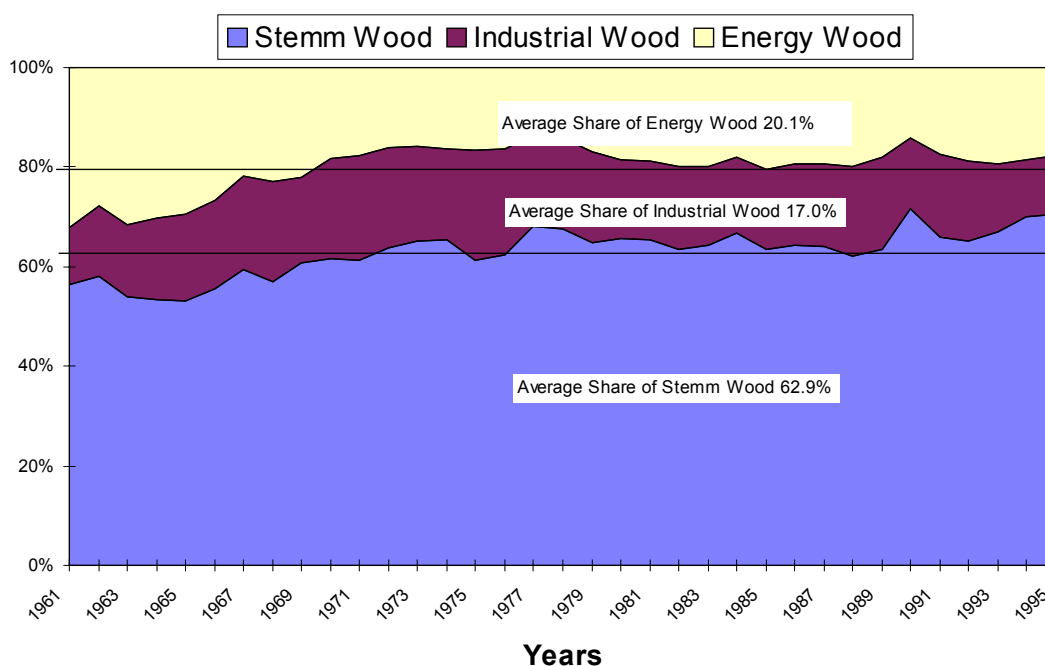
Wood Processing: The annual production of semi-processes products (BSF/BUWAL, 1997, 85) shows the following aggregates. Sawnwood production turns around 1.5 million cubic meters of which 90% are coniferous. Plywood production has always been small and practically disappeared since 1990. Particle board production used to be at a level of 600-700 000 cubic meters and has decreased during the last years. In 1996 the production of wood pulp and cellulose amount to around 900 000 tons. Paper production was at almost 1.5 million tons relying to a considerable extent on recycled waste paper and imports (BUWAL 1998a, 77-79).

Figure 10: Wood Production in Swiss Forests since 1961, Divided in Different Assortments



Source: BSF/BUWAL, 1997, p.73. Data before 1975: Swiss Federal Forest Statistic. Bern.

Figure 11: Proportional Division of Wood Production in Swiss Forests since 1961, Divided in Different Assortments



Source: BSF/BUWAL, 1997, p.73. Data bevor 1975: Swiss Federal Forest Statistic. Bern.

### 2.5.3 Non-timber forest products

A recent report (SAEFL 1997b, 51-53) contains some information on a large variety of non – wood -products. The study made an effort to quantify the various components. Even if the results are only of indicative value, they show the order of magnitude of the importance of these products. Based on economic value estimates the collection of mushrooms and honey, tree nurseries and Christmas tree production, bark chips and compost mould, as well as fodder from pastureland are of particular importance . An interesting aspect is the value estimate of the food of wild animals which would probably need further critical consideration.

Table 16: *Quantity and Value of Non-wood Products per Year*

| Product   | Quantity or Number     | Value in SFr./Year | comments                      |
|---|------------------------|--------------------|-------------------------------|
| Chestnuts   | 12,000 kg              | 56,000.-           | pilot project                 |
| Mushrooms   | 735,000 kg             | 8,100,000.-        | includes individual use       |
| Honey   | 500,000 kg             | 7,750,000.-        | includes individual use       |
| Beeswax   | 12,800 kg              | 75,000.-           |                               |
| Seeds of forest plants  | 4,200 kg               | 178,000.-          |                               |
| Tree nurseries  | 1,500,000              | 2,250,000.-        |                               |
| Christmas trees   | 400,000                | 5,300,000.-        |                               |
| Decorative materials  | 8550 m <sup>3</sup>    |                    |                               |
| Medicinal use of flowers, roots, herbs, berries, moss, lichen | 25,000 kg              | 335,000.-          | dry material                  |
| Bark chips  | 700,000 m <sup>3</sup> | 24,500,000.-       |                               |
| Dead leaves   | 3,200 m <sup>3</sup>   |                    | for decoration and compost    |
| Compost, mould  | 27,000 m <sup>3</sup>  | 2,160,000.-        |                               |
| Food and fodder:  |                        |                    |                               |
| - Forest pastureland  | 42,500,000 kg          | 15,700,000.-       | 150,000 ha of forest pastures |
| - Meat consumption by wild animals                            | 261,000 kg             |                    | only for lynx and boar        |
| - Consumption of plants by wild animals                       | 115,000,000 kg         | 31,200,000.-       |                               |

Source: SAEFL, 1997b, p. 52.

Hunting and game are another factor of considerable economic weight especially if the cost for equipment and permits are take into account.

Table 17: *Hunting and Game*

|                               | Quantity or number | Value in SFr./year |
|-------------------------------|--------------------|--------------------|
| Culls mammals                 | 128,669            |                    |
| Culls feathered game          | 53,179             |                    |
| Number of hunters             | 31,110             |                    |
| Venison                       | 1,597,300 kg       | 13,900,000.-       |
| Skins, pelts                  | 30,000             | 300,000.-          |
| Trophies                      | 15,000             |                    |
| Cost of equipment and permits |                    | 38,900,500.-       |

Source: SAEFL, 1997, p.51.

#### 2.5.4 Forest functions

Changing Demands: Forests were used as a local resource for firewood, pasture, supply of construction timber and a wide range of products needed in daily life. Commercial wood production became an important objective during the last century generating revenues for the land owners. In mountainous areas the protective values of forests against the effects of natural calamities are a major reason for maintaining and protecting the tree cover. Whereas these aspects continue to have a determining influence on the management practices, other objectives also gained more weight during the last 30 years. Forests are now of considerable value for recreational use in urban and peri-urban regions, as well as an asset for tourist developments especially in the Alpine and Jura regions. Furthermore they are of increasing importance with respect to the protection of water resources..

From a recent representative empirical study for the whole of Switzerland we know that during the summer period almost 60% of the population visit forests daily or at least once a week, another 30% once or twice per month. During the winter season daily and weekly visits amount to almost 40% and monthly visits to over 30% (BUWAL 1998).

Table 18: *Frequency of Visits to Forests by Seasons / Switzerland*

|               | almost daily | once / twice a week | once / twice per month | less than once per month | never  |
|---------------|--------------|---------------------|------------------------|--------------------------|--------|
| summer season | 13.5 %       | 44.3 %              | 29.2 %                 | 9.2 %                    | 3.7 %  |
| winter season | 9.0 %        | 28.9 %              | 33.5 %                 | 16.3 %                   | 12.2 % |

Source: BUWAL, 1998b, p.26.



Based on a studied area of 160,000 ha indicative data on the protective importance of forests in Switzerland have been collected (SAEFL 1997 : 65-68). They show that 42% of the forests provide protection against landslides with higher proportions in the mountainous regions. Of the total area of water protection zones 50% or 65,000 ha are situated in forests. In the Alpine regions of the country between 7 and 19% of the forests have special protective functions against avalanches.

*Table 19: Forest Cover in Water Protection Zones (Percent)*

|  | Jura | Plateau | Pre-Alps | Alps | South. Alps | Switzerland |
|--|------|---------|----------|------|-------------|-------------|
|  | 53   | 39      | 32       | 34   | 56          | 48          |

Source: SAEFL, 1997b, p. 68.

*Table 20: Percentage of the Forest Area with a Special Function for the Protection of Soil*

|                                    | Jura   | Plateau | Pre-Alps | Alps   | South. Alps | Switzerland |
|------------------------------------|--------|---------|----------|--------|-------------|-------------|
| Studied area in ha                 | 13,571 | 3,913   | 23,368   | 95,958 | 25,729      | 162,461     |
| Protection against landslides %    | 35     | 34      | 47       | 53     | 58          | 42          |
| Protection against avalanches in % | 0      | 0       | 7        | 18     | 19          | 10          |

Source: SAEFL, 1997b, p. 66.

With regard to the importance for conservation and landscape protection one should mention that more than 200,000 ha of forest are in areas which have been classified as landscapes of national importance in federal inventories. Altogether 19% of the forests are located in federal inventories indicating high values to be protected.

*Table 21: Forest Area in Inventories of Sites of National Importance*

| Type of protection area   | Forest area in ha |
|---|-------------------|
| National Park and 44 nature reserves  | 6,700             |
| Federal Inventory of Water and Migratory Bird Sanctuaries                   | 960               |
| Federal Game Reserves   | 23,200            |
| Federal Inventory of Mires  | 580               |
| Federal Inventory of Bogs   | 110               |
| Federal Inventory of Floodplains  | 6180              |
| Federal inventories for the protection of landscapes of national importance | 200,000           |

Source: SAEFL, 1997b, p.58.



### 3 Forest Economics

#### 3.1 Forest and Forest Industries in the National Economy

Share of the Forest Sector in the Gross Domestic Product: In 1995 the total value added of the Swiss wood processing industry was 5.4 billion Swiss francs or 1.5% of the gross domestic product (BFS/BUWAL 1997, 81). The value added of forestry amounted to slightly more than 400 million Swiss Francs or 0.1% of GDP (BFS/BUWAL 1997, 80). The contribution of the forest and wood processing sector to the national economy fell by 50% between 1975 and 1995.

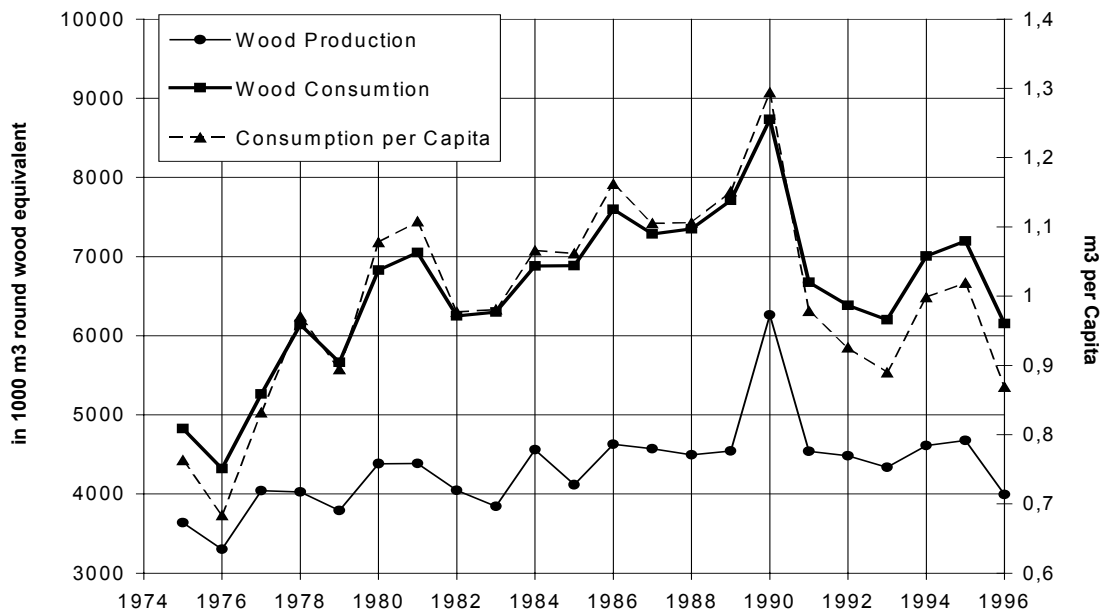
Table 22: *Economic Importance of the Wood Processing Industry*

|   | 1975  | 1985  | 1995  |
|---|-------|-------|-------|
| Total added value timber industry in mio SFr. | 3,900 | 4,650 | 5,410 |
| Sawmill industry                              | 350   | 400   | 470   |
| Particle and fibreboard industry              | 100   | 150   | 170   |
| Pulp, paper and cardboard industry            | 600   | 800   | 930   |
| Joinery, furniture industry and parquetry     | 2,000 | 2,300 | 2,680 |
| Carpentry, timber work                        | 600   | 800   | 930   |
| Others  | 250   | 200   | 230   |
| In % of the gross domestic product            | 2.8   | 2.0   | 1.5   |

Source: BFS/BUWAL, 1997, p. 81.

Wood consumption: Total wood consumption (in round wood equivalents) rose from 5 million m<sup>3</sup> in 1975 to a peak of almost 9 million m<sup>3</sup> in 1990. It dropped considerably in 1991 and oscillated at a level between 6 and 7 million m<sup>3</sup> in the following period (BFS/BUWAL 1997). The overall consumption pattern followed the increase in population of 1 million inhabitants during the same period. The per capita consumption remained more or less stable at 1 m<sup>3</sup> per person varying annually between 0.9 and 1.3 m<sup>3</sup> per capita.

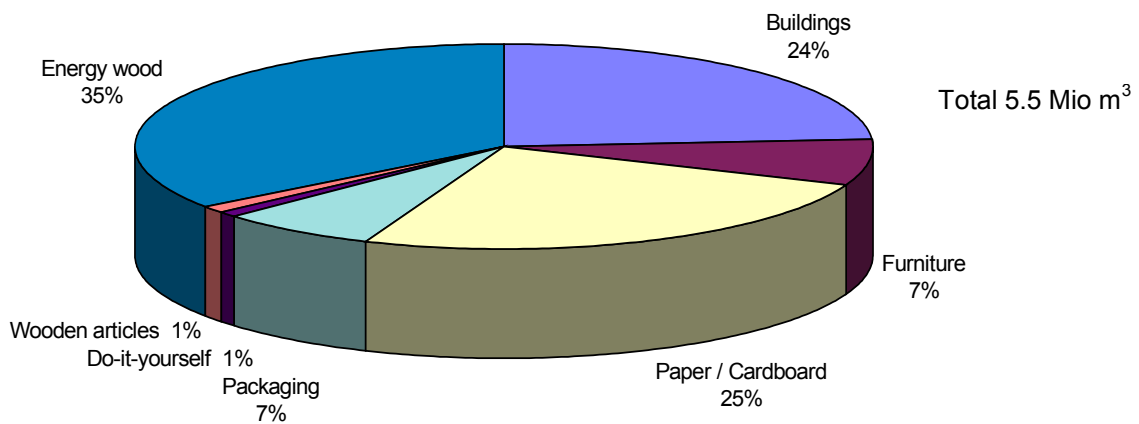
Figure 12: Total wood consumption (round wood equivalent), per capita consumption and domestic wood production



Source: BFS/BUWAL, 1997, p.100. ; BFS, 1998, p. 69 and 105.

Major components of final wood consumption: In 1996 the final wood consumption by major components (in solid wood volume) showed the following proportions (BUWAL 1998, 12): one third of the consumption is wood for construction, furniture and wooden articles; one third is consumed as paper and packaging material; and one third is used for wood energy. In comparison with the corresponding figures of 1991 the consumption of wood for construction and furniture as well the use of wood for energy have increased.

Figure 13: Final Wood Consumption by Type of Product 1996 (solid wood)



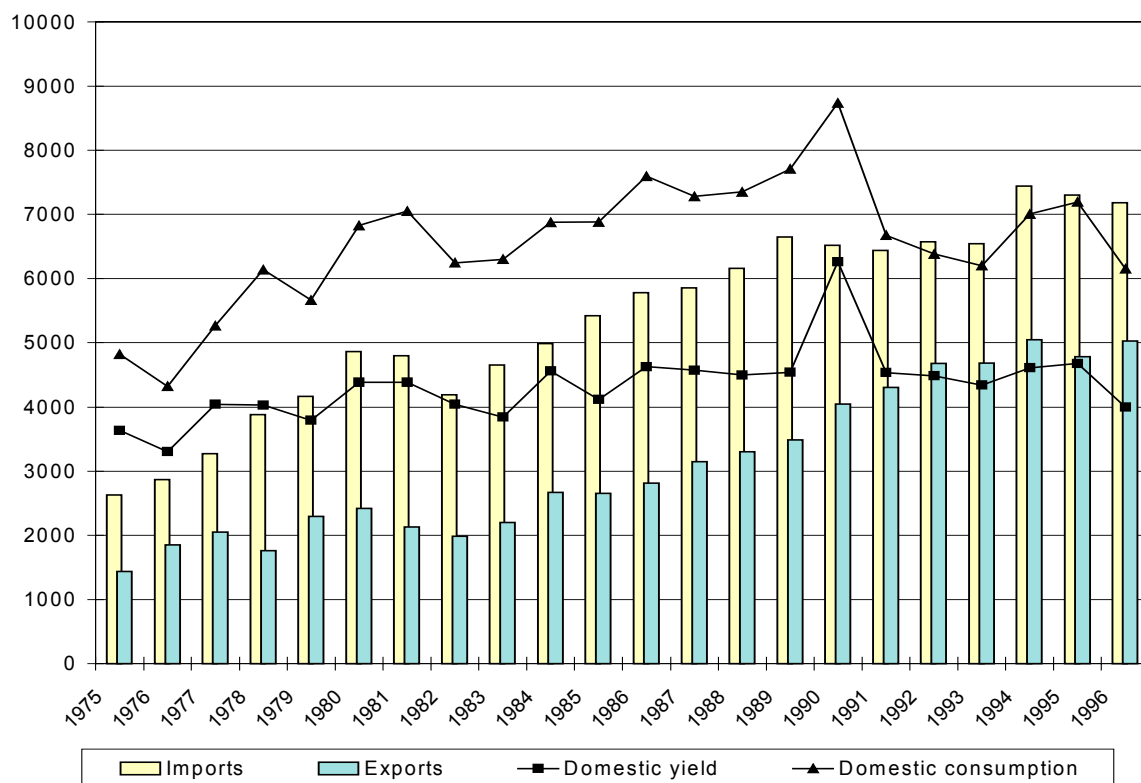
Source: BUWAL, 1998a, p. 12 (modified).

Table 23: Major Components of Final Wood Consumption in 1991 and 1996 (Solid Wood Volume)

| Reach           | 1991                |      | 1996                |      | Difference |
|-----------------|---------------------|------|---------------------|------|------------|
|                 | 1000 m <sup>3</sup> | in % | 1000 m <sup>3</sup> | in % | %          |
| Buildings       | 1212                | 21   | 1239                | 24   | +2         |
| Furniture       | 381                 | 7    | 397                 | 7    | +4         |
| Paper/cardboard | 1909                | 33   | 1371                | 25   | -28        |
| Packaging       | 340                 | 6    | 403                 | 7    | +19        |
| Do-it-yourself  | 65                  | 1    | 73                  | 1    | +12        |
| Wooden articles | 65                  | 1    | 65                  | 1    | 0          |
| Energy wood     | 1810                | 31   | 1910                | 35   | +6         |
| Total           | 5782                | 100  | 5458                | 100  | -6         |

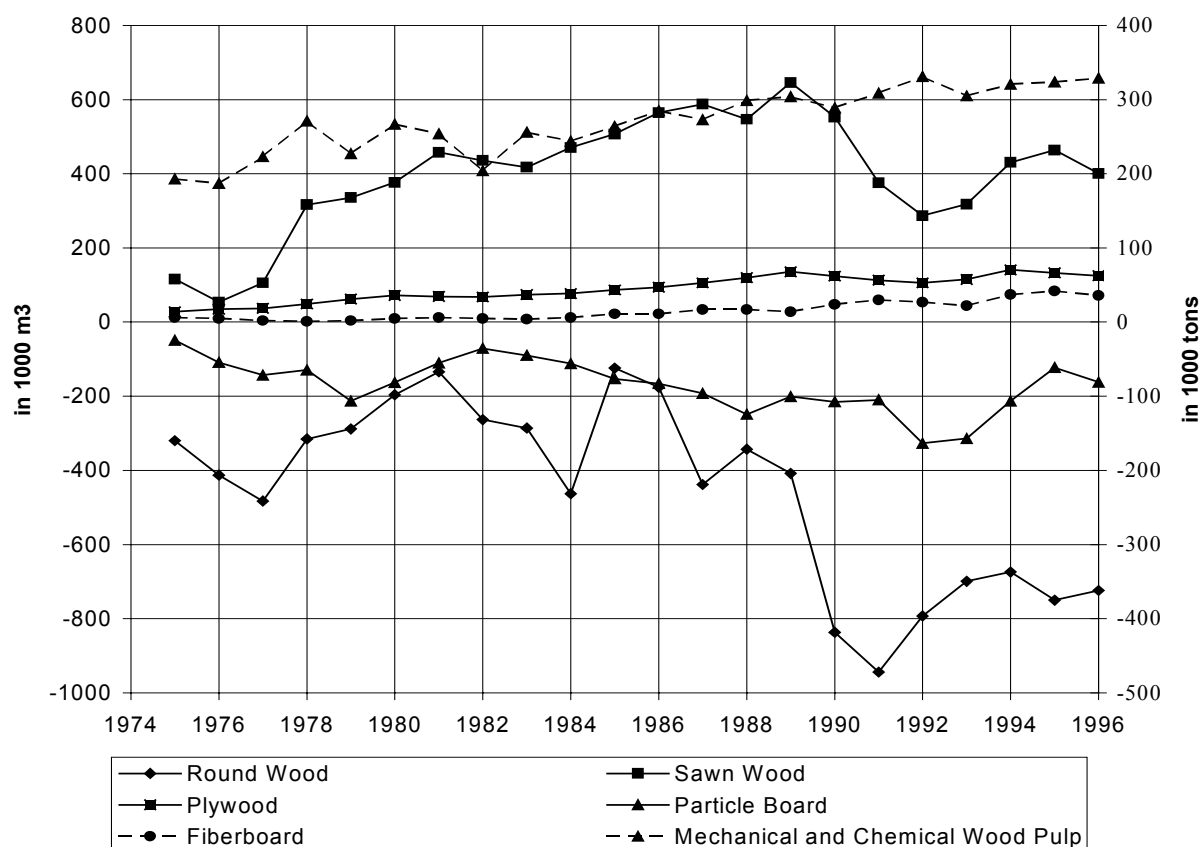
Source: BUWAL, 1998a, p.97.

Wood balance: The wood balance (in roundwood equivalents) shows that approximately two thirds of the consumption are compensated for by annual fellings. Imports were around 7 million m<sup>3</sup> in 1996 and exports around 5 million roundwood equivalents (BFS/BUWAL 1997, 96).

Figure 14: Wood Balance of Switzerland 1975-1996 (in 1000 m<sup>3</sup> roundwood equivalents)

Source: BFS/BUWAL, 1997, p. 49.

Figure 15: *Development of Net Imports for different Timber Products (Fiberboards, Mechanical and Chemical Wood Pulp in 1000 Tons)*



Source: BFS/BUWAL, 1997, p. 88.

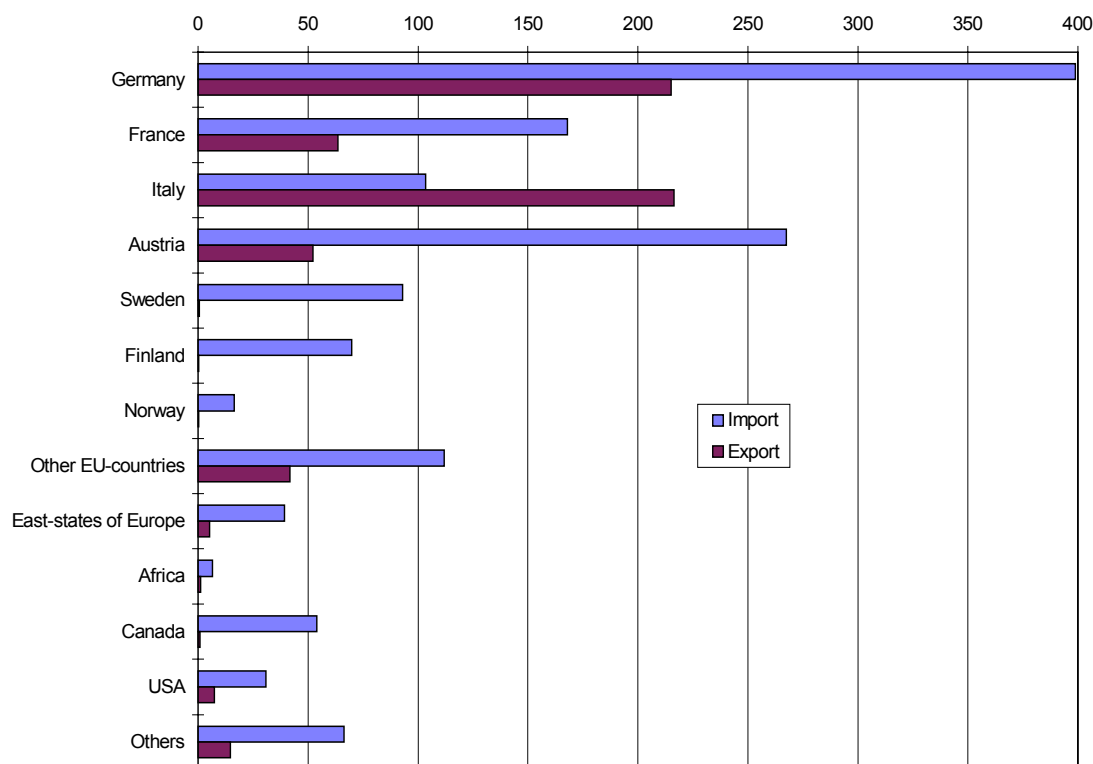
Export and Import Values: In financial terms exports amounted to 2,609 million Swiss Francs (2.9% of all exports) and imports to 4,861 million (5.6% of total imports). Net imports were 2,252 million Swiss Francs. 90% of the trade in unprocessed wood, semi-finished products, finished products and cellulose (1996) takes place between Switzerland and countries of the European Union. Imports originate mainly from Germany, Austria, France, Italy and Scandinavia. Unprocessed wood and wood products exports go mainly to Italy and Germany as well as to France and Austria to a lesser extent.

Table 24: *Export and Import Values of Wood and Wood Products 1995 (in Million Swiss Francs)*

|             | Total | Wood/<br>Wood Products | Pulp/<br>Cellulose | Paper | Furniture,<br>Prefabricated Buildings |
|-------------|-------|------------------------|--------------------|-------|---------------------------------------|
| Exports     | 2,609 | 534                    | 86                 | 1,735 | 254                                   |
| Imports     | 4,861 | 1,114                  | 311                | 2,124 | 1,312                                 |
| Net Imports | 2,252 | 580                    | 225                | 389   | 1,058                                 |

Source: BFS/BUWAL, 1997, p.48.

Figure 16: Value of Import/Export (in 1000 Swiss francs)



Source: BFS/BUWAL, 1997, p.94 and 95.

### 3.2 Employment

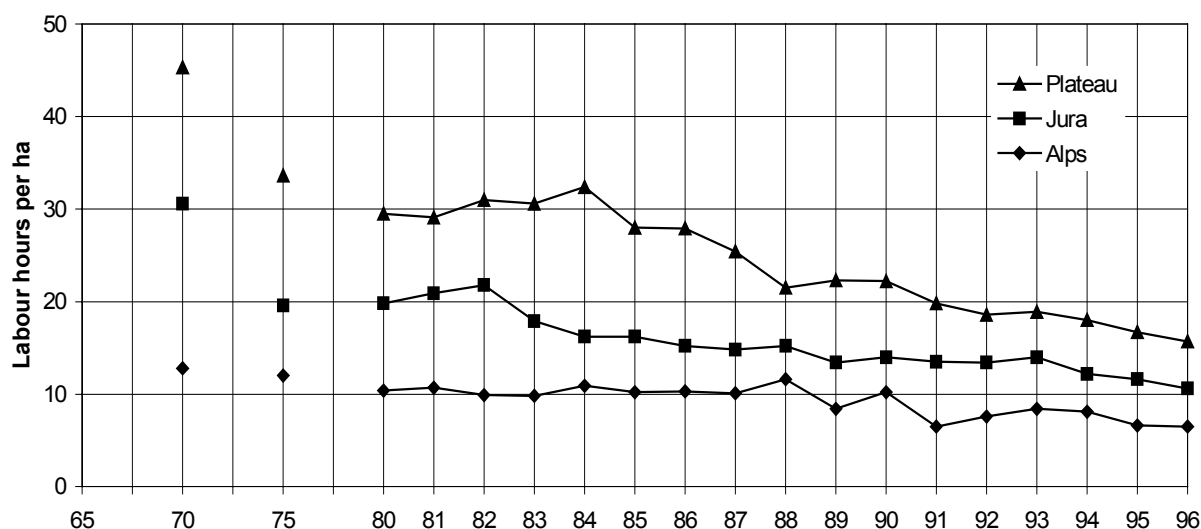
Employment in the forestry sector is in the order of 9,000 man year equivalent in 1995 (BFS/BUWAL 1997, 80). Total employment including forest contractors remained stable during the last 20 years. In the public sector there is a clear shift towards a permanent labour force, whereas temporary labour decreased by 70% over a period of 20 years. Productivity in wood production per hectare increased. Between 1980 and 1996 labour input for wood production in the Plateau area dropped from 30 to 15 hrs/ha, in the Jura from 20 to 10 hrs/ha, and in the Alps from 10 to 7 hrs/ha (BFS/BUWAL 1997, 78).

Table 25: Number of employees in forestry

|                    | 1955   | 1965   | 1975  | 1985  | 1995  |
|--------------------|--------|--------|-------|-------|-------|
| Public forests     | 10,281 | 9,245  | 7,177 | 6,899 | 5,470 |
| - Permanent labour | 3,219  | 4,166  | 4,603 | 4,915 | 4,749 |
| - Temporary labour | 7,062  | 5,079  | 2,574 | 1,984 | 721   |
| Private forests    | 4,916  | 3,080  | 2,333 | 2,405 | 1,888 |
| Forest Contractor  |        |        |       |       | 1,744 |
| Total forestry     | 15,197 | 12,325 | 9,510 | 9,304 | 9,102 |
| in % nationally    | 0.6    | 0.4    | 0.4   | 0.3   | 0.3   |

Source: BFS/BUWAL, 1997, p.80.

Figure 17: Labour input for wood production (in hours per ha forest area)



Source: BFS/BUWAL, 1997, p.78.

Employment in the wood processing industry amounts to almost 90,000 jobs, which is 8% of the total industrial sector and 2.4% of the national labour force (BFS/BUWAL 1997, 81). Joinery, furniture making and parquetry together with carpentry and timber work provide two thirds of wood processing employment opportunities. In comparison with the figures of 1975, employment in wood processing has remained stable, but its importance in the national labour market has decreased.

Table 26: Number of employees in the wood processing industry

|   | 1955   | 1965    | 1975   | 1985   | 1995   |
|---|--------|---------|--------|--------|--------|
| Sawmill industry                          | 9,621  | 8,501   | 5,435  | 5,938  | 5,113  |
| Particle and fibreboard industry          | 1,315  | 2,862   | 2,012  | 1,373  | 1,123  |
| Pulp, paper and cardboard industry        | 9,142  | 9,593   | 8,852  | 6,159  | 4,156  |
| Joinery, furniture industry and parquetry | 41,901 | 55,704  | 53,191 | 52,816 | 50,726 |
| Carpentry, timber work                    | 15,202 | 14,715  | 7,183  | 12,976 | 19,623 |
| Others                                    | 11,663 | 6,694   | 3,415  | 3,587  | 2,9712 |
| Wood trade and transport                  | 3,500  | 4,800   | 4,700  | 4,300  | 4,000  |
| Total wood processing industry            | 92,344 | 102,869 | 84,788 | 87,149 | 82,589 |
| in % nationally                           | 3.9    | 3.7     | 3.1    | 2.9    | 2.4    |

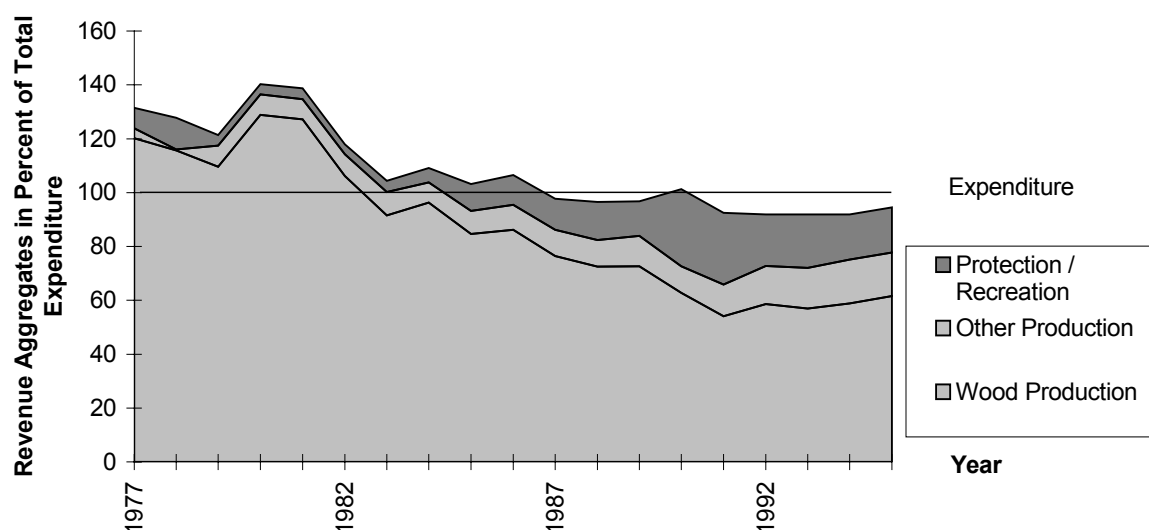
Source: BFS/BUWAL, 1997, p.81.

### 3.3 Profitability of Forest Enterprises

The federal forest statistics provides information on 3,700 public forest owners with regard to income, expenditure and aggregates of production (BFS/BUWAL 1997). The statistics distinguishes between management activities related to wood production, other production such as nursing and smaller wood working units, and services for protection and recreation. Even if this information cannot be interpreted fully to established accounting practices, it gives a fairly representative picture over long time periods on the development of the economic situation of the public forests. The Swiss forest owner association offers an entrepreneurial accounting system, which is used by an increasing number of forest owners (WVS 1996). Additional information is available from federal and cantonal budgets which finance the majority of expenditure for protection investments and maintaining forests with high protective values. Altogether the data of the forest statistics show that from 1987 onward the proceeds from wood production and services have not been fully covering the expenditures of public forest enterprises with the exception of 1990, which was the year with an exceptionally high yield due to the Vivian storm.

Financing of forest management activities depends increasingly on public expenditures for securing protection values and other public interests. At present the proportion of proceeds from wood sales oscillates for all public forests at a level of 60%, and at a level of 40% in the Alpine region. The observed trends confirm that multiple use forest management, which combines private and public interests, requires an expanding income basis from public sources. The federal and cantonal governments, other public entities as well as the public forest owners themselves contribute to the financing of the forest operations in various combinations

Figure 18: *Proportion of Revenues by Output Segments in Relation to Total Expenditure of Public Forest Enterprises in Switzerland (Fixed Assets Excluded)*



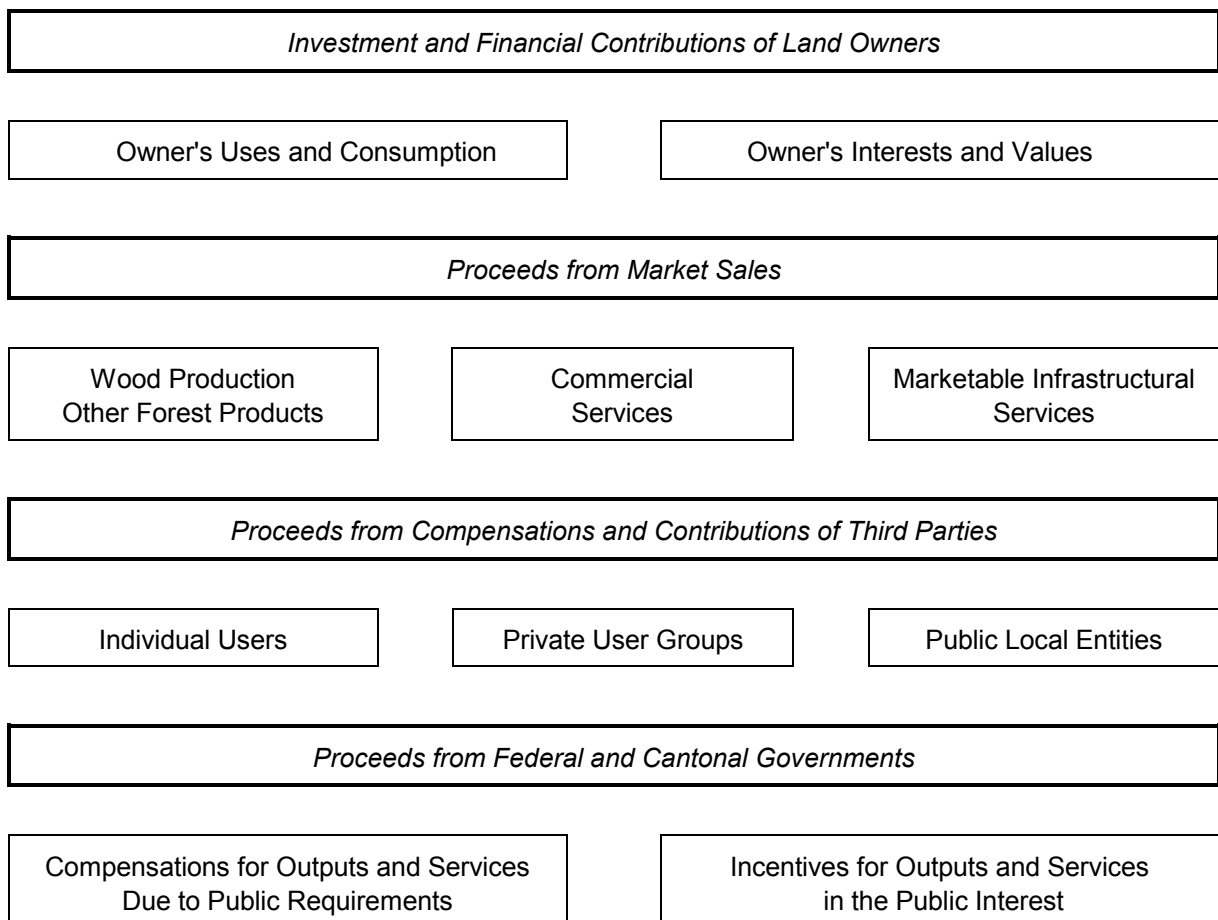
Source: Schmithüsen and Schmidhauser, 1998, p.110.

Figure 19: *Proportion of Revenues by Output Segments in Relation to Total Expenditure of Public Forest Enterprises in the Alps (Fixed Assets Excluded)*



Source: Schmithüsen and Schmidhauser, 1998, p.112.

Figure 20: *Financing of Multiple Outputs and Services from Forest Land Management in Switzerland*



Source: Schmithüsen and Schmidhauser, 1998, p. 103 (modified).



## 4 Forest and Forest Related Policies

### 4.1 Legislation

**Federal Constitutional Competences:** The Swiss Federal government has a comprehensive set of constitutional competences with regard to natural resources conservation and environmental protection. The set includes competences which were established in the 2nd Federal Constitution of 1874 in particular with regard to forests and protection from water calamities (Art 24), and competences introduced by constitutional amendments after World War II (Schmithüsen 1995, 46). The latter refer to the protection of nature and landscape (Art. 24 sexies), land use planning (Art. 22 quater), environmental protection (Art. 24 septies) and to economic well fare (Art. 31 bis).

There are further federal competences which have to be considered in the present context, since the policies which they enable may have important impacts on forest protection and forestry development. This refers to cross-sectoral competences such as training and education, scientific research, regulating commerce, entrepreneurial activities and employment. It also includes sectorial competences such as for water protection and management, agriculture and energy (Kissling/Zimmermann 1998).

**Federal and Cantonal Competences in Forestry Matters:** The federal level has a frame competence, focusing on the protection of forest lands. The cantons are responsible for the implementation of federal and cantonal regulations. They have a fairly large domain of own competences, which include forest management planning, support to public and private forest owners, and organisation of the cantonal forest services. The joint public land management system, laid out by the Federal Constitution, facilitates a balance between national and regional interests and contributes to a wide range of locally adapted political solutions.

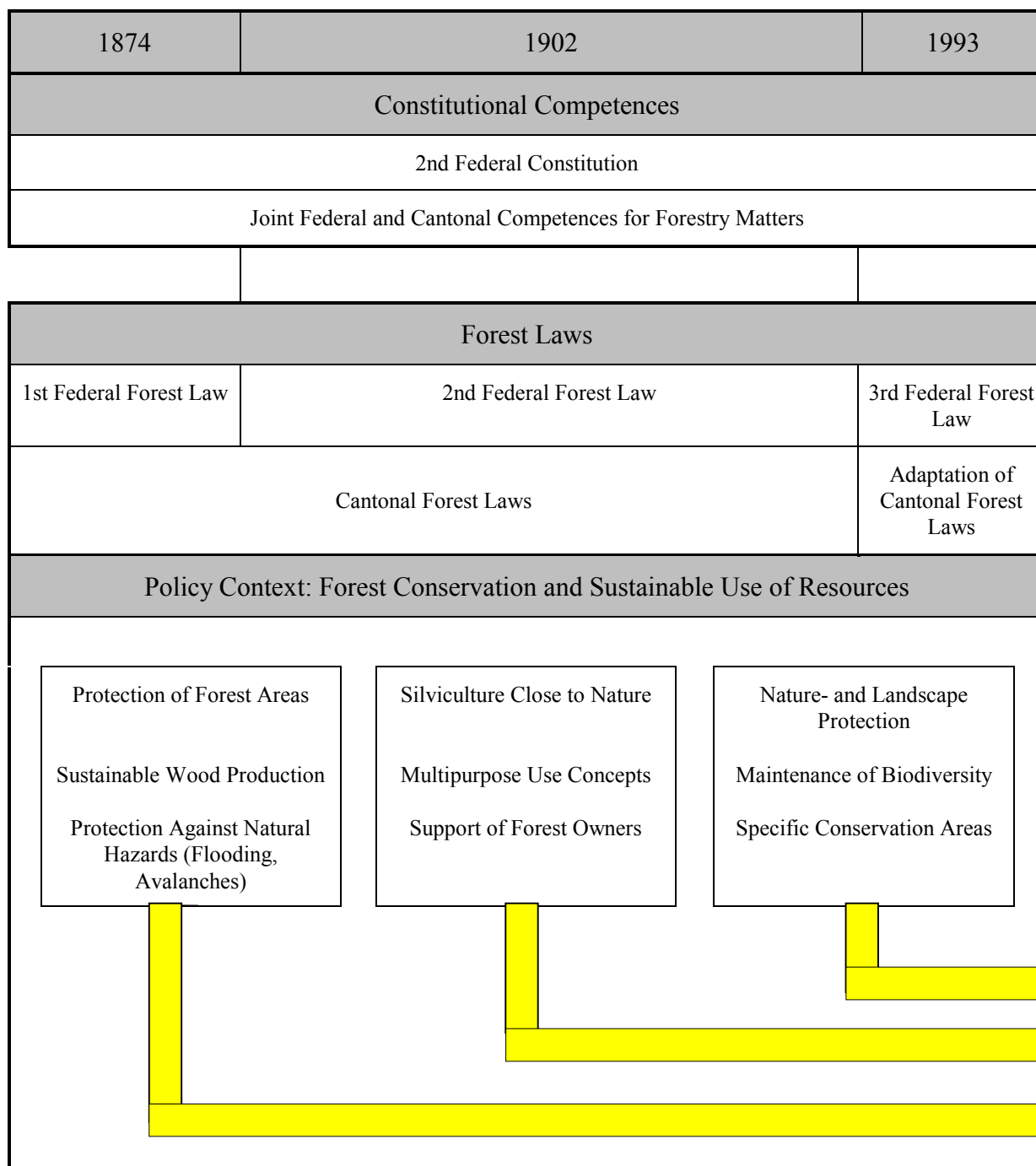
**Federal Forest Law of 1993 (FL):** The new Federal forest law was adopted by the two chambers of the federal parliament in 1991 and it is in force since 1993. The new law reacts to important changes of the role of forests in society and focuses on two central issues. First, it aims at a balance between the interests and possibilities of forest owners, and the increasing and diversified interests of public user groups. Second, it tries to establish an equilibrium between public demands and public commitments in order to protect forest lands and to maintain a wide range of socially desirable forestry outputs. The forest law of 1993 retains the principle of forest protection and conservation, which so far has proved to be useful. It provides for a multifunctional sustainable forest management, which aims at the protection from natural hazards, wood production, recreational and educational uses, landscape and nature conservation as well as at the forest sector development (Art. 1 FL). The protection of nature and landscapes has become one of the specific requirements to be addressed in planning and management regulations. Forest utilisation may be reduced in certain areas, if compatible with the general objectives of the law. In addition, specific forests may be set aside by the cantons in order to maintain and conserve biodiversity (Art.20 FL). With regard to forestry development, the law introduces the principle of compensation to forest owners, if they are required to carry out work or provide services of public interest at costs which cannot be covered otherwise (Art. 36-38 FL). Furthermore the law regulates the federal support of education and training as well as of monitoring activities (Art. 29, 33 FL). It also allows for the possibility to transfer specific tasks to non-governmental organisations, and contains a new article which stipulates that the public and the political authorities have to be regularly informed (Art. 32, 34 FL).

*Figure 21: Articles of the Swiss Federal Constitution Relevant to Forests and Forestry*

| <i>Articles Giving Competences in Forestry Matters</i> |   |
|--|---|
| Art. 24  | Frame Competence on Forests             |
| Art. 24 sexies   | Nature and Landscape Conservation       |
| Art. 24 epties   | Environmental Protection                |
| Art. 31 bis  | Economic Welfare and Stability          |
| <i>Articles Referring to Sectoral Aspects</i>          |   |
| Art. 24, 24 bis, 24 quater                             | Water Protection and Management         |
| Art. 24 octies   | Energy                                  |
| Art. 25  | Fishing and Hunting                     |
| Art. 31 octies   | Agriculture                             |
| <i>Articles Referring to Cross-Sectoral Aspects</i>    |   |
| Art. 22 ter  | Ownership Guarantee                     |
| Art. 22 quater   | Land Use Planning                       |
| Art. 23  | Public Works (Infrastructure)           |
| Art. 27  | Higher Education                        |
| Art. 27 sexies   | Scientific Research                     |
| Art. 31  | Freedom of Commerce and Enterprise      |
| Art. 34 bis  | Insurance against Accidents             |
| Art. 34 ter  | Employment Regulations                  |
| Art. 34 novies   | Unemployment Insurance                  |
| Art. 36 ter  | Use of Gasoline Customs                 |
| Art. 36 sexies   | Protection of the Alps                  |
| Art. 37 quater   | Trails and Footpaths                    |
| Art. 41 bis/ter  | Levy of Taxes                           |
| Art. 42 ter  | Financial Equilibrium Among the Customs |
| Art. 64  | Competence in Civil and Contractual Law |

Revision of Cantonal Forest Legislation: Because of the shared competences as stipulated by the Federal forest law, the cantons are now in the process of revising their forest legislation. Approximately half of the cantons already completed this task. The others have prepared projects, which are at different stages of parliamentary deliberations (Keel/Zimmermann 1997). Major issues which require cantonal regulation and which have raised conflicting debates during the legal process are the definition of minimum criteria for forest areas; the system of compensation in kind for land for which a clearing permit is issued; the regulation of access for mass-events in the forests; forest management planning; public financial transfers to forest owners; and the organisation of cantonal forest services.

Figure 22: Evolution of the Swiss Forest Legislation



Source: Schmithüsen, 1995, p. 45-50

## 4.2 Actors in Forest and Forest Related Policies

At the federal level the two chambers of parliament and the Federal council are the principal actors in setting the Federal public forest policy. They are responsible for the programme formulation and annual budgetary decisions on public funding. Since 1998 policy implementation has been the task of the Federal Department for the Environment, Transport, Energy and Communication. Within the department the Swiss Agency for the Environment, Forests and Landscape is in charge forest related matters, such as game protection and protection against natural calamities amongst others.

At the cantonal level the main institutional actors are again the parliament and government, which presently play an important role in the formulation of new cantonal forest policies. Forestry matters may be implemented by various departments such as the department for agriculture public infrastructures and environment. A Public Forest Service with headquarters, field districts and range units exists in all cantons. The conference of the Cantonal Forest Directors and of the chiefs of the Cantonal Forest Services act as liaison units between the cantons and with the Federal administration.

In recent years new actors appeared on the scene, which shape political processes that lead to the adoption or reinforcement of forestry programmes (Schmithüsen 1995, 48). This refers to the role of citizens and of the mass media, which acquired a much higher sensitivity for the political impact of conservation. It also refers to the spectrum of political parties, environmental parliament groups and commissions as well as a large number of professional organisations. The Swiss Forestry Association, the Swiss Forest Owner's Association and the cantonal affiliates are the principal representatives of the forest sector. The interests of the forestry personnel are represented by other specialised organisations. In the wood processing sector a larger number of associations exists representing different branches of manufacturers and wood product traders. Joint committees and liaison groups such as the Swiss Association for the Forest, the Rio Committee on Forests and the Swiss Wood Processing Industry Conference have been established. These organisations facilitate an exchange of information and foster the co-operation among the different policy actors.

A significant development is the creation and consolidation of a wide range of non-governmental organisations, which engage in the promotion of nature protection (Schmidhauser et al. 1993; Schmidhauser 1997). The role of these groups is important in several respects. They are not only the driving force behind articulating public concern, but they also assume a major role in the implementation of conservation programmes by using the expertise of their members. In addition, land owners are increasingly involved in the conservation. By using their rights of appeal in the courts they are important agents in the administrative decision making process. The conservation groups formulated criteria on sustainable forest resources utilisation and set up monitoring systems in order to evaluate policy results.

The Swiss environmentalist group includes approximately 10 organisations with specific nature conservation objectives. Together the four largest groups have more than 300,000 members (including double membership). Whereas forest owners and forest industry organisations represent primarily economic interests and special uses associations have rather limited objectives, the conservation groups have more general concerns which deal with the environment, sustainable development, nature- and landscape protection. At the cantonal level user groups which practise a wide range of recreational activities play an important role in influencing the policy formulation and forest management planning.

Figure 23: Institutional Policy Actors at Federal and Cantonal Levels

| Federal Level  | Cantonal Level  |
|--|---|
| Parliament with 2 Chambers   | Great Council (Parliament)  |
| Federal Council  | Government Council  |
| Department for Environment, Transport, Energy and Communications   | Various Departments e.g. for Agriculture, Public Infrastructures or Environment |
| Swiss Agency for the Environment, Forests and Landscape (SAEFL)  | Cantonal Forest Services with District Officers and Range Units                 |
| Swiss Forest Agency in charge of forest related matters, wildlife and protection against natural hazards |   |
| Policy Coordination Units  |   |
| Conference of Cantonal Forest Directors (Ministry)   |   |
| Conference of Chiefs of Cantonal Forest Services   |   |

Figure 24: Major Swiss Associations and Groups Involved in Forest Policy Development

|  |  |
|--|--|
| <i>Forest Sector Associations:</i>                 | Swiss Forestry Association; Swiss Forest Owner Association; Swiss Association of Engineers and Architects; Swiss Foresters Association; Forestry Personnel Association of Switzerland; Swiss Association of Forestry Enterprises   |
| <i>Forest Industry Associations:</i>               | Swiss Sawmill and Wood Industry Association; Swiss Carpenter's Association; Association of Swiss Furniture Manufacturers; Swiss Association of Paper Manufacturers; Association of Swiss Timber and Sawwood Traders; and others  |
| <i>Nature Conservation Associations:</i>           | Swiss Association for Nature; World Wildlife Fund Switzerland; Swiss Association for the Protection of Birds and Nature; Swiss Homeland Association; Pro Natura (Swiss League for the Protection of Nature); Swiss Alpine Association; Swiss Water and Air Protection Association; Aqua Viva (National Committee for the Protection of Rivers and Lakes) |
| <i>Environmental Protection Associations:</i>      | Swiss Association for Land Use Planning; Swiss Environmental Protection Association; Helvetia Nostra; Swiss Energy Foundation; Swiss Traffic Association; and others   |
| <i>Interest Groups Representing Specific Uses:</i> | Cantonal Hunting and Fishing Associations; Swiss Jogging Association; Swiss Sports Association; Swiss Union for Walking-Trails; Regional Tourism Development Associations  |
| <i>Joint Committees and Liaison Groups:</i>        | Swiss Association for the Forest; Rio Committee on Forests; Swiss Forest Industry Conference   |

### 4.3 Forest Policy Tools

**Regulative and Incentive Instruments:** Whereas previous policies relied mainly on prohibitions and obligations, a more proactive approach with a wider range of policy instruments is now taken (Zimmermann 1994; Kissling/Zimmermann 1996). Regulative instruments keep their importance, in particular with regard to protecting forest areas from uncontrolled changes in land-use and from devastating practices. Instruments which restrict forest management decisions, however, are replaced by joint management systems which engage forest owners and public authorities on a negotiation and contractual basis. A critical review of the existing incentives for afforestation, forest roads and co-operation of forest owners is necessary in order to develop output oriented systems and accurate measures of performance and impacts. New categories of incentives for silvicultural practices close to nature, multiple use management and promoting measures are introduced in order to maintain biodiversity. Compensatory payments to forest owners for specific tasks or restrictions in the public interest are provided for by the new federal forest law. On the whole policy instruments are more specifically related to determined public targets with precise commitments of the beneficiaries.

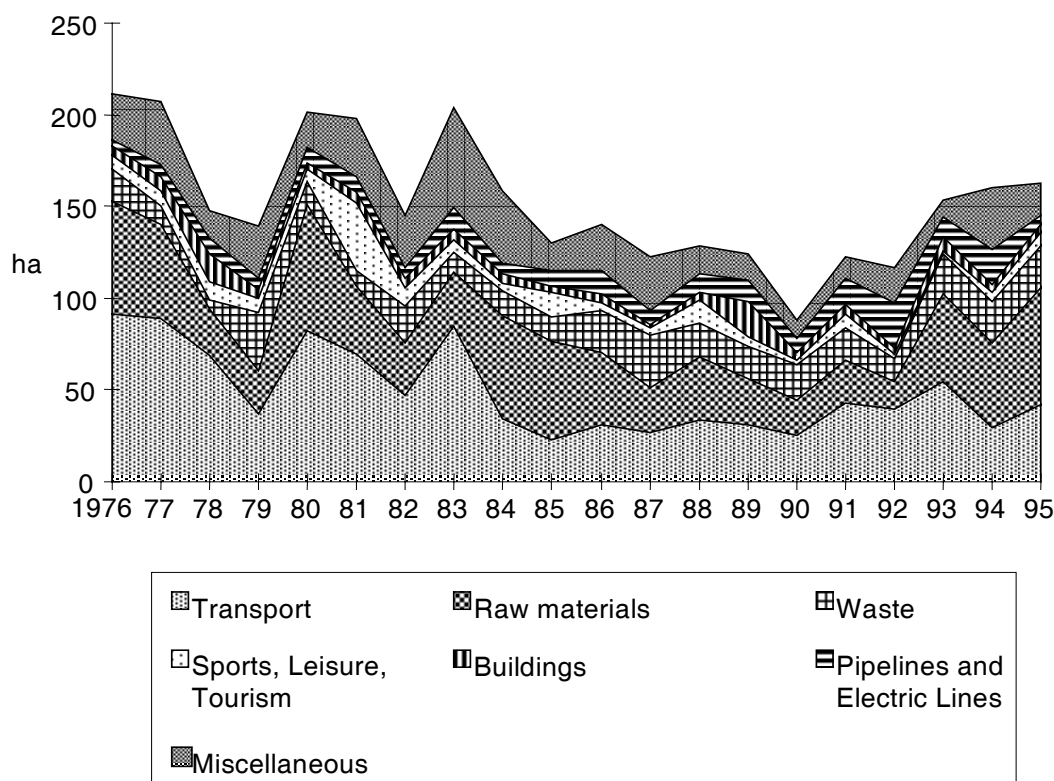
**Informational (persuasive) Instruments:** With the shift to a collaborative forest policy, informational and persuasive instruments gain considerable weight (Schmithüsen 1997). This refers to information and debate in parliament and in other political entities, to information and arbitration processes among different interest groups, and foremost to a more substantial dialogue between forest owners and public authorities. Monitoring and performance measurement systems produce information on forest health, composition of forest stands, and on the impact of uses, as they affect forest ecosystems and biodiversity. There is also an increasing demand for information on the economic performance of forest enterprises and on services rendered to the public as part of sustainable forest management.

**Process steering instruments:** These instruments are particularly concerned with the organisational structures and competences, and communication practices between governmental services and non-governmental organisations. Decision making procedures among public agencies, the establishment of lead agencies, organisation of public hearings, as well as regular assessment and evaluation are important issues. A noticeable element is the tendency to separate more clearly the regulatory function of public forest services from their role as managers of the forest land. The allocation of financial resources in relation to specific targets based on global budgeting and/or service contracts is a new feature in public process-steering (Schmidhauser/Schmithüsen 1998). It requires criteria of financial controlling, which measure efficiency (output/input), effectiveness (attainment of objectives) and economy (real costs/standard costs) based on best practices.

**Impact of Policy Measures:** The present national forest policy programme is only five years old. As a result, we know little about compliance, effectiveness, efficiency, side-effects etc. To date there has been no systematic and scientific evaluation, either of the whole public forest policy programme or of some individual or specific instruments or measures (Zimmermann 1998). Switzerland is still a long way from having a systematic, scientifically oriented evaluation of its public forest policy. However, there are data and information available which are suitable for a partial evaluation of the principal instruments of Swiss forest policy. From the Forest Statistic Yearbook, for example, we know in which region or canton deforestation permits have been granted. The development is marked by a certain regularity concerning the annually deforested surface. With regard to the purpose of deforestation, three categories are dominant: traffic installations, raw material and refuse. No information is available on the number of applications and the area involved, which are refused formally or informally by the forest authorities. It is not evident whether more applications for deforestation authorisations are submitted by private or

public bodies. The same refers to information on the amount of land reforested as compensation in the same region. Altogether we know little about the influence of the policy instruments, other policy programmes as well as of other social and economic factors on the development of the forest area at the present time. Crucial questions in connection with impacts and outcomes, effectiveness and efficiency of the federal forest conservation policy can thus not be answered.

Figure 25: *Authorised Deforestations in Switzerland*



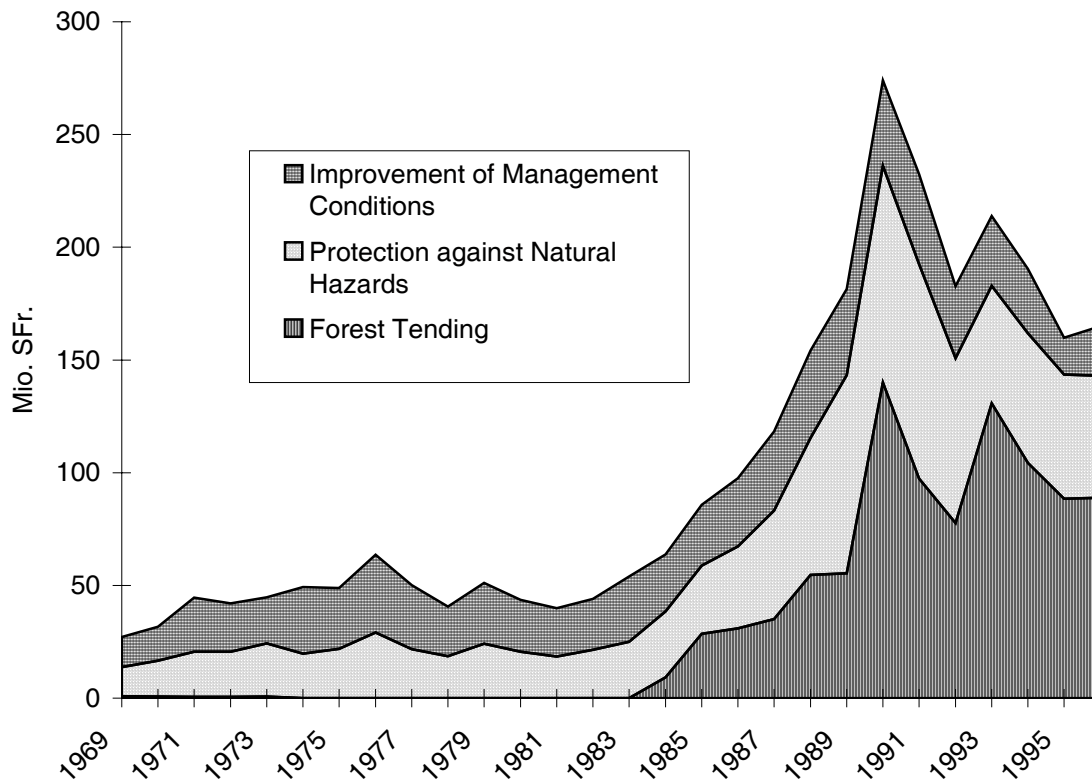
Source: BFS/BUWAL, 1993, p.68. ; BFS/BUWAL, 1997, p.68.

Very similar is the situation relative to financial contributions, the second principal instrument of the federal forest policy. From the budget and the account of the Confederation we know the amount allowed each year by the Federal Assembly for the financing of three types of measures: forest tending, protection against natural hazards, and improvement of forest management conditions. Due to the fact that the majority of public financial support is granted for measures carried out in protective forests, the mountain regions are far more affected by financial decisions than the rest of the forest area. An estimate, based on the 1996 figures published in the official gazette, shows that the share of the Alps and Jura in the decisions made by the Swiss Forest Agency on public funds was as follows (Zimmermann 1998): 85% for forest tending; 100% for protection against natural catastrophes; and 75% for measures of improving forest management conditions. 90% of the decisions of the agency thus referred to forests in mountainous regions, which is considerably higher than the proportion of these forests within the country.

With regard to the impact and outcome of financial incentives and compensation in forestry important questions still remain to be answered. It would be particularly interesting to know whether, and if so how and to what extent, federal and cantonal funds have influenced the behaviour of the forest owners or forest enterprises (question of effectiveness). For example, have the incentives encouraged the tending of more forest or other forest areas? What would forest owners have done without public financial support? Have they changed their activities in a

direction suggested by the forest policy programme? What are the cost-benefit-effects (question of efficiency)? Are the goals of the financial incentives achieved completely or only partially? What are the positive and negative side-effects of the various financial measures on the structures of forest enterprises and for the timber industry? There remain a lot of questions to be answered both by the scientific research and the forest administration.

Figure 26: *Financial Support allocated by the Confederation for Forest Measures (1969-1996)*



Source: BFS/BFL, 1985, p.61. ; BFS/BUWAL, 1993, p.74. ; BFS/BUWAL, 1997, p.74.

#### 4.4 Forest Policy in Relation to other Policy Areas

The various constitutional amendments led to a growing network of distinct policy areas focusing on resources conservation and environmental protection:

- conservation linked to the use of renewable natural resources such as forest, water protection and fishery policies;
- conservation of nature and landscape as well as of the available space;
- conservation of the environment in particular with regard to air, soil and pollutants;
- improvement of economic conditions.

Cross-sectoral conservation programmes refer to nature- and landscape protection, land use planning and environmental protection (Kissling/Zimmermann 1998). The various programmes are complementary, but to some extent also in competition with each other. Sectoral resource policies tend to integrate conservation aspects, cross-sectoral conservation policies become more and more involved in regulations of specific uses, and land use planning integrates all aspects of



land development and conservation. Cross-sectoral conservation objectives have an increasing impact on the development of policies for forest protection and sustainable forest management.

Figure 27: Evolution of Major Swiss Conservation Policies

| Policy Areas | Constitutional Competences | Policy Programmes |                     |
|--------------|----------------------------|-------------------|---------------------|
|              |                            | Initial           | Last Major Revision |

| Cross Sectoral Conservation Policies |                            |           |                          |
|--------------------------------------|----------------------------|-----------|--------------------------|
| Nature and Landscape                 | 1962/1987<br>Art. 24 sexes | 1966/1987 | Current Partial Revision |
| Land Use Planning                    | 1969<br>Art. 22 quater     | 1979      | Current Partial Revision |
| Environment                          | 1971<br>Art 24 septies     | 1983      | Current Partial Revision |

| Policies Aiming at the Conservation of Specific Resources |                              |                        |           |
|---|------------------------------|------------------------|-----------|
| Forests   | 1874<br>Art. 24              | 1876/1902              | 1993      |
| Water   | 1874<br>Art. 24 <sup>1</sup> | 1877/1916 <sup>2</sup> | 1991      |
| Fishery   | 1874<br>Art. 25              | 1875/1888              | 1973/1991 |
| Hunting/Wildlife  | 1874<br>Art.25               | 1875/1904/1925         | 1986      |

<sup>1</sup> Further Constitutional Amendments 1908, 1953, 1975 (Art. 24 bis, Use and Protection of Water Resources)

<sup>2</sup> Further revisions in 1955/1971 (Protection of Water Resources)

Source: Schmithüsen, 1995, p. 45-50

A centre-piece in the expanding federal conservation policies was the adoption of the Nature and Landscape Conservation Act in 1966 (Schmithüsen 1995, 46 f). The law was the starting point for a new policy area, which evolved considerably during the eighties. The law emphasises the systematic conservation of biotopes, remaining mire landscapes and alluvial forests. The most important instrument introduced by this law was the right to appeal for non-governmental nature conservation organisations. The constitutional amendment on environmental protection of 1971 provided for "protecting man and his natural environment from harmful or irritating impacts". Its legal implementation was achieved in 1985, when the Federal Law on Environmental Protection was adopted. The law establishes general guidelines such as the principles of general prevention and responsibility of intervention. It contains procedural and administrative provisions with regard to the right to appeal of non-governmental organisations, environmental impact assessment procedures and the designation of competent governmental authorities among others. In addition, the law addresses specifically those conservation areas, which had not been regulated

before: air pollution, protection against noise, control of environmentally dangerous substances, soil protection and waste disposal.

Conservation is not limited any more to the protection of certain species or endangered biotopes. Instead it aims at the integration of conservation aspects in the general resource management (Keller et al 1997). Most of the conservation measures support the protection of forest areas, which is in any event reinforced by forest law. One of the most effective instruments in this context is the right to appeal against deforestation permits (including forest roads) by recognised private nature conservation organisations. Similarly the environmental impact assessment gives an opportunity for conservation agencies and private organisations to intervene in administrative procedures at an early stage and thus to claim that the forest area is maintained.

Current legislation and federal jurisdiction require that conservation aspects have to be considered (Art. 5, 4 and 20 FL). The forest authorities are thus obliged to consider ecological and conservation aspects with the same attention with which they examined silvicultural and economic aspects in the past. The inventories elaborated during recent years have accumulated a wide range of information which can be used in order to evaluate more accurately the ecological importance and the relative conservation values of all kind of lands including forests (Brassel/Brändli 1999). At present these inventories are mainly relevant at the level of the cantons, when examining the need to establish new nature protection areas in forests. In future they will be of increasing importance in connection with forestry operations and forest management planning.

A federal policy on land use planning was initiated with the adoption of the planning law in 1980. Its principal objectives are the conservation of the available space and a balanced development of settlements in the various regions. It establishes nature- and landscape protection as one of the important elements in the planning and regulation of land use. It integrates the available information on land development activities, indicates conflicts between use and protection, and provides participatory procedures for arbitration. Its principal instruments are development plans for the cantons which are binding for the federal government, land use plans of the communities binding for land owners, and development concepts of the federal authorities by subject areas.

The linkages between land use planning and forest policy programmes follow from the objectives and principles determined by the Federal Land-Use Planning Law (Art. 3). It provides for the protection of natural resources and forests, preservation of landscapes and recreational areas, as well as the maintenance of important forest functions. In addition to these cross-sectoral objectives, there are those of the forest law, which stipulate the maintenance of the country's forest in its extent and prevailing regional distribution (Art. 5 and 7 FL). The co-ordinating role of land-use planning involves many sectoral policy areas including transport, energy, agriculture, forestry, mineral exploitation as well as urban and regional development. The role of land-use planning is of particular importance if demands for forest clearing arise, if the land is divided in settlement areas and open spaces by zoning, and if forest areas and forestry related land-use is determined.

Important linkages between land use planning and forest policy exist when determining forest areas and forestry related land use. The forest law provides that the borders of forests have to be defined and are to be marked in land use plans (Art. 11ff FL). The Federal Law on Land Use Planning requires the agreement of the land use planning- and forest authorities for forest roads, forest operating centres and other permanent infrastructure (Art. 22 and 24). An area which needs a more coordinated approach is the extension of nature conservation and recreational zones to forest lands. Since this may imply considerable restrictions for forest owners and forestry, the participation of the competent forest authorities in making such decisions is essential. Aspects which have so far received little attention in both policy programmes are the linkages between

regional development and forestry and the potential impacts of changing land uses outside forest areas on the forest.

## 4.5 International Policy Developments

Rio Process: National sustainability concepts and action plans are directly linked to the 1992 UNCED Conference in Rio (Agenda 21). For this purpose an interdepartmental commission representing 20 offices was established in March 1993. A report has been produced, concerning the operationalisation of sustainable development (IDARio 1995) together with an inventory of actions (IDARio 1996) and updated in 1997 (IDARio 1997). An action plan for sustainable development, which incorporates mid-term planning, has been devised by a small high level expert group (Conseil du développement durable 1997). Based on these findings, the Federal Council presented a strategy for sustainable development in 1997 which is now the main document for further actions (Federal Council 1997). The strategy focuses on measures in different policy fields realisable in the 1995-99 legislative period. In the meantime, Parliament has requested the Federal Council to present a project for ecological tax reform. The administration will now formulate proposals for the attention of the Federal Council. The Council has since March 1998 an elected advisory board of international experts whose task is to develop innovative ideas for a sustainable development.

Ministerial Conference on the Protection of Forests in Europe: Switzerland is a signatory to the resolutions adopted at the three ministerial conferences on the protection of forests in Europe which have taken place in Strasbourg (1988), Helsinki (1993) and Lisbon (1998). It made specific contributions in implementing the six resolutions of Strasbourg as well the four adopted in Helsinki (Conference Report Vol. I 1998). With regard to the guidelines for sustainable forest management and for the conservation of biodiversity (Resolutions H1, H2) the main actions are an assessment of Swiss forest policy, a national debate on appropriate criteria and indicators for SFM and the elaboration of a middle-term forest development strategy, the setting aside of forest reserves as well as the establishment of a gene reserves network (Conference Report Vol. II, 227, 1998). During the preparatory process of the Lisbon Conference an important contribution has been made by identifying more clearly the social elements of sustainable forestry (FA/ECE/ILO 1997).

Altogether, the Federal forest law of 1993 provides a solid basis in implementing the various international instruments both in a world wide as well as in a European perspective. The major challenge is now to foster specific actions and monitoring, and to re-enforce international cooperation with regard to public policies which involve a wide range of governmental and non-governmental stakeholders. This is, for instance, reflected in the objectives of the Swiss Forest Agency which emphasise quality standards of forestry management, promotion of a public debate on the role of forests, and measures for long-term financing of sustainable forestry practices.

Switzerland has recently completed a process of bilateral negotiations with the European Union which covered amongst others trade traffic and research. It is involved in the process of shaping the Alpine Convention. There are considerable differences between Switzerland and the EU countries with regard cross-sectoral and sectoral policies that relate to sustainable land-uses and environmental conservation. The policy trends point, however, in the same direction (Zimmermann 1998); they refer to more a consistent consideration of ecological aspects in resources utilization, public compensations of forestry outputs in the common interest, and policy measures which integrate forestry more closely at regional and local levels into rural development.

## 4.6 Forest Education and Research

Technical and professional forest education is provided for by the forest worker apprenticeship, by two forestry schools, and by the department of forest sciences of the Swiss Federal Institute of Technology (ETH) in Zurich. A study of 1994 indicates that less than one third of university graduates were engaged in the public administration, one third in research and teaching and the remaining third in the private sector (Lanfranchi et al. 1995). The tendency that graduates find employment in a wide range of activities increases, particularly as independent professionals or as employees in private companies. Similar developments occur for the graduates from technical forestry schools.

“On the job training” and continuing education is promoted by central Co-ordination and Documentation Centre (CODOC), which has been established in 1988 by the Swiss Forest Agency and which has expanded its activities considerably in the following years. Professional and technical training and education in wood processing is provided for by the Swiss School for Wood Technicians and Engineers in Biel. The center has introduced new Programmes and makes a significant contribution in promoting modern technologies and quality standards in timber utilization. The Federal Institutes of Technology in Zurich and Lausanne offer special programmes for architects and engineers in wood construction and technology.

Forest research is mainly carried out by the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) in Birmensdorf and Davos and its two regional branches at the ETH Lausanne (Antenne Romande) and Bellinzona (Sottostazione Sud delle Alpi). Major research contributions are made by the Department for Forest Sciences and the Department for Environmental and Natural Sciences of the Swiss Federal Institute of Technology (ETH) in Zurich. The Department of Forest Sciences has teaching and research units in the field of forest inventory and planning: forest policy and forest economics; forest pathology and dendrology; silviculture; wood sciences; and wood technology. There is also a growing number of institutes in Cantonal universities and in other Federal Centers which are engaged in forest related as well as nature conservation and environmental protection research. Wood research is mainly undertaken by the two Federal Institutes of Technology in Zurich and Lausanne, by the Federal Institute for Materials (EMPA) in Dübendorf and by the Swiss Wood Engineering School in Biel.

Swiss forest research is at present in situation of rapid and rather profound changes moving from the established pattern of applied forest sector activities to a much broader perspective of natural resources management and environment. The new mandate of the WSL adopted by the Supervisory Council (ETH Rat) in 1997 shows this evolution. The institute's programmes focus now on landscape including social aspects, on forestry with more attention on economic factors, and on protection from natural hazards including monitoring and evaluation. The central theme are terrestrial ecosystems that are less intensively used and the impacts which result from human interventions and conservation measures. Similar developments exist at the ETH Zurich with efforts to create broader networks integrating environmental sciences and disciplines concerned with land use, primary production and rural development.

International research co-operation such as through IUFRO and IPCC as well as European networks such as Cost and FAIR are of considerable importance in reorienting and broadening national research programmes.

## 5 Main Issues and Challenges

Changing Demands On Forests: Changes occur in a highly complex society in which the tertiary sector contributes more than half of the employment and economic activity, technology and information processing induce rapid adjustments, and in which the majority of the population lives in an urban or peri-urban environment. As a result the forests are looked upon not only for wood production but also as a resource and recreational area which generates many benefits to the communities and which may be used by the citizens.

The multiple expectations of the population and the shift in the social meaning of trees and forests are demonstrated by an inquiry for the mountainous regions of the country (Schmithüsen et al. 1998; Zimmermann et al. 1996, 1998). 90% of the respondents have the opinion that recreation, protection, landscape, tourism and nature will have in the future an equal or higher weight when it comes to judge the relevance of forests. Wood production and forest employment is assessed by 80% of the respondents as of equal or increasing and by nearly 20% of diminishing importance. Altogether the demands which result from such expectations appear of an evolutionary nature and refer as already in the past to the need of maintaining forests in order to protect settlements and infrastructure as well as to a combination of uses and social values. What changes is their relative importance with an increasing emphasis on nature conservation and recreational activities.

*Table 27: Assessment of Present Importance of Forests*

| Predefined Choices     | very important | important | less important | not important |
|------------------------|----------------|-----------|----------------|---------------|
| Recreation Space       | 44.9 %         | 45.1 %    | 8.8 %          | 1.2 %         |
| Protective Environment | 69.4 %         | 27.5 %    | 3.0 %          | 0.2 %         |
| Landscape              | 44.8 %         | 47.0 %    | 7.6 %          | 0.7 %         |
| Wood Production        | 36.7 %         | 48.0 %    | 14.1 %         | 1.2 %         |
| Tourism                | 19.0 %         | 39.2 %    | 32.3 %         | 9.5 %         |
| Employment             | 19.8 %         | 46.7 %    | 30.6 %         | 2.9 %         |
| Natural Space          | 72.3 %         | 26.4 %    | 1.2 %          | 0.2 %         |
| Economic Development   | 15.5 %         | 40.4 %    | 35.3 %         | 8.8 %         |

Source: Schmithüsen et al., 1998, p.45.

Table 28: *Assessment of Future Importance of Forests*

| Predefined Choices     | rather increasing | constant | rather diminishing |
|------------------------|-------------------|----------|--------------------|
| Recreation Space       | 52.8 %            | 42.0 %   | 5.2 %              |
| Protective Environment | 49.2 %            | 42.7 %   | 8.0 %              |
| Landscape              | 23.6 %            | 69.6 %   | 6.7 %              |
| Wood Production        | 34.1 %            | 47.9 %   | 18.0 %             |
| Tourism                | 30.5 %            | 60.4 %   | 9.1 %              |
| Employment             | 19.3 %            | 62.5 %   | 18.2 %             |
| Natural Space          | 58.7 %            | 36.7 %   | 4.7 %              |
| Economic Development   | 23.4 %            | 59.0 %   | 17.6 %             |

Source: Schmithüsen et al., 1998, p.46.

Old and New Forest Related Conflicts: The conflicts relate to economic efficiency in a world wide competitive environment versus cultural values and personal identification; to social divergences on individual demands and personal choices versus efforts and restrictions in the common interest for present and future generations; and to a changing understanding of the role of government with strong pressure for deregulation. They involve contradictory interests between the expansion of public infrastructure and settlement areas versus maintaining the forest area; between compensatory afforestation and natural forest successions versus agricultural and touristic land-use; between forest production and technology versus use restrictions and nature conservation; between the interests of land owners and other users; and between different user groups and various kinds of recreational uses. There are also conflicts with regard to various options of forest management which result from contradictory concepts of the role of forest owners, forest services, non-governmental organisations and the public. Such conflicts reveal more fundamental disagreements on political and institutional issues in particular on forest sector regulation at the local, regional and federal level, on financial contribution to provide multiple benefits from forestry; and on the role of public administrations and non-governmental association in rural and urban developments.

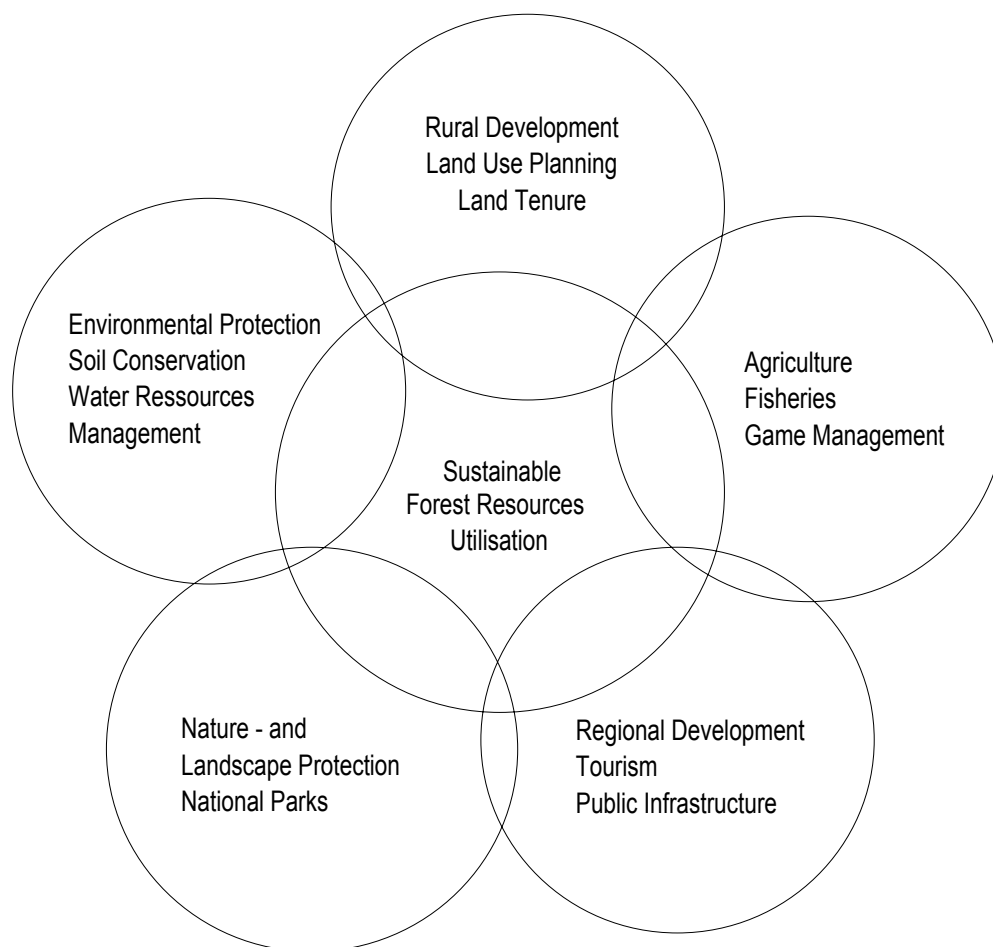
Policy Development: Policy formation and implementation is increasingly concerned with the role of forests as parts of nature and landscape, as parts of the global environment and as integrative elements of culture. Policy processes lead to a wide range of programmes with growing impact on forest protection and forest management. This involves cross-sectoral programmes of nature and landscape protection, land-use planning and environment as well as natural resources and regional development policies. A broad policy network emerges that integrates different social regulations related to the protection and sustainable use of forests. This raises issues on the relevance of forest policy for the objectives and measures of neighbouring programmes, and refers to the impacts of policies which address other land-uses and cross-



sectoral conservation. The linkages between different policy areas have become a central element in shaping future forestry practices.

Forest planning which largely focussed on regulating timber flows and forestry practices has now an additional and crucial task in implementing complex policy networks at local and regional levels. It is an integrative part of determining varying and multifunctional land-use and landscape management, which considers economic outputs and values associated with nature to be of equal importance.

*Figure 28: Public Policies with Important Impacts on Sustainable Forest Resources Utilization*



Source: Schmithüsen, 1998, p.13.

**Challenges to Sustainable Forestry Practices:** The expanding range of conservation needs, combined with more information on the values of biotopes and ecosystems leads increasingly to concerns on the ways and means in which forests are to be utilised and managed (Schmithüsen 1995, 49). Forestry is no longer an uncontested sectoral activity, which is left to forest owners and foresters. Forest owners are accountable for the far reaching demands of conservation groups and the increasingly sensitive public. Forest management is not limited to its traditional role of ensuring sustainable wood production. It integrates many more aspects and has to prove that the forest uses safeguard biodiversity and protect cultural and aesthetic patterns.

A combined approach of conservation and sustainable uses puts new demands on forest management in order to acknowledge the interdependence between investments in resources

utilisation and restrictions of uses. This requires political arbitration processes based on a broader perspective of the economic and social issues at stake. Conservationists need to understand the rationale of forestry activities within the broader context of regional development. Forest managers need to understand that economic and competitive wood production implies a compromise between uses and preservation and that alternative solutions are as much political as technical issues.

The values associated with forests are locally specific, and have different implications in time and space. Forest management practices which are flexible and multipurpose oriented facilitate the integration of varying priorities. It provides for a kind of utilisation which satisfies different groups of the community and leaves opportunities related to changing social demands. For such reasons conservation of natural forests, silvicultural practices close to nature, and selective uses which maintain specific ecosystem potentials will gain even more importance. The need to satisfy different user groups and simultaneously accommodate changing demands on forests has shaped forestry practices in Switzerland. As a result, Swiss forests are characterised by a large variety of vegetation and selective utilisation patterns, which in turn are a valuable asset for the future.

**Challenges to Forest Owners:** Due to the high share of public forests in Switzerland and in view of the strong instruments for direct democratic intervention at all levels of the community, the objectives of what is to be considered as appropriate forest practices will become more and more subject to pluralistic political bargaining processes. Such processes will be of particular importance when local and regional decisions on forests are at stake. The change from the principle of sustainable wood production to the much broader meaning of sustainable forest management offers a basis for more differentiated and locally specific management objectives which correspond to the needs of the land owners and the public. Such a change is facilitated by the fact that the past and current forest management in Switzerland has led to forest stands which allow a variety of silvicultural treatments and which have a high potential for protecting biodiversity and conserving nature

The challenges to public forest owners are foremost to react to changing public demands in a transparent manner and to use decision making processes that favour a consensus among user groups. This again implies the task to convince the political bodies to provide the necessary organisational and financial means for multifunctional forestry practices sustaining a variety of public uses. The challenges to private forest owners are in particular to articulate their immediate interests, to deal with external demands largely focussing on immaterial values, and to maintain their autonomy in management decisions in a situation where they depend increasingly on financial support and compensations from public entities.

**Challenges to Foresters:** A new repartition of the commitments of owners, public entities, user groups and non-governmental organisations in a combined multipurpose resources management perspective is the consequence. The self-financing capacity of the forest sector has to be seen within a political framework that stimulates sustainable production satisfying private and public interests. The challenge to foresters in Switzerland will be to determine the actual and potential benefits from forests, to define the ecological limits of uses, to analyse competing as well as complementary demands and to evaluate the impacts of alternative management strategies. Their work relates to the significance of forests in the overall land-use patterns and as a constituting element of landscapes and environment. All this requires economic thinking, knowledge of political processes for arbitration and consensus finding, and openness for the social dynamics which determine a specific set of demands in a country, a region and at a given locality.

**Challenges to Education and Research:** Swiss forest research and education are at present in situation of rapid and rather profound changes moving from the established pattern of applied

forest sector activities to a much broader perspective of natural resources management and environment. The new mandate of the WSL adopted by the Supervisory Council (ETH Rat) in 1997 shows this evolution. The institute's programmes focus now on landscape including social aspects, on forestry with more attention on economic factors, and on protection from natural hazards including monitoring and evaluation. The central theme are terrestrial ecosystems that are less intensively used and the impacts which result from human interventions and conservation measures. Similar developments exist at the ETH Zurich with efforts to create broader networks integrating environmental sciences and disciplines concerned with land-use, primary production and rural development. International research co-operation such as through IUFRO and IPCC as well as European networks such as Cost and FAIR are of considerable importance in reorienting and broadening national research programmes.

**Challenges to Public Forest Administrations:** The multiple demands on forests in a rapidly evolving economic and political environment require the maintaining of the high level of forest management and a flexible adaptation of forestry practices to the complex interactions between private and public interests. The streamlining of state intervention in accordance with the principles of new public management is one of the important factors of change. It implies a more precisely defined balance between political targets and commitments, between public benefits and financial resources, and between multiple forestry outputs and cost sharing to produce such outputs. New ways of implementing public policy programmes based on target oriented outputs and contractual arrangements have been introduced in order to improve the efficiency of the public sector and to link more consistently commitments and required resources. The forest sector and forest administrations have, in fact, been chosen in several cases as pilot projects in order to gain experiences with the application of new public management concepts.

The diversification of public demands on forests, a new understanding of sustainable development, profound changes in the relationship between government and citizens as well as structural limitations on financial resources are decisive factors that determine the range of action of public forest administrations. In the future this requires even more than now:

- openness and flexibility in reacting to public demands on forests and forestry practices;
- comprehensive and continuously renewed knowledge on the ecological, social and economic criteria which determine their political relevance;
- transparency in the preparation of decisions and negotiation abilities with non-governmental organisations, citizen groups and other administrations;
- and economic thinking in efficiently using scarce public funds for specific tasks in order to foster multifunctional forest resource development.

The ongoing changes, both at the level of the federal government and of the cantonal forest services, are steps in this direction. Further efforts will be required to ensure sustainable uses and the conservation of nature in the forests of Switzerland.

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The Swiss Agency for the Environment, Forests and Landscape (BUWAL) publishes a series and provides special reports relevant to forestry development, nature conservation and environmental protection. In the same line are the series and documents published by the Swiss Federal Institute on Forest, Snow and Landscape (WSL) and by the Department of Forest Sciences of the Swiss Federal Institute of Technology (ETH) in Zurich. A valuable source of information is the Swiss Forestry Journal with contributions in German and French.

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|---|--|
| Department of<br>Forest and Wood Sciences; ETH                                | <a href="http://www.waho.ethz.ch">http://www.waho.ethz.ch</a>  |
| Chair of<br>Forest Policy and Forest Economics                                | <a href="http://www.waho.ethz.ch/ppo/">http://www.waho.ethz.ch/ppo/</a>  |
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