

# Coevolution of forestry and society in Finland: from preindustrial to industrial forestry

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Finland is the second largest net exporter of forest products in the world, but has the highest forest cover in Europe. How is this paradox possible? The purpose of this paper is to investigate the coevolution of the Finnish forestry and society with the de jure and de facto transitions from preindustrial to industrial forestry since the 14<sup>th</sup> century until the 1950s. Finland had this change during the first half of the twentieth century based on the transitions to de facto and de jure sustained yield of timber, and on the excess of the industrial use to the non-industrial use of timber. Unexpectedly, de facto transition took place a few decades prior to de jure transition. Therefore, it was inferred, that the Grand Land Reform and the increasing forestry incomes and real value of forests were the major factors causing this transition and not any specific forest policy. Wars, imports of technology and know-how and various other foreign impacts and scientific paradigms have also played a role in the transition to industrial forestry in Finland. The wars have promoted privatization of forests and increased demands for forest products. Private property rights are theoretically most efficient for sustainable management. Colonization of forests by land reforms and privatization of forests have been the longest trend in the history of the Finnish forestry. Accessible low-value forests are mostly deforested and degraded but high-value forests sustained. The increasing forestry incomes and the value of forests have also decreased poverty and decreased the opportunity cost for sustainable forestry. Public policies have been a necessary but not a sufficient condition in this transition.

## 1. Forestry and society

This article is a part of an ongoing global research project “Evolution and transitions of sustainable forestry in Costa Rica, Finland, Japan and Korea: Case studies and comparative analyses” (Palo et al. 2004). Tropical deforestation was estimated in 1980 as 11 and in 2005 as 14 million ha/a. Deforestation has expanded in spite of multitude of global, international and national political efforts to decelerate it. The core issue here is the vague knowledge so far about the underlying causes of deforestation. This project aims to study ex post, how these four countries have been able to stop deforestation and maintain their high forest covers and in this way to find out potential invariances by comparative analysis to facilitate effective policy proposals for the tropics.

On per capita basis Finland is rich in forest resources, which implies relative economic abundance in forest resources. Finland has the second largest forest area in Europe after Sweden. Finland has only 0.5 per cent of the total global forest area, but its share of the global exports of all kinds of forest products is 10% and 25% of the printing and writing paper. Next to Canada, Finland is the largest net exporter of forest products in the world. (Peltola 2003) Finland has the highest forest cover per land area in Europe (Fig.

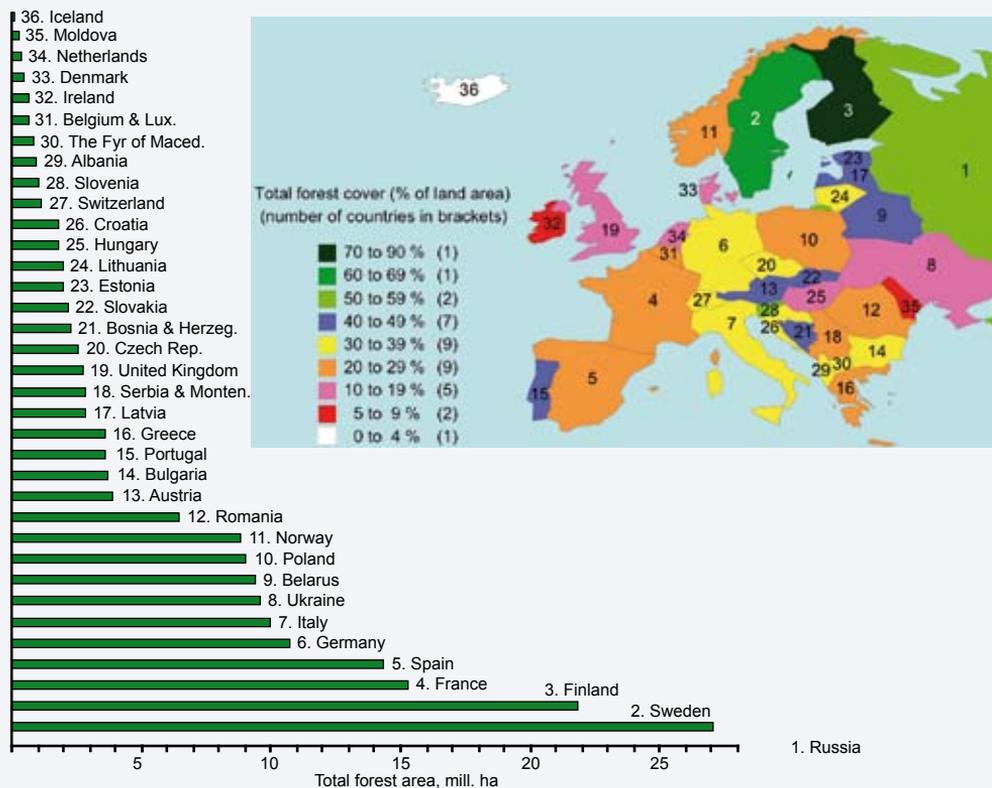


Fig. 1. Forest area map of Europe (data source: FAO 2005, design by Erkki Lehto).

1), which implies also relative environmental abundance in forest resources. How has this kind of positive coevolution of forestry and society been possible in Finland? In most other countries along with population and economic growth the forest cover has declined.

For a small country exports play a vital role in economic development. Finland provides a unique case in the whole world, where forest products exports have had a key role in economic development for centuries (Åström 1978, Raumolin 1984a, Palo 1988, Raumolin 1990, Kuisma 1993, Palo and Uusivuori 1999). The forest resources of the country have been largely exploited in this process. Until the middle of the 20<sup>th</sup> century this led to deforestation and forest degradation but later on to sustained yield of timber. This development has required a mix of

policy and market instruments with support from a number of other institutions.

History of forestry in Finland has been studied by a high number of scholars, e. g. earlier by Meinander (1945), Helander (1949) and Laitakari (1960) and a doctoral dissertation by Snellman (1996), and most recently the doctoral dissertations by Ruuttula-Vasari (2004) and Tasanen (2004). Michelsen (1995) published his "History of Forest Research in Finland. Part 1. The Unknown Forest." This is so far the widest document in English about the history of forestry in Finland from the 1840s to the early 1920s. While Part 1 described primarily the history of forestry, Part 2 was planned to describe the history of forest sciences, but, unfortunately, it has not appeared so far. These studies have been executed by following the traditional paradigm of descriptive

history studies with an emphasis on using original empirical information and data from various archives.

Kuisma (1993) adopted an international demand-oriented approach in his comprehensive study on Finnish forest industries and forestry. Palo (1993) applied a forest policy framework with political power application into his study on the history of forestry in Finland since 13<sup>th</sup> century. Later on, Palo (2001) studied with similar but expanded framework how forest resources had guided the wars by G8 Economic Powers through centuries. Ollonqvist (1998) had an economic policy framework to analyse forest policy evolution in Finland since 1928. Björn (2000) made a case study of two neighbouring municipalities in Eastern Finland with a soft framework of preindustrial, industrial and postindustrial forestry. Rytteri (2002) applied a framework of environmental and social responsibility in a case study of a leading forest industry corporation (Enso-Gutzeit) in Finland.

In Sweden Stridsberg and Mattsson (1980) applied a framework of power relations and causal changes in their Swedish forest history project. In Denmark Fritzboeger (2004) studied the evolution of forest ownership from 1150 to 1830 by applying a property rights theory framework.

We shall apply a theoretical framework of political science, institutional economics and ecological economics, coevolutionary approach and a case study method. Mostly secondary sources of empirical historical observations are used. Accordingly, in this respect our approach is different from the first group of historians but has some similarity with the latter group. The framework is a comprehensive and eclectic one. It is not only limited to economic, sociological, political, ecological or silvicultural aspects. Rather an ambitious attempt is made here in order to integrate these different disciplines (cf. Clawson 1973). We shall discuss the various reservations of this approach at the end of this paper.

*The purpose of this paper is to study first the coevolution of the Finnish forestry and society in a long sweep until the 1950s with a particular reference to de jure and de facto transitions from preindustrial forestry to industrial forestry. Second, an analysis of transition from preindustrial forestry to industrial forestry driven by wars, foreign technology and know-how is given. Third, we analyse parallelly the transition from preindustrial forestry to industrial forestry by describing the impacts of ecological conditions and markets as well as social, political and cultural institutions. Finally, a discussion and some conclusions are arrived at.*

We restrict our article here primarily on the evolution and transitions into industrial forestry from 14<sup>th</sup> century to the 1950s. By this time the paradigm of industrial forestry became fully developed and the *de facto* transition was realized. In the 1960s a totally new era of intensified national planning and mechanization of logging started in Finnish forestry as well as the first signs of the appearance of the environmental non-governmental organizations to the forest policy arena took place. The theoretical framework of this paper is primarily based on Palo et al. (2004). The coevolution theory is a newcomer in this paper.

So far, none of the numerous scholars in Finnish forestry history have specifically focused on the transition process from preindustrial to industrial forestry. However, Raumolin (1984b) has studied "The formation of the sustained yield forestry system in Finland". His study is more of a descriptive one than an attempt to identify the causes of the transition to sustained yield forestry. *Accordingly, there exists a gap of knowledge concerning the multiple factors, which have facilitated the transition in Finland to industrial forestry. We aim to produce novel findings in filling this gap.*

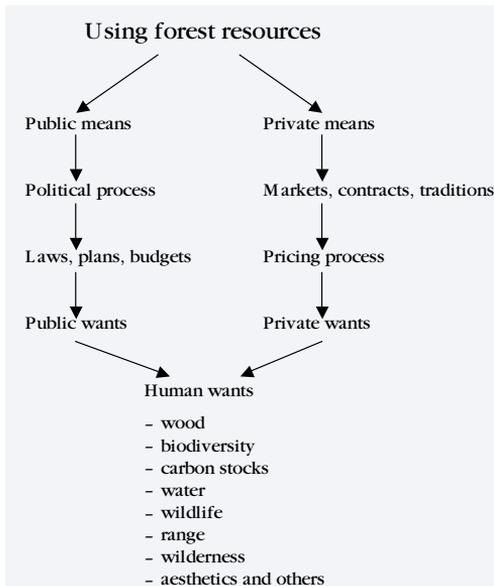


Fig. 2. Policies and markets as regulators of production, distribution and consumption of forest products and services (modified from Cubbage et al. 1993).

## 2. Theory, method and data

### 2.1. Industrial forestry paradigm

Deforestation and *preindustrial forestry* were prevailing in Finland until the latter half of the 19<sup>th</sup> century resembling the contemporary situation in most developing countries. Even, if the *de jure* rhetoric towards sustainable forestry may have arrived to those countries, the *de facto* situation lies a long way from sustainable forestry situation and practices.

Deforestation can be regarded as a socio-economic-environmental process, which mostly lies external to the traditional controls of markets and governments (Fig. 2). Overcoming deforestation is here regarded as a first step towards sustainable forestry in transition from preindustrial forestry to *industrial forestry*. The next step to overcome is forest degradation or a decrease of the volume and quality of the growing stock of trees. The third category in our typology

### Box 1. The typology of preindustrial forestry, industrial forestry and postindustrial forestry.

Three development stages of forestry (Mather, A. 2001, Pirot et al. 2000):

1. Preindustrial forestry: subsistence; open access
  - traditional knowledge
  - common property – closed access
  - colonization: state ownership–open access-deforestation
  - 1a. Traditional pre-industrial forestry: hunting, fishing, shifting cultivating, gathering of firewood, food, medical plants, etc.
  - 1b. Agricultural forestry: clearing of forests for agriculture, agro-forestry, grazing of cattle, fodder, shelter belts, other support to agriculture
2. Industrial forestry: sustained or progressive yield of timber; private property
  - scientific forestry knowledge, forester education: paradigm formation
3. Postindustrial forestry: sustainable forest management/forest ecosystem management
  - scientific ecological, sociological, forestry knowledge, forest ecosystem education, paradigm transition; private, community, public property rights

here is *postindustrial forestry*, which we exclude from our analysis in this paper. This transition will be studied in the next phase of our research project. The typology with the objectives of each category is explained in Box 1.

*In industrial forestry* the objective is sustained yield of timber for industrial purposes. This paradigm was gradually developed along with the expanding international trade by wooden ships, industrialization and the consequent appearance of scarcity of timber and firewood supplies, especially during the 18<sup>th</sup> and 19<sup>th</sup> centuries in Germany. Industrial forestry paradigm in its utmost sophistication requires privatization of forest property rights as a pre-condition for its success according to the property rights theory. From the economies of scale point of view the foresters stressed that the state was the

most appropriate forest owner. Special forest research and education activities to support industrial forestry were mobilized during the 18<sup>th</sup> century first in Central Europe, Russian Empire and Japan. (Cf. Steen 1984)

Scientific breakthroughs, such as the model of normal forest, forest and land rent theories, were created in support of the paradigm of industrial forestry. These new scientific findings were included in the curricula of a growing number of Forestry Colleges (Forest Academies) and universities during the 19<sup>th</sup> century in Europe, Japan and India and later on during the 20<sup>th</sup> century in other parts of the world for educating professional foresters. Industrial forestry was gradually created as a strong scientific paradigm that was shifted to the successive generations of forestry students via educational facilities in different parts of the world.

Varying interpretations of sustained yield forestry in the course of history have appeared (Steen 1984). Here we restrict in the sustained yield of timber, which also has had a number of indicators. The weakest one was to maintain certain forest area non-declining (under continuous forest cover/tree growth). A stronger physical interpretation of sustained yield referred to the 'normal forest', which was able to produce a continuously (intergenerationally) non-declining timber supply. The World Forestry Congress III by FAO in Helsinki in 1949 recommended the idea of progressive forestry (Saari 1949), continuously increasing timber yields, to be followed by FAO member countries. This idea coincided with the diffusion of the idea of economic growth as the principal objective of economic policy. The progressive yield idea can be viewed as the strongest physical interpretation of the sustained yield or industrial forestry (Saari 1962).

The Faustman model (König-Faustman model in German literature) was based on the idea of computing the discounted intergenerational net benefits from afforestation investments and applying the idea of opportunity cost to the capital invested.

With this model the land expectation value could be calculated on an even-age monoculture forest stand in perpetuity. The original idea was to find the financially optimum path from the present forest structure to the normal forest. The German forest economist Martin Faustman (1849) had financial profitability of forestry as a background for developing his famous model. More recently, many variations of the Faustman model have been developed.

The conceptual core of the sustained timber yield was a model of a "normal forest". It was defined as a theoretical concept, where a forest was composed of sites of uniform productivity, of single tree species, of equal size of each age class of trees, and with no risks for future growth and harvest. After the first tree stand or age class had reached the optimal rotation age, it would be clear felled and regenerated by planting or sowing. Later on each year an equal clear felling by age class could be done until perpetuity. In the normal forest the annual cut would equal the annual increment and the forest would operate like a factory. Also timber would be produced and harvested for industrial uses. Therefore, the whole paradigm is called industrial forestry. (Steen 1984, Raumolin 1990)

We regard industrial forestry and post-industrial forestry as scientific paradigms according to Thomas Kuhn's (1962) concept (Box 2). It was a major scientific effort first to create this paradigm of industrial forestry primarily during the 19<sup>th</sup> century in Germany. The stage of industrial forestry is indicated primarily by an officially expressed objective of sustained timber yield and secondarily by a situation, when industrial use of roundwood is exceeding the non-industrial use. It was also a time consuming process to transfer the paradigm of industrial forestry to politicians and foresters in Finland since the 1850s. This process along with the extension of the message to forest owners, industrialists and public at large took about a century in Finland (Helander 1949, Raumolin 1984b, Tasanen 2004, Ruuttula-Vasari 2004).

## Box 2. Thomas Kuhn's science paradigm (Kuhn 1962).

1. A science paradigm:
  - scientific definitions and their relationships
  - assumptions
  - exemplars/model problems
  - beliefs
2. Normal science
  - problem solving within a paradigm
  - a scientist is working within a paradigm
3. Scientific revolution
  - anomalies cannot be explained by the paradigm
  - adoption of a new paradigm – slow shift/revolution

## 22. Politics, policies, power

Politics and policies are composed of the interplay of formulating the objectives, instruments and institutions and implementations. Who decides the objectives, means and institutions is a crucial power issue in forestry and forests (Tansey 2000).

Politics is defined as “the science and art of government; the science dealing with the form, organization and administration of a state or a part of one, and with regulation of its relations with other states” (Shorter Oxford English Dictionary). Politics is practiced typically by governments, political parties and vested interests. Policy is defined as “a definitive line of action”. Social power is a fundamental phenomenon in politics.

Power in social sciences is defined to mean a capacity of the first actor to affect the behaviour of another actor against its own will towards attaining the goal of the first actor. In this context the power of the vested interests or a group of actors sharing the same interests is most interesting. The source of power by vested interests may be based on strong finances, on familiarity of politicians and political processes, on strong ability in lobbying, on superior information and know-how, on easy access to media, on corruption, military power, cultural hegemony, etc.

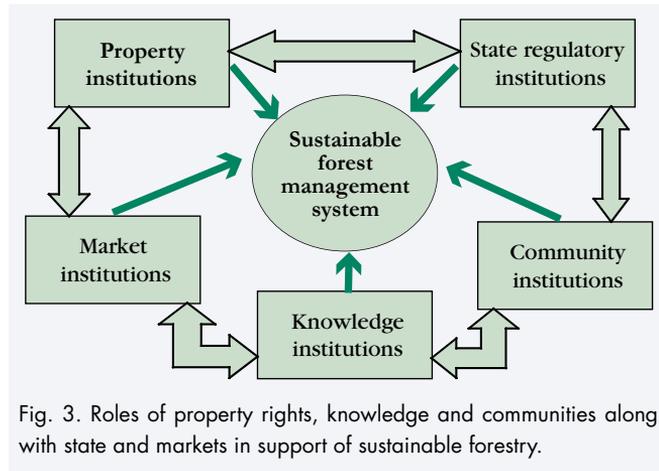
Under dictatorships the strongest vested interests, such as business, military and religious regimes can have dominant impacts. Along with the advancement of democracy countervailing powers, such as democratic political parties, trade unions, farmers unions and NGOs have their chances to balance the power arena. The vested interests that have most affected in the objectives and means of forest politics and policies have varied by time and country. We shall next turn to the key issue of forest ownership. It should be carried in mind that property rights of land and forests have also always indicated social and political power, and especially so in rurally dominated societies (cf. Fritzbøger 2004).

## 23. Property rights

*Industrial forestry and postindustrial forestry paradigms presuppose both state and market control.* In order to facilitate both of these controls an institution of property rights has to be created by the state. Property rights are socially accepted official rules, which govern the access to forest resources and give guidance about the rights and liabilities of the various actors, both forest owners and non-owners (Fig. 3).

Only under clear and strong property rights each forest holding has an owner, who will prevent the non-owners from exercising non-legal activities in his/her forest. The creation of competitive markets and effective government policies also require operational property rights. Often four different theoretical sources of the historical appearance of property rights are introduced as follows: the prior occupation, the invested labour, the right to freedom, and the institutional economics (utilitarian) theory (Fritzbøger 2004). We apply here the last one.

The state has the capacity to establish socially accepted rules or juristic infrastructure by legislation and land reforms for governing the duties and rights of the various economic actors. Four basic regimes



of property rights or tenure are generally identified: open access, common property, private property and state property (e. g. Bromley 1991).

*Open access* is the most common real forest property regime in the developing countries. The absence of property rights either in the law or in the implementation results in an open access regime in the field. Typically no one's property is everyone's property. Open access to any resource results in deforestation, forest degradation, wasting of timber and conflicts as described by Hardin (1968) in his eminent paper and also e. g. by Fritzboeger (2004).

In a *common property regime* the ownership is defined to belong to a certain group of people, such as villagers or a tribe. Open access in this case is closed by the members having the right to exclude the non-members from the use of a common property forest.

*Public property regime* refers to an exclusive ownership by the state, one kind or another, on behalf of the society. A forest service or a department of forestry has been vested the right to manage the state forests in public interest.

In a *private property regime* the forest owners have the right to manage, log and otherwise use the forest resources. They have, on the other hand, the duty to behave according to the existing legislation, admin-

istrative orders and the societal norms. The non-forest owners have the right to only acceptable uses and the duty to permit the acceptable uses by the forest owners. The private property regime minimizes bureaucracy in management and has good chances to utilise local knowledge.

*The efficient property rights structure* is universal, exclusive, transferable and enforceable. It also requires separability of rights and a full specification of rights and duties for the property owners and non-owners. Universality means that all resources are privately owned. Exclusivity refers to a situation where all benefits and costs accrue only to the owner. Transferability means that property rights are transferable from one owner to another on voluntary basis. Enforceability refers, finally, to a situation where property rights are secure from involuntary seizure or encroachment by non-owners. *Only the private property regime may fulfil all these conditions of the efficient property rights.* (cf. Zhang 2000)

#### 24. Roles of state and market

The state and the market are the two principal institutions in market economies, how to control forestry and the allocation of inputs, production and distribution of forest goods and services for satisfying of human needs

(Figs. 2 & 3). The model of Fig. 3 assumes in support of state and market, however, not only property rights, but also community institutions, e. g. forest management associations, environmental NGOs, forest certification, such as traditional spiritual beliefs related to forests or common access for recreation in all forests in some countries. Research, development and human capacity building, along with traditional knowledge and various NGO-activities can be identified as knowledge institutions (Fig. 3).

Most communist regimes have collapsed in applying only government control or a socialistic central planning system. A similar approach has been surprisingly common in forest policy. FAO's journal *Unasylva* (1993) published a special issue on forest policy and legislation. Unfortunately, the whole issue failed to introduce any complementary role of the markets along with the government. On the other hand, by applying only a market system without effective government regulation has also produced many failures among developing nations (Stieglitz 2003).

After the collapse of the Soviet Union and a transition from a plan to a market in numerous other previous socialistic countries, an increased interest on the roles of the government and the market has appeared in economics. A search for an optimum mix of markets and public policies is considered as a global priority (Stieglitz 2003) but only rarely in forestry (e. g. Palo 1997, Palo, Uusivuori and Mery 2001). The state and market institutions are in this paper viewed as complements to each other.

## *25. Coevolution as a research strategy*

Coevolution theory (e. g. Murman 2003, Lamberg and Ojala 2005) is applied here as an approach to analyze evolution of sustainability both in forestry and in the society as an interactive mutually causal activity.

Coevolution is defined in the following way. "Two evolving populations coevolve if and only if they both have a significant

causal impact on each other's ability to persist" (Murman 2003, p. 22). Murman (2003) studied coevolution of firms, technology and national institutions in the industry in Britain, Germany and the United States.

The following five system requirements have been identified for a successful application of the coevolution theory: units of transmission, sources of variation, mechanisms of transmission, processes of transformation and sources of isolation.

The evolutionary theory has inherently a multilevel approach. Therefore, it is essential in evolutionary analysis to identify the different levels of study as or units of transmission. Here our primary level is forestry sector and the secondary level is the society. However, we have to consider also the various impacts, which enter Finland from the third level: the external world. Similarly, we have to identify how the forestry sector transfers its impacts at the firm level: at forest owners, forest industry firms, contractors, loggers and other local actors. (Figs. 4-5)

Forests compose the fifth level in our study (Fig. 5). Forests are changed both by ecological conditions (Fig. 4) and by the local actors (Fig. 5). We shall identify the various causal impacts, which are transmitting the system from preindustrial forestry to industrial forestry. The sequence is often composed of impacts from the external world to the society and from there to the forestry information system, forest policy, local actors of forestry and finally to forests (Figs. 4-5).

The sources of variation originate from the different levels. For example, wars, technology, know-how, markets, political regimes and scientific paradigms have often arrived to Finland from the external world (Fig. 4). Sometimes they have also appeared from the Finnish society or even from the forestry sector. Our principal variation here is the transition from the preindustrial forestry to the industrial forestry. The relevant processes of transmission towards sustainable forestry are the five institutions of Fig. 3.

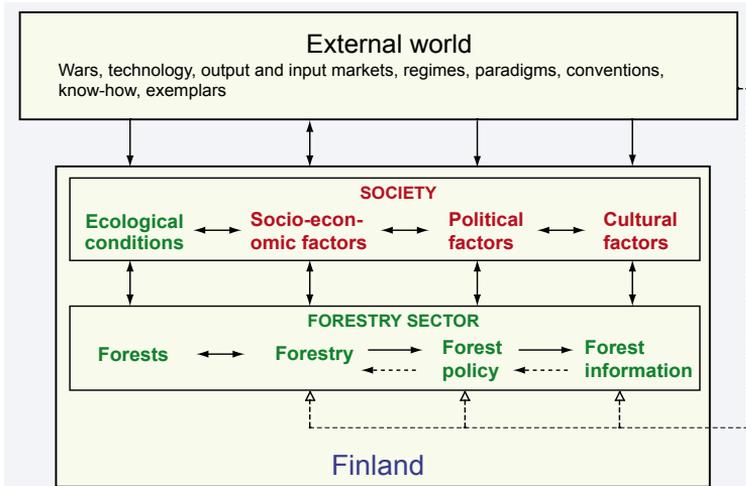


Fig. 4. Model of coevolution of forestry sector and society towards sustainability with impacts from the external world (modified from Palo 1993). (Key: solid line = causal impact; dashed line = information flow)

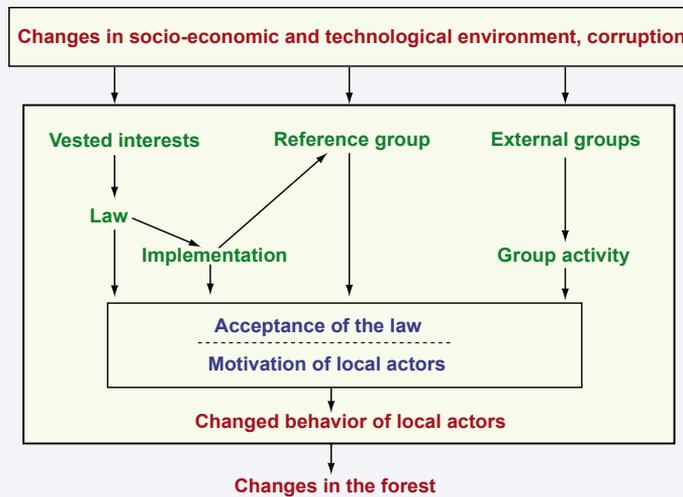


Fig. 5. A model of transition from de jure to de facto situation under a new law (modified from Stjernquist 1973).

## 26. Method and data

In the single case studies Yin (2003) lists five different rationales. We apply a rationale of longitudinal case study. Yin (2003, p. 42) defines this category as “studying the same single case at two or more different points in time”. Its purpose, supported by our theory (Palo et al. 2004), is to identify “how certain

conditions change over time, and the desired time intervals to be selected would reflect the presumed stages at which the changes would reveal themselves”. This rationale may be described as a cross of a contemporary case study and a historical study.

The choice of a case study unit is critical for the success of our research. We define the case study unit as the evolution and

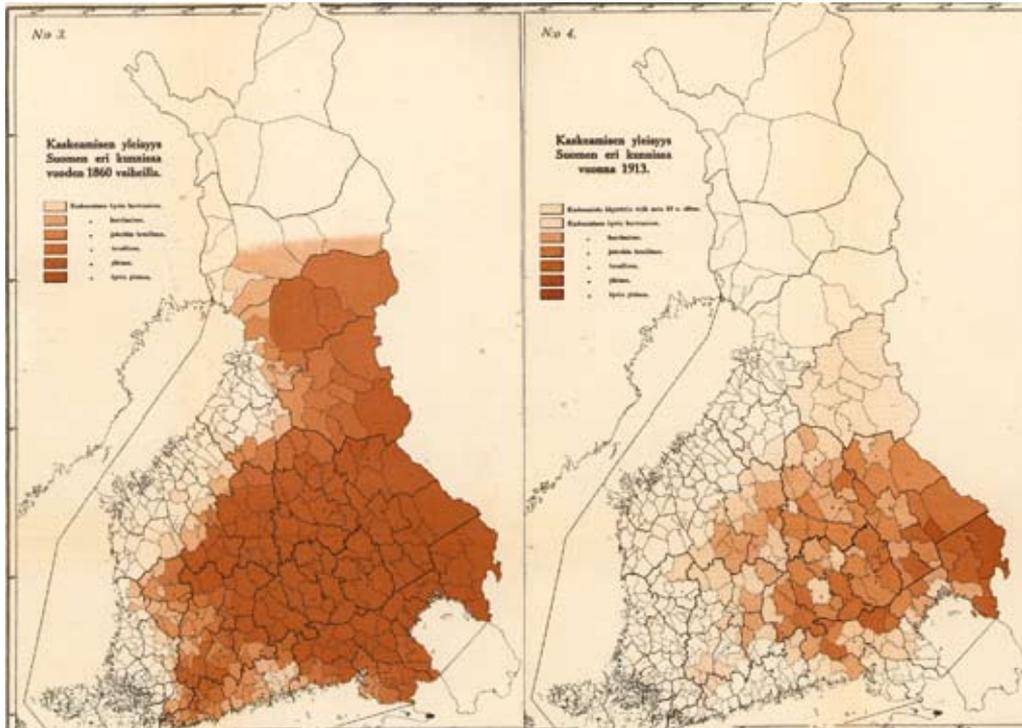


Fig. 6. Shifting cultivation in Finland in 1860 (left) and 1913 (right) by Heikinheimo (1913). (Dark = high)

transition of forestry from preindustrial to industrial forestry. This choice matches with Yin's idea that a "case" can be some event or entity, e. g. organizational change. This aspect reflects the longitudinal case study. The causal linkages between forestry and the society are vital for our study.

The emergence and evolution of the relevant socio-economic systems and institutions supporting sustainable forestry will be described. The historical evolutions of their transitions from open access to industrial forestry are described by applying a common conceptual framework (Figs. 2-5). In this transition the key issue is how to overcome socially excess deforestation and forest degradation.

Our empirical observations are directed by this framework to exogenous and endogenous factors relevant to transitions which consist of wars, technology, science paradigms, political regimes, institutions, indi-

viduals and markets that all have impacts on the evolution of sustainability both in forestry and in society.

Empirical statistical data are based primarily on existing forestry, forest industries and socio-economic statistics. A multiple source evidence strategy is applied. The Yearbook of Forestry Statistics in Finland (Peltola 2003) is a primary statistical data source. The descriptive historical observations are based on secondary sources as indicated in the forthcoming text.

### 3. *De jure* and *de facto* transitions

#### 3.1. *De jure* transition

Especially in the course of the 19<sup>th</sup> century forest clearing was expanded for shifting cultivation (Fig. 6) and in order to establish per-

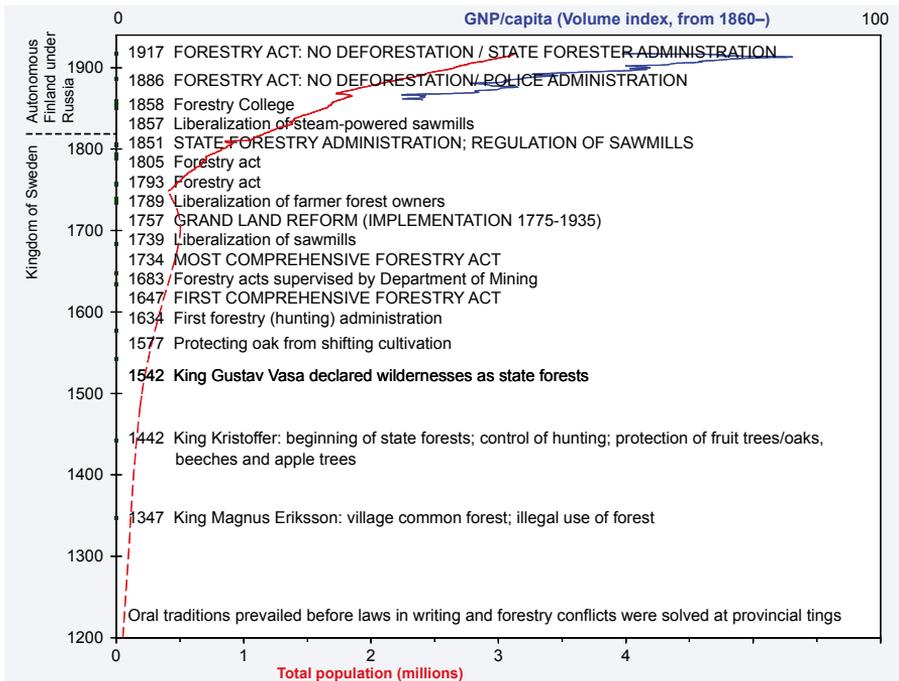


Fig. 7a. Evolution of forestry legislation 1240–1917 in Finland with population since the 13th century and income per capita in 1860–1917.

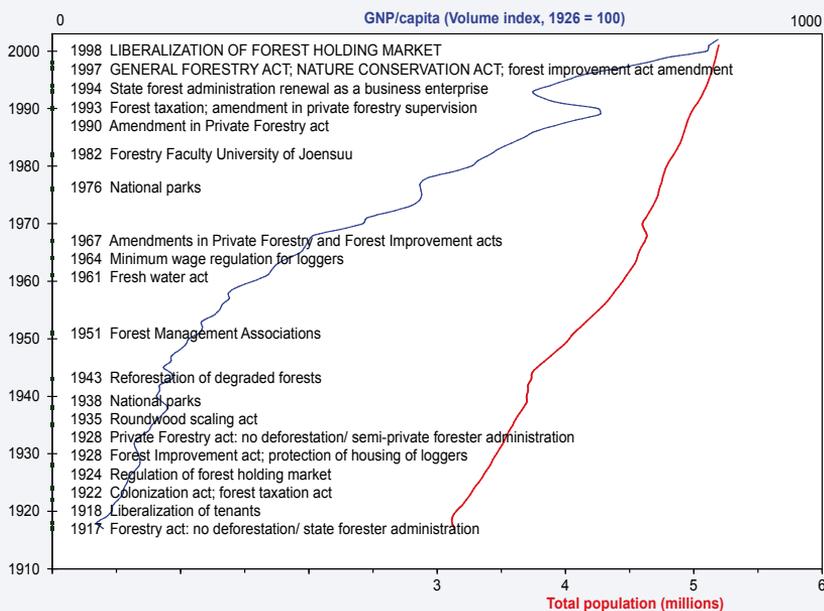


Fig. 7b. Evolution of forestry legislation in independent Finland with population and income per capita.

manent arable fields. This took place along with the population and income growths (Fig. 7a). Shifting cultivation was a land-extensive form of subsistence, while more dense population required more land-intensive forms of agriculture (Åström 1978).

Also the construction of wooden ships and the production of tar demanded for increasing amounts of timber. The population increased in Finland from one to two and a half million from 1800 to 1900. More people demanded for more wood for fuel and construction and for more cattle and increasing grazing in forests. All these changes increased the scarcity of forests nearby more densely inhabited areas. The senate became worried about the forest situation and ordered the first national assessment of forests to be carried out (Fig. 15). The wide-spread scarcity of forests mobilized new forestry reforms.

This population growth was facilitated not only by the reforms in food production but also by new technology of steam engines, pulp and paper making out of wood, other industrialization as well as by the 109 years of peace in Finland as a politically autonomous part of the Russian Empire, expanding “home markets” in Russia and expanding exports also outside Russia. Finland entered into an era of steady and comparatively fast economic growth (Fig. 7a, 14). Steam engine-driven sawmills, wood pulp, paper and paperboard mills appeared gradually to produce leading export commodities (Fig. 8).

It is rather exciting to realize the appearance of numerous government laws and acts (Fig. 7a) in order to regulate forestry since the 14<sup>th</sup> century to follow closely the socio-economic development described below. However, for centuries to come the implementation of these laws was not effective, although various “forestry” administrations were created (Box 3).

A first step of *de jure* sustained yield of timber arrived in the form of the new forestry law of 1886, although the 1647 and 1734 laws already had some elements of sustainability (Tasanen in this volume). The

### Box 3. The evolution of forestry administrations in Finland since 1639.

- 1639/Queen Kristina: Jägerkorps/regulating of big game hunting
- 1851: Provincial foresters/surveyors
- 1858: Forester education & state foresters regulating state forests
- 1886: Police force regulating private forestry
- 1917: Provincial state foresters regulating private forestry
- 1928: Semi-public forestry boards for private forestry
- 1996: Semi-public forestry centers regulating all forests

1886 law declared simply that deforestation is not allowed (Box 4). It was preceded by some important laws and acts, such as the Grand Land Reform (Isojako) of 1757, State Forest Service in 1851 and 1859, the College of Forestry in 1858, and two NGOs: The Economic Society of Finland in 1797 (Hushållnings-föreningen i Finland) and the Finnish Society of Forestry (Finska Forstsällskapet) in 1877. However, the 1886 law first time explicitly expressed the basic condition for sustainability: to stop deforestation with some specification. The 1886 law did not, however, ban forest degradation.

Rather soon it was realized that the police corps under the leadership of the governors were not able to implement effectively the forestry law of 1886 (Helander 1949). Three successive committees were set up to redress this law. However, under the prevailing political circumstances it was not before 1917 that a new act and its implementation administration of state foresters to regulate private forestry were created (Box 5). This act expressed both prevention of deforestation and forest degradation in form of allowing the cut of young coniferous forests only by appropriate thinning and not by clear felling. Interesting enough this act and the establishment of the Forest Research Institute took place just before 6 December 1917, when Finland declared her ultimate sovereignty. (Fig. 7a)

#### **Box 4. The forestry law of 1886 in Finland.**

- "Forest should not be cleared and devastated" (Reforestation by natural or artificial regeneration required, if the site not cleared for agriculture or construction)
- Implementation by provincial governors and police
- Sanctions: fines temporarily by governor and finally by court
- Effectiveness poor due to unclear definition of 'forest devastation' and weak implementation

#### **Box 5. The private forestry act of 1917 in Finland.**

- "Forest shall not be logged in such a way that natural regeneration would be risked."
- "Young coniferous forest should not be logged in conflict with rational thinning."
- Implementation by provincial forester, provincial and municipal forestry boards, subordinated to state forest service.
- Obligatory reporting to a municipal forestry board about coming commercial logging.
- Sanctions by provincial forestry boards: logging ban; the value of illegally logged timber lost, if the ban is violated.

The 1917 Forestry Act was a landmark among the numerous forestry acts until that time, because the implementation of the act became effective. If the act was violated according to the judgement of the provincial state forester supervising the implementation, the forester could negotiate a voluntary banning of future logging for a certain period with the forest owner. If this did not work, the case was taken to a court.

The effectiveness of the implementation of the 1917 act is supported by the facts that already in the first year of its implementation in 1919 logging was banned in 6,000 ha, in 1920–1924 from 15,000 to 27,000 ha, and in the last year 1929 in 73,000 ha of forests. Another requirement at the case of banning

was a compulsory planting or sowing of the deforested site. However, only minor implementations in this front took place due to the scarcity of the staff. (Helander 1949) The growing stock was increasing in the 1920s (Fig. 9), not due to increasing increment but because the drain was lower than the increment (Fig. 10).

In 1928 four new forestry laws were, however, launched by the Social Democratic government of Dr Väinö Tanner, who was a big forest owner himself. Mauno Pekkala, a forester, as the Minister of Agriculture and a member of the Parliament, was another key person to facilitate such a radical reform of forest legislation. Among them were the new private forestry law, another law defining its administration, a law on state subsidies for drainage and reforestation, and a law on housing of loggers and timber floaters.

The contents of the 1917 forestry act were maintained nearly the same in the new private forestry law, but the implementation organization was changed from a pure state one to a semi-public one on a provincial participatory principle, and also forestry extension was included among the tasks of the administration along with the law implementation. Sixteen Provincial Forestry Boards and one Central Forestry Association (Tapio) for the Finnish speaking parts and two Provincial Boards and one Central Forestry Association (Skogskultur) for the Swedish speaking parts of Finland were established. Their activities were subordinated under the State Forest Service and the Minister of Agriculture.

The fresh Boards employed 50 foresters and 180 local forest rangers by the end of the 1930s. This staff used most of its time in various forestry extension activities and only one third in the supervision of the private forestry law of 1928. Still the staff for the implementation of the law was numerous in comparison with the staff implementing the 1917 act. Accordingly, also the areas of banned forests increased considerably from the 1920s. About 0.4 million ha of forests were annually banned during 1930–1959

(Hellström 1993). The growing stock was still increasing during 1930–1955 but levelled off in the late 1950s (Fig. 9).

Also in 1928 a new kind of policy instrument was activated: state subsidies for forestry investments on a cost-sharing basis for private and state (until 1953) forest owners for increasing wood production. State funding was allocated for forest drainage and planting of spruce only. A parallel organization of 14 districts was created under the supervision of the two Central Forestry Associations. A number of foresters and forest rangers were also recruited by this new organization, which can be regarded as an instrument to support progressive forestry. In 1948 the design and construction of logging roads was added under this law. Forest drainage was expanded to 78,000 ha in 1939 a total of 0.72 million ha became drained during the 1930s. After the wartime interruptions drainage works were gradually expanded in the 1950s to 0.12 million ha in 1959. (Helander 1949, Holopainen 1968)

The 1928 laws were amended several times during the following decades but their basic contents remained the same until 1996 (Fig. 7b). The Tanner government launched also in 1928 a radical law to improve the low-standard housing conditions for the loggers and timber floaters in remote logging camps. This law was amended in 1947. A Committee on the Forestry Workers Occupational Training worked during 1952–1958 as a symptom of major future changes in logging and floating. It proposed seven schools to be established for this kind of training. One of them would deal with mechanization training. The implementation of these proposals was started in 1962. (Holopainen 1968)

The extension work by the provincial Forestry Boards was carried out jointly with the local Forestry Management Associations. Their number increased from 86 to 310 during 1929–1939 partly due to the simultaneous state subsidies. These local associations were important policy instruments (Fig. 3) to extend rational methods in marking trees for sale and for silviculture and in

that way to support sustained yield of timber by preventing further forest degradation. During 1898–1928 forestry extension had already been promoted in small scales by local Agricultural Associations with minor state subsidies. (e. g. Holopainen 1968)

The Forestry Management Association Act of 1950 was the last important successive legislation in supporting the *de jure* transition to sustained yield of timber. Until that time the associations had been operated on voluntary basis with some state subsidies since 1898 and more so since 1931. The purpose of the new law was to tax the private forest owners in order to provide them extension services by forestry professionals employed in forest management and in timber sales within these now law-based local forestry associations. The Associations now received a new public financing channel and a semi-public status under supervision of the provincial Forestry Boards.

The paradigm of sustained timber yield became later on more sophisticated in Finland. In 1948 a group of six leading silviculturists defined a system of thinning from below as the only acceptable way of forest management (see more in Leikola in the present volume). This paradigm was adopted by the private forestry boards and it became an unofficial law in order to escape degradation of forests. An orthodox phase or normal science of industrial forestry in Thomas Kuhn's (1962) terminology had arrived to Finland latest in the 1950s.

In 1949 FAO organized the World Forestry Congress III in Helsinki. This was a great global support to Finland being in a rapid recovering phase from the calamities of the World War II. Dr Eino Saari, Professor of Forest Policy at the University of Helsinki, was the Chairperson of the organizing committee. He also was able to insert to the final declaration of the Congress an expansion to the paradigm of the Sustained Timber Yield as follows. Instead of maintaining the yield non-decreasing intergenerationally, it should be continuously increased (Saari 1949). This was in accordance with the new theory of

economic growth in general economics.

In summary of the *de jure* transition the 1917 Forest Act firstly banned deforestation. This aimed to prevent a decrease of forest area, which is regarded as the weakest criterion of sustained yield of timber. The act did not limit the scale of mature timber logging and in this respect there was no guarantee for sustainable logging. The act secondly regulated logging of young coniferous forest and in this way was partly supporting also the maintenance of the growing stock and future cutting possibilities. (Saari 1962) The 1928 Forest Law did also cover non-coniferous forests but did not change the basic contents. Another 1928 law on drainage and reforestation supported even the idea of progressive forestry. The 1950 Law on Forestry Management Associations was important in connecting the Associations with the Provincial Forestry Boards and giving additional support for the Boards in local forestry extension work.

### 32. *De facto* transition

Sustained yield forestry has been observed applying several alternative indicators. Here we use the transition of the volume of growing stock of timber from a decreasing phase into an increasing phase as an indicator of transition from non-sustainable to sustained yield of timber, which can be regarded as the major objective for industrial forestry. As another indicator for industrial forestry we use the time when industrial wood utilization will exceed non-industrial wood utilization. (Palo et al. 2004)

A transition from *de jure* sustainability to *de facto* sustainability is approached with the model of Fig. 5. When a new law is launched, it is by no means guaranteed that it will also become effective. First of all, the rationale of the law has to be formulated according to commonly accepted concepts of justice and equality. Second, the implementation organization has to be competent, motivated and reasonably free from corruption.

An existence of a reference group, to give an example of law-based behaviour, would also be beneficial. Some external groups may successfully lobby for or against the law even during its implementation.

*De facto* sustained yield was observed as a transition from declining growing stock to increasing growing stock of timber around 1900–1910 (Fig. 9). The data are based on scientifically designed and implemented national forest inventories by the Forest Research Institute since 1923. The last estimate for 2001 was 2,100 million m<sup>3</sup> (Peltola 2003). Thus today the growing stock is at the level of the medium scenario in 1800. The further we depart back towards 1800, the more unreliable the data are becoming. Therefore, three scenarios were constructed for the data prior to 1923. Another time series (Fig. 10) indicates that the increment has been predominantly higher than the drain of the growing stock of trees since 1900. The Figs. 9 and 10 mutually support each other.

This finding of the *de facto* sustained yield of timber starting point of Figs. 9–10 is unexpected, because it is preceding *de jure* sustained yield of timber in private forests in 1917. The timing of 1900–1910 is even more surprising, if it is considered with the model of Fig. 5. According to it the maturation of the real effects of a new law is a time-consuming process. Also a comprehensive enforcement of the Private Forestry Law did not start before the end of the 1920s due to a restricted staff in the implementation of the 1917 Act.

The State Forest Service with 40% of total forests had of course had a half a century to operate towards sustained yield forestry but that time was primarily used for closing the access of local people to these forests (Ruuttula-Vasari 2004). Learning how to make timber sales profitable had been another major activity. It was not until the late 1920s that proper silviculture and until 1930s that large-scale drainage of peatlands were mobilized.

We have to solve this paradox by crediting

primarily the markets (Fig. 3) for this early breakthrough of *de facto* sustained yield of timber. Naturally, there had existed an interplay of policies and markets, but finally the structural changes, such as closing down of shifting cultivation (Box 6), tar distillation and wooden shipbuilding, have been decisive in this unexpected finding. Also the scale of forest fires started to decrease along with the decrease of shifting cultivation and tar distillation. Increasing stumpage prices and forestry incomes also played their positive roles. (See more in Section 52 below) The effective implementation of the Great Land Reform was, of course, a necessary precondition for the increasing stumpage prices.

The depression of exports during the World War I did also contribute to this increase of the growing stock (Figs. 10–11). A similar depression and an increase in the growing stock was also visible during the World War II.

The establishment of the Forest Tree Breeding Foundation in 1948 was one forerunner of the later expansion of sowing and planting of trees. Two years later the Central Forestry Association Tapio organized a Silvicultural Campaign (Metsämarssi) in order to promote sowing and planting of trees, tending of juvenile stands, and thinnings. Juho Kusti Paasikivi, the President of the Republic attended personally the opening ceremonies of the campaign. A total of nearly a half a million citizens (ten percent of the total population) participated in these manual silvicultural works during the campaign.

When the act of 1917 and the law of 1928 favoured natural regeneration as the first alternative to be considered in regeneration, the texts of the laws were interpreted in such a flexible way, that the foresters could interpret the opposite in the later post 1950 implementation of the 1928 law. The clear felling sites with sowing and planting as a method of regeneration remained at low levels during 1929–1949, but reached 30,000 ha in 1950. The area was doubled during the 1950s (Holopainen 1968)

The total utilization of domestic round-

#### **Box 6. The factors terminating the era of shifting cultivation in Finland in 1870–1920.**

1. Government policies
  - Great Land Reform with clear and strong tenure for farmers and state forests 1776–
  - State Forest Service administration 1851–
2. Markets
  - Increasing real stumpage prices
  - Increasing incomes to farmer forest owners
    - Increase in agricultural productivity
    - Increasing imports and decreasing prices of grains
  - Increasing of general level of income
  - Increasing industrialization and urbanization
  - Slowing down of population growth

wood in Finland rose from 26 to 54 million m<sup>3</sup> in 1900–1959 (Fig. 11). This total is composed of different uses, such as domestic industrial use, domestic non-industrial (primarily fuel, but also some timber for construction, fencing, poles, pilings etc.) and exported industrial uses. The industrial use surpassed the non-industrial use in 1925–1950. Therefore, we have terminated this paper in the 1950s. The non-industrial use grew larger than the industrial use only during the exceptional times of the Great Depression of the early 1930s and during the World War II and just after it. The period 1925–1950 coincides well with the high share of 70–90% of forest products in all the commodity exports during those years (Fig. 8).

*We may conclude that Finland has transitioned from preindustrial to industrial forestry during the first half of the twentieth century based on the transitions to de facto and de jure sustained yield of timber and finally on the excess of the industrial use of timber in comparison with the non-industrial use.*

Next, we shall turn to the exiting issue, which additional factors have been supporting the transition from preindustrial to

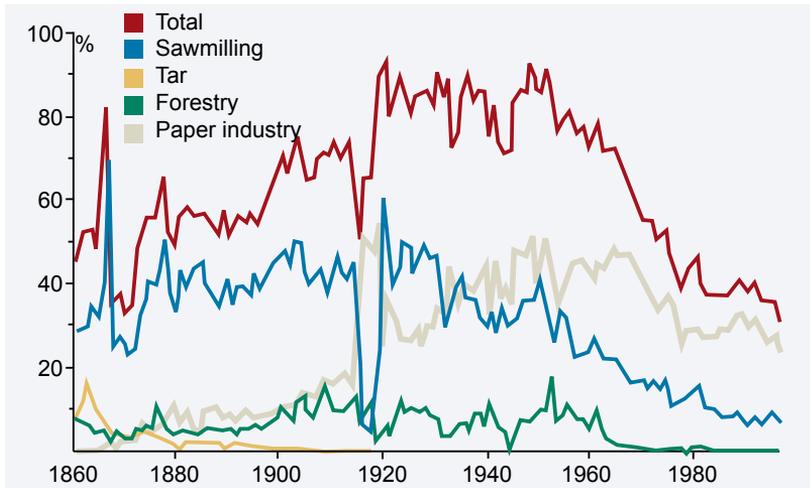


Fig. 8. Exports of forest products in 1860–1990 as percentages of the total value of commodity exports (Seppälä et al. 1980).

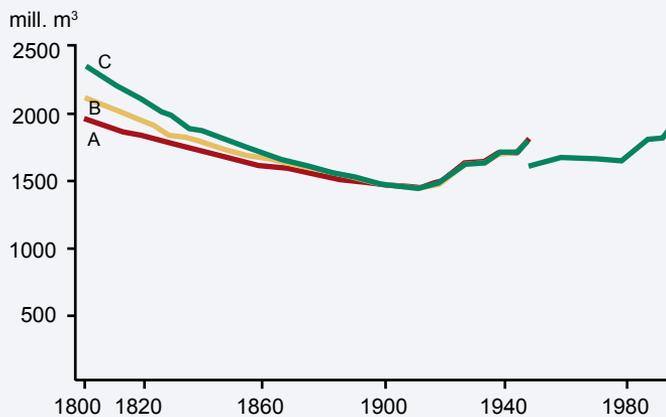


Fig. 9. Growing stock of timber in 1800–2000 in Finland. Note: Finland lost 12% of its forest area to the Soviet Union as a result of the 1939–1944 war. (Myllyntaus et al. 1998).

industrial forestry? It may be rather evident that this transition cannot be a result of any single factor but a combination of multiple factors as assumed in Figs. 2–5.

## 4. Impacts of wars, technology and know-how

### 4.1. Impacts of wars

King Gustavus II Adolphus launched “the Trade and Sailing Order” in 1614. This occasion has been regarded as the beginning of a *mercantilist political regime*, which was

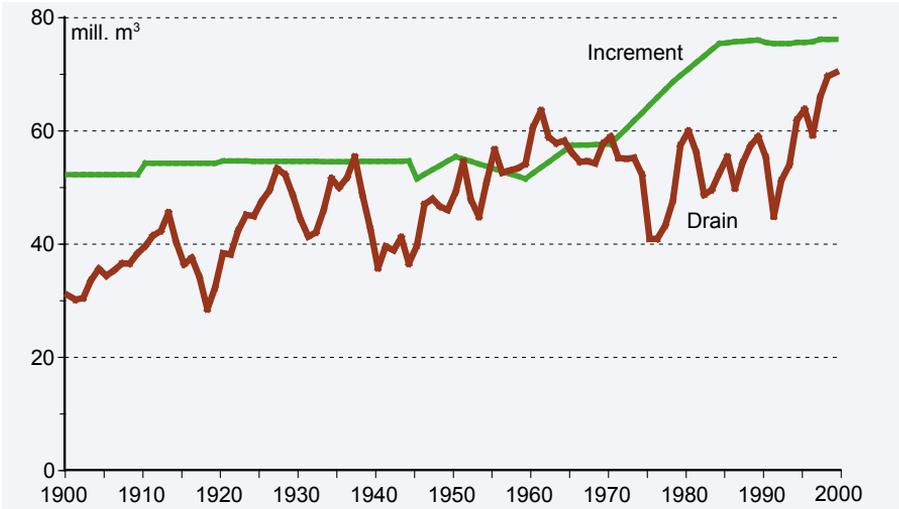


Fig. 10. Increment and drain of growing stock of trees in Finland 1900–2000 (data: Sevola 1999).

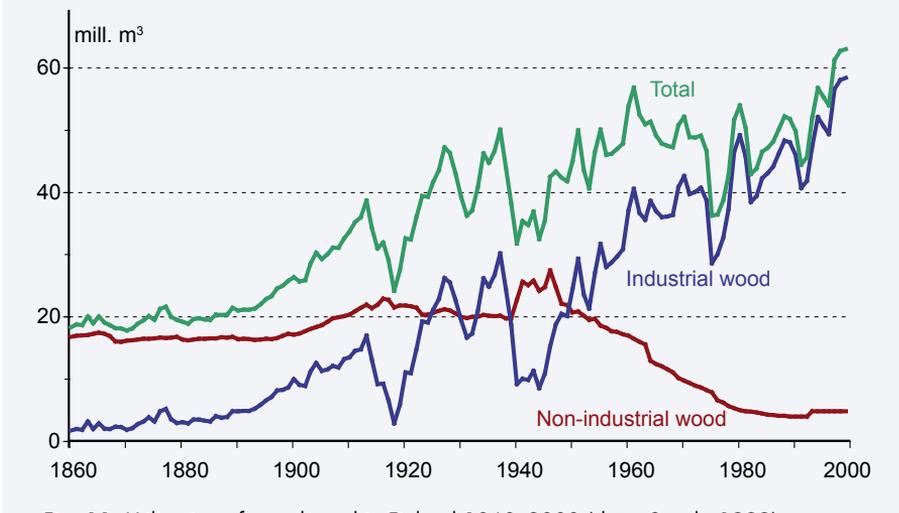


Fig. 11. Utilization of roundwood in Finland 1860–2000 (data: Sevola 1999).

adapted to Sweden from abroad. The aim was to restrict imports and support exports as well as to increase the endogenous stocks of gold and silver and to be better prepared for the next war. Only four Finnish towns of the southern coast received the right to export directly abroad. The other towns on the western coast had to sail their goods either to Turku or to Stockholm in transit for their exports. This policy meant state support

for producing copper, iron and silver with a state regulation of preindustrial forestry (Fig. 7a). Those metals composed 80–90% of the value of exports in Sweden until 1809 (Stridsberg and Mattsson 1980).

Finland was a province of the Kingdom of Sweden since the 12<sup>th</sup> century until 1809. The Swedish kings were frequently participating in wars, which caused continuous losses of men, horses and resources but

hardly any benefits to Finland (Åström 1978). It is interesting to observe that Sweden stopped going wars after losing Finland to Russia. The Swedish kings were also fond of hunting. Hunting was adopted as the main objective in the management of crown forests. It was supported by a special administration Jägarkorps since 1639. Imperialistic foreign policy supported by wars made Sweden a great power in Europe during the 17<sup>th</sup> century.

Sweden participated successfully in the 30 Years' War primarily in Germany until the treaty of Westfalen in 1648. The strategic role of forests was realized not only for the navy and commercial fleet, but also for mining and weapons production. This was one reason along with the mercantilist regime for the launching of the first proper forestry decree in Sweden in 1647 (Fig. 7a). The decree was published both in Swedish and Finnish. It clarified the forest ownership, the use of common forests, the rights of tenants and banned a wide range of illegal activities, as well as defined punishments for each violation. (See more Tasanen in this volume.)

Russia conquered Finland from Sweden two times in the first half of the 18<sup>th</sup> century: first in 1713–1720 and second in 1740–1743 (Isoviha, Pikkuviha). As a consequence Sweden lost its territories east of Kymijoki-River in Finland to Russia. Sweden also lost its Baltic territories and its Great Power era was terminated. The state economy was ruined after these long lasting wars. New ways had to be found out how to increase the national wealth. A special Finnish Deputation was established to promote welfare in Finland. The Great Land Reform was introduced in 1747 to Sweden from Holland and Great Britain by Jacob Faggot. A subsequent law was launched ten years later by the Parliament. The primary idea of this reform was to increase productivity in agriculture but it became of key importance also for future forestry.

Sweden joined France and its allies in the War of Pommer against Prussia in 1757–1762. The war became expensive. It was

partly financed by printing more money. A serious economic crisis followed. Economic reforms were required. One such reform came in 1766 when the cities of the western coast (Pohjanlahti-bay) of Finland were liberated for free access to sail abroad. (Mäntylä 1987)

Russia conquered Finland again in 1808 as a consequence of a pact by Napoleon and Alexander I. The pact was agreed at Tilsit in East Prussia in 1807. When Napoleon could not win Britain by war, he chose an economic blockade. He banned all shipping from continental Europe to Britain. Napoleon wanted Alexander to pressure Sweden to join this blockade (Zetterberg 1987). The Finnish ports were supplying about a half of the tar needed by the British navy. Napoleon wished Alexander I to stop the deliveries of tar from Finland to Britain.

Finland was a province of Sweden for more than 600 years. When Sweden lost Finland in 1809 Finland surprisingly inherited its Swedish legislation, e.g. the laws of 1734, 1789 and the forestry act of 1805. Accordingly, Finland had a four chamber Diet/Parliament and its own autonomous government (Senate) with a growing number of national administrative offices. A "Grand Duchy of Finland" became established. The Russian Emperor became, however, the supreme power to accept the laws and major nominations proposed by the senate and the parliament.

"Old Finland" or the prior Finnish territories lost to Russia in 1720 and in 1743 were soon reunited to Finland proper. This promoted sawmilling and tar production in eastern Finland due to strong commercial houses and know-how in the cities of Viipuri and Hamina. Those ports also became again accessible for exports of forest products from eastern Finland. However, Finland was in a poor condition after the heavy war. Some economic reforms were expected.

Alexander I asked in 1816 the Senate to prepare a plan for the promotion of silviculture and forestry. The Senate responded in 1823 that the best way for Finland to promote forestry was to intensify the imple-

mentation of the Great Land Reform. The Great Land Reform had covered most part of Finland by 1875 or in a century. This was a prerequisite for the competitive functioning of both the market institutions and the state regulatory institutions in forestry (Fig. 4).

The number of independent farms with forest lots grew from 30,000 to more than 100,000 during this reform. In addition 50,000 new tenant farms were established. (Tasanen 2004) This strategy was most relevant towards sustainable forestry. Establishing clear and strong property rights facilitated competitive markets, increasing value of standing timber and effective policy implementation whenever the other sufficient conditions appeared.

Russia lost the Crimean war in 1854–1855 to the Ottoman Empire, which was strongly supported by Great Britain and France. The joined British and French navies arrived also to the coasts of Finland in order to eliminate strategic stocks of tar and other naval supplies and ships. They destroyed the fortress of Bomarsund in the Åland Island, the ports of Hamina, Loviisa, Kotka, Uusikaupunki, Rauma, Oulu and Raahelä, but failed in June 1854 to destroy the port of Kokkola. The Royal Navy lost there a landing boat and 29 lives of its marines. Kokkola received a high reputation in the Russian press as an example of a patriotic defence of the vast Russian Empire. This publicity may have partly affected the new Tsar Alexander II to adopt a favourable attitude towards Finland's development (Kauppala 2004).

The war interrupted the exports of sawnwood and tar from Finland to Western Europe for two years. This caused serious losses to the commercial houses producing and exporting these products. The Finnish Senate helped the companies to survive by giving guarantees and low-interest loans. After the Crimean war a boom in demand for forest products appeared in Europe. This saved the handicapped companies to wait for the forthcoming business opportunities due to the liberalization of the economy some years later. (Michelsen 1995)

After the death of a conservative tsar Nikolaus I Russia got a new emperor Alexander II in 1856 just after the Crimean War. He immediately asked the Finnish Senate to promote exports, industrialization, establishment of schools, and improve the infrastructure for traffic. A new vice chairman of the Senate (prime minister) Fabian Langenskiöld was nominated in order to guarantee the implementation according to the liberalistic regime. Immediately the Senate started to prepare reforms in legislation. The use of steam in sawmilling was allowed in 1857 and the log quotas were removed in 1861. The Parliament was invited in session in 1863, first time after 1809. A number of other more general liberalistic reforms were executed (e. g. Palo 1993).

*The war of 1870–1871* between Prussia with its allies and France had its impact on the high boom in demand for sawnwood in the 1870s (Helander 1949). Another consequence of the war was the unification of Germany, which accelerated economic growth there and consequently also import demands for Finnish exports. For example, the sawmilling cities of Kotka, Pori, Oulu and Kemi were then created nearly overnight. The economic accessibility of logging was expanded all over Kymijoki, Kokemäenjoki, Oulujoki and Kemijoki watercourses deeply to the interiors of Finland.

*Russia won the war of 1875–1876 against the Ottoman Empire* in Bulgaria. Due to the high costs of the war the volatility of the Russian ruble became high and a recession arrived to the Russian economy. The Finnish exports of pulp were decreased and the investments in new mechanical pulp mills stopped for 1874–1880. (Helander 1949)

*Russia lost a war against Japan in 1906.* This was a great surprise not only to Russia but also to the rest of the world. This was the first step by Japan in its series of imperialistic wars in hunting for timber and oil. In the treaty Japan got the southern part of Sakhalin Island and free access to take over Korea. Both of these territories became important timber suppliers for Japan until

the end of the Japanese occupation in 1945. (Palo 2001)

The Tsar Nikolaus II initiated reforms in Russia proper and also in Finland in order to improve the welfare and the social atmosphere. Russia got its own parliament 'duma', where Finland was not represented. Finland was able to create a most modern one-chamber parliament in 1906, still under the Russian empire. The suffrage was extended to all adult men and women. This reform was the first of its kind in Europe and the second one in the whole world after New Zealand. The new parliament facilitated the agrarian party (Maalaisliitto) and the labour party (Suomen Sosialidemokraattinen Puolue) to become the largest parties.

This reform played its role in the forthcoming forest policy reforms. For some years already there had been a social tension in Finland among farmers due to the increased purchases of forest holdings by forest industry firms (Kajander 1901). The reformed parliament gave a law in 1915 to reject purchases of forest holdings by forest industry firms. Its implementation was not, however, effective. After an additional law of 1924 (Lex Pulkkinen) the non-industrial private forest ownership became stable and expanding also partly due to some other laws to promote colonization.

These years after the war against Japan were in many ways the hay days of national awakening in Finland. New political parties, cooperative movements, financial and cultural associations were created, including one to promote private forestry within the Finnish speaking territory (Tapio) and another in the Swedish speaking coastal territories (Skogskultur). The education of foresters was transferred from Evo to the University in Helsinki in 1908. The Society of Forest Sciences (Suomen Metsätieteellinen Seura) was established in 1909.

*Russia lost the World War I in 1917 to Germany.* This ended the rule of Nikolaus II in the March Revolution of 1917. The loss in the war was also one cause underlying the communist revolution in Russia in Novem-

ber 1917. Another cause was naturally the emergence of *the socialistic political regime* from Germany and Britain to Russia. Finland took this opportunity and declared the country sovereign in about a month. After 109 years of political autonomy the democratic institutions were already so diversified and advanced in Finland that only a national army, diplomatic missions and a substitute for the tsar as the supreme political power had to be created. (Jussila 1987)

The communistic revolution closed all the imports by Russia from Finland. Russia had been a favourable duty-free zone for Finnish exports of multiple kinds. The Finnish forest industries had to establish a new strategy, how to penetrate to the western markets in the sales of pulp, paper and paperboard. An operational solution in the form of exports marketing cartels, Finncell, Finnmap, and Finnboard, was found according to a German model of import cartels. In 1918 Germany was the principal buyer of pulp and paper products from Finland. (Skippari et al 2005)

After 1918 the forest products dominated the Finnish exports until the 1950s with a 70–90% share of the total (Fig. 8), because the textile, machine and agricultural industries, which had been major exporters to Russia, could not penetrate to the western markets. One more key institution was created by the forest industry firm: The Central Association of the Finnish Forest Industry CAFFI. It became immediately the most influential lobbying body in the domestic politics. (Kuisma 1993, Skippari et al. 2005)

*A civil war took place in Finland in 1918.* This was caused by various social inequalities in Finland, the regime of socialism and the neighbouring revolution in Russia. The war lasted only less than a half a year but times of political instability continued somewhat longer. The new democracy was at stake also in the early 1930s coinciding political upheavals in Italy, Germany and some other European countries. However, the democracy survived in Finland. Typical to the politics of the 20<sup>th</sup> century political

power rested primarily the longest times with the agrarian party and/or social democratic party, both of which were strongly supporting democratic system of government but also the poorest strata of the population.

Still in 1918 as a consequence of the civil war the fresh “white” government of Finland made a radical land reform to liberate the tenant farmers. As a rule they got their farming land but also a woodlot. This advanced also privatization of forests because a part of the tenants had been farming in the state forests. Another major land reform, Lex Kallio, was launched in 1922. Jointly as a consequence of the two reforms about 150 000 new independent farms with their forests were created until 1935. (Holopainen 1968)

According to the paradigm of the industrial forestry (Box 1, Section 21 above) rational forestry management required such a long time perspective that the state and forest industry corporations as large-scale forest owners were the best owners. Farmers did not have the capability for rational forestry management. The farmers were not in a position to hire professional foresters and their time perspective was too short. In Finland this view was shared by most influential professors A. K. Cajander (1918), Eino Saari (1929) and Viljo Holopainen (1968). Most foresters adopted this view. They did not pay attention to the favorable income distribution impacts, to the ample labour supply for logging and floating and to the increase of democratization by this small-scale farmer forest ownership pattern typical to all the Scandinavian countries.

The government also sacked the director of the Forest Service, Mr P. J. Hannikainen, and nominated Dr A. K. Cajander, Professor of Silviculture, as his follower. Hannikainen had not stopped his daily work in his office as the rest of the staff during the “red government” in Helsinki. Cajander later became nominated three times as the Prime Minister of Finland. Consequently, he became a most influential forest politician and a key person

to promote forestry and forest sciences.

The “white” government socialized, still in 1918, two forest industry companies, Ab H. Gutzeit & Co and Ab Tornator, which had been in Norwegian ownerships. The socialization was based on a pressure by Germany, which was afraid that these strategic resources would easily be transferred into British ownership (Kuisma 1993). Germany was still in war against Britain on the western front. Germany had made a pact in April 1918 with the “white” government of Finland in order to supply a military intervention to southern Finland in support of the “white” army. The pact included the control of the Finnish foreign trade and an access to Finnish forest and other natural resources. This socialization was not mentioned in the pact but was in the line with its contents. (Rautkallio 1977)

The World War II in 1939–1945 caused a severe loss of forest resources and industries to Finland. Twelve percent of the forest area (Fig. 9) and a capacity of 0.5 million tons of pulp and paper mills, 50,000 m<sup>3</sup> of plywood as well as a capacity of 0.6 million m<sup>3</sup> of sawmills had to be given to the Soviet Union according to the treaties of 1944 and 1947 (Lindroos 1993). While exports were strongly decreased by the wars (Hjerppe 1989) the industrial use of roundwood decreased from 30 to 10 million m<sup>3</sup> from 1937 to 1940–1944 (Fig. 11). Accordingly, the increment clearly exceeded the drain (Fig. 10) and the growing stock of trees increased in the remaining Finnish territory.

Also more major land reforms due to the wars were implemented in Finland. More arable land and forests were allocated from the state, municipalities, firms and manor estates to evacuated farmers from the territories lost to the Soviet Union. Also the soldiers had been promised new land. The land reforms not only gave employment and incomes for a high number of people but they also consolidated the Finnish democracy against a communist revolution. The share of forest ownership by the non-industrial private forest owners increased accord-

ingly from 51% to 63% and the respective share by the state decreased accordingly from 40% to 28% (Holopainen 1968).

The war also raised Dr N.A. Osara as a Minister of Forestry and Energy Supplies in the wartime government in 1943–1944. He was able to launch a law on reforestation of low-productive forests in 1943. Dr Osara continued to be a most influential forest politician in the post-war era. As a Director of Tapio he expanded forest management planning and initiated logging road construction in private forests. As a Director of the State Forest Service (*metsähallitus*) since 1952 he mobilized the expansion of large-scale clear fellings in northern Finland. These novel activities created additional employment and incomes.

In the 1940s Finland experienced an energy crisis among all other calamities and problems created by the wars. A comprehensive state regulation of forestry was created. During the war some oil and coal were imported from Germany but for some years after the war those foreign energy supplies were closed for Finland. Dr Osara led a national body to organize supplies of fuelwood and charcoal (Fig. 11), which were most essential for the survival of the country. Even railways and road traffic were dependent on wood-based fuels. All this activity created extra employment and incomes at the period. This was highly valuable for the society especially during the post-war years (Lindroos 1993)

Minister Osara established a committee in 1943 for complementing the ban of deforestation with obligatory minimum requirements for silviculture to prevent forest degradation and to replace the private forestry act of 1928. The forestry law of 1948 in Sweden was used as an exemplar, when the committee completed its mission in 1953. This proposal was strongly supported by professional foresters but opposed by the agrarian party and the Farmers' Union MTK. The law proposal was never accepted. Afterwards, the foresters started to innovate new ways to intensify forestry management via

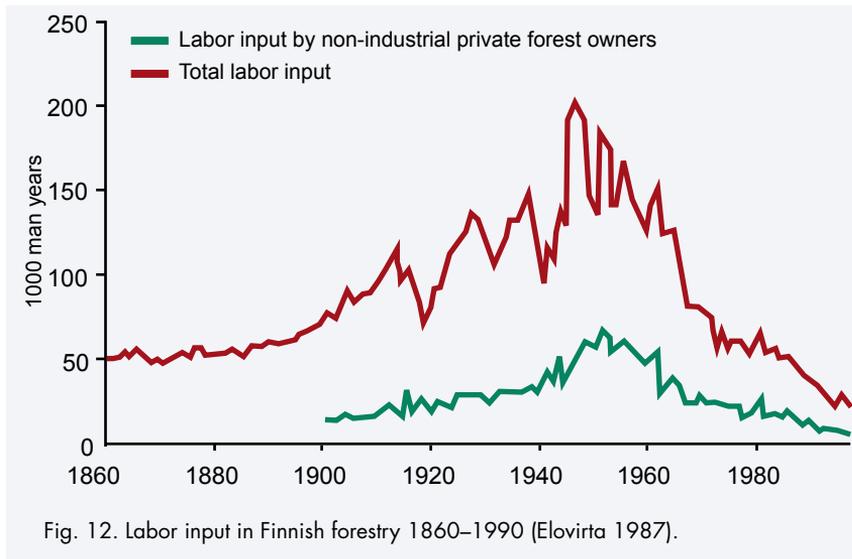
national forestry programs. (Palo 1993)

In the aftermath of the World War II Europe experienced a remarkable boom in reconstruction of housing and rehabilitating the industries destroyed by the war. This caused a boom in the demand for forest products in 1947–1949 (Ollonqvist 1998). This boom was highly welcomed by the Finnish national economy in order to create additional employment and income for the people and country ruined by six years of wars.

The Korean War in 1950–1953 caused even a higher boom than the previous one in the demand for forest products in Europe. This benefited greatly the Finnish forest industry firms and forest owners. Never in the history before or after have the stumpage prices risen so fast. This created more employment and incomes for a high number of people. In fact, the labour input in forestry was highest during this period (Fig. 12).

In 1952 Finland exported to the Soviet Union the last goods in compensation of the war damages required by the Treaty of Paris in 1947. This post-war epoch under compulsory war reparations to the Soviet Union had been important in developing Finland's metal and machine industries, especially pulp and paper machine production and ship construction (Jokinen 1988). Also in 1952 the government rationing of consumption was ended. Finland started to open more towards free trade with Western Europe. Finland never received any financial Marshall aid from the United States as the most other European war-going nations did. Therefore, the post-war recovery has special comparative merits for Finland.

As a summary the wars have had impacts both on the transition to sustainable forestry and on the impacts of forestry on society. First, the post-war reconstructions have increased the demands for forest products and the value of forests. Second, the privatization of forests has created numerous small holdings all over Finland. This has expanded the supply of labour for logging and floating and maintained the wages at



low levels until the 1950s. This again has supported increasing stumpage prices and the value of forests. Third, the privatization of forests with increased number of holdings has increased an equal distribution of forestry incomes both functionally and spatially, which again has strengthened the economic development. A real coevolution of forestry and society has taken place due to the consequences of the wars.

#### 42. Impacts of foreign technology and know-how transfers

Boards and planks were manually made for centuries with axes and later with saws. The first water-powered sawmill of Finland was established in 1540 in Halikko, south-western Finland. This technology arrived to Finland via Sweden from Holland. Gradually, these sawmills were spread all over southern and western parts of the country and in the 19<sup>th</sup> century also to the central, eastern and northern parts. Shipbuilding and exports were the primary customers of those hydro-powered sawmills. Their utilization of logs was strictly controlled by the government and the scale of logging remained restricted in comparison with shifting cultivation and

tar distillation. (Meinander 1945)

The Finns had been constructing boats and small ships capable for inland waters and Baltic Sea coasts from the times immemorial. The know-how of designing and constructing wooden ships capable for sailing in open seas arrived during the 17<sup>th</sup> century from Holland via Sweden. The Swedish navy established a shipyard at Kronoby in the neighbourhood of Kokkola the central western coast of Finland. From there the know-how spread around and this province became the pioneer in wooden shipbuilding and foreign trade of tar and sawnwood for about two centuries. These economic activities became important sources of employment and income both for the urban and rural people.

L.G. Hartman, the “Prime Minister” of autonomous Finland invited a *Swedish forester G.E. Segerdahl* to consult him during the second forestry commission preparing the forestry law of 1851. Sweden had had a forestry college already since 1830 and also since 1838 a concept of a modern state forestry administration. Hartman was convinced that Finland’s future lied in the rational exploitation of her forest resources. Exports of forest products could support imports of goods that could not be produced

domestically. However, a better knowledge should be found about the volume and growth of forests. A state forest administration and forestry college had to be created. (Helander 1949)

Fabian Langenskiöld, the follower of Hartman, invited baron *Edmund von Berg, the Principal of Tharand Forestry Academy in Germany* to consult him in 1858. Von Berg made an excursion of one month with C.W. Gyldeń, the Director of State Survey and Forest Service, around some parts of Finland and recommended an establishment of a regular administration for the state forests, a college for forester education, freedom for sawmilling, timber and export markets, and state regulation for private forests. He also gave instructions for silviculture and forest management and stressed the importance of clear border lines between the state and private forests. (See more Tasanen in this volume)

Steam engine had been invented by James Scott in Scotland in 1769. The first steam engine-driven sawmill had been established in Sweden in 1847 by a British businessman. In Finland it was forbidden to drive sawmills by steam engines until 1857. More and more steam engine-driven sawmills were established during the rest of the century. Parallely, the sawnwood production by the water-powered sawmills was gradually decreasing. The total sawnwood production tripled from the late 1860s to the early 1890s. (Helander 1949)

In a sawmilling boom of the 1870s a number of Norwegian and Swedish businessmen and sawmillers arrived to Finland with their know-how and capital. Until those days the major rivers in Finland had been considered unsuitable for driving logs down due to the forceful rapids, which had broken the logs. The Norwegians, such as Aslak Holmsen and Hans Gutzeit by the Kymi River and Terje Olsen by the Kemi River with their teams taught the Finns an innovation how to pass the logs aside the forceful rapids by constructing light v-shaped wooden passageways. This innovation along with the

high simultaneous demand boom turned the history of forestry in Finland towards a continuous expansion of sawmilling and an increase in the real value of forests. A number of other innovations to improve floating of timber arrived from Russia. (See more about floating of timber: Pakkanen in this volume)

The demand for paper increased continuously in the first half of the 19<sup>th</sup> century along the spread of reading of newspapers and books. Finland had had paper mills since 1667. Until the 1860s only residual textiles were used as raw material for paper-making. Friedrich Keller in Germany invented the method of making mechanical pulp from wood in 1844. Another German Heinrich Voelter developed the system further and got it patented in 1856. Simultaneously, Carl Wilhelm Holmström in Viipuri, Finland invented his own method of making mechanical pulp from wood. He established the first mechanical pulp mill in Finland in 1856. This mill was a pioneer of its kind in Scandinavia. Until 1875 there were already 12 mechanical pulp mills in operation in Finland.

Charles Watt of England and Hugh Burgers of the United States patented in 1853 a sulphate method of chemical cooking of pulp from wood. In 1866 Benjamin C. Tilghman patented a sulphite method of cooking pulp from wood. This invention became operational only after C.D. Ekman of Sweden improved the method in 1872. In 1880 the first sulphate pulp mill started its production at Valkeakoski in Finland. The first sulphite pulp mill appeared in production one year later at Kuusankoski. In 1885 there were 27 chemical pulp mills in operation in Finland.

A paper machine was invented in France and Britain already around 1800. The first paper machine using textile residues as raw material was assembled in Tampere in 1841. Since the 1870s paper machines were integrated with mechanical and chemical pulp mills. In 1879 there were seven mechanical pulp mills with integrated paper machines out of a total of eleven mills, and only one



Photo: Finnish Forest Research Institute

Photo 1. Extraction of logs by a horse and sledge. Snow and frost lowered the costs of extraction.

mill, where paper was still produced manually. (Kuisma 1993)

The innovation of constructing channels arrived to Finland from other European countries. In the 1830s smaller channels were constructed in central and eastern parts of the country. Finally a major channel was completed in 1856 to connect the lake system of Saimaa to the Bay of Finland. This made possible the transport of sawnwood and timber from inland by ships directly abroad. Steam engine-driven ships of iron and steel were another innovation in water traffic. They gradually started to replace wooden sailing ships. Also railways construction started in the 1860s. Parallely, communication also became revolutionized by foreign inventions, such as the cable and telephone systems.

It took a long while before truck transportation of roundwood started to grow in importance on roads and highways. In fact, after various experiments in earlier decades

the truck transportation started to expand not before than in the 1950s. This was also the beginning of trials with tractors and their gradual expansion in replacing horses in extraction of logs (Photo 1) from the logging site to the road or riverside. Also the first power saws arrived simultaneously. But a large-scale breakthrough of tractors and power saws took place after the 1950s. (Rauhalahti in this volume)

It is surprising how slowly technological innovations were created in forestry since the last decades of the 19<sup>th</sup> century until the 1950s. Trees had been felled by axes until the end of the 19<sup>th</sup> century, but since then a two-man manual saw with a broad blade (Photo 2, *justeeri* in Finnish) from North America and Sweden gradually penetrated to the logging of large-diameter timber (Lehonkoski 2004). This was used also for bucking the trunks into relevant assortments. Later on, a one-man manual saw with a narrow blade with wooden frames was developed



Photo 2. Felling a tree by a two-man manual saw (for big trees) in the early 20<sup>th</sup> century. Most logging took place during winter.

in Finland for small dimension trees (Photo 3, pokasaha in Finnish). In the 1950s the wooden frame was replaced by a steel frame (Photo 4) originating from Sweden. Both saw logs and pulpwood were manually peeled in the forests with simple tools (Photo 5). (See more: Rauhalahhti in this volume)

In summary, foreign technology and know-how have been key factors in promoting Finland's transition to sustained yield of timber and industrial forestry. Imports of foreign technology have expanded and diversified the capacity of forest industries

to demand for more timber and of more varying dimensions and tree species. In this way the stumpage prices, forestry incomes and the value of forests have increased in support of sustained yield and industrial forestry. Foreign know-how was needed in the application of the new technologies but also in comprehending the contents of the new paradigm of sustained yield forestry.



Photo: Finnish Forest Research Institute/Poavo Aro

Photo 3. Bucking a tree by one-man manual saw of wooden frames, which was used for small trees. Work efficiency study is going on in the 1930s.



Photo: Finnish Forest Research Institute

Photo 4. Bucking a tree with steel-framed manual saw in the 1950s.



Photo 5. Debarking a log with a manual tool (petkele)

## 5. Impacts of ecological, market, social, political and cultural factors

### 5.1. Ecological factors

Finland is located between Sweden and Russia and between the 60<sup>th</sup> and 70<sup>th</sup> latitudes (Fig. 1). This location is such a northern one that only Iceland, as a whole country, is comparable in this respect worldwide. For example, in the western neighboring country Sweden most of the population lives

more south from Finland. In those peripheral latitudes not many options traditionally existed for raising welfare: the Icelanders have been fishing and processing fish and the Finns have been growing trees and processing timber. In those simple means of production and with strong comparative advantages in their foreign trades the two nations have created some of the highest levels of living among all the nations.

Due to the warm Gulf Stream in the Atlantic Ocean along the Norwegian coast not only Norway but also Sweden and Finland



The National Art Gallery Ateneum in Helsinki, copyright/Kuvasto 2006

Photo 6. Shifting cultivation in 1893 by a family in Lapinlahti, Central Finland, painted on the spot by Eero Järnefelt, one of the foremost painters of the time.

enjoy much milder climate in comparison with the same latitudes in Siberia, Alaska and the northern territories of Canada. Especially, the two coniferous endogenous tree species of high commercial value, pine (*Pinus sylvestris*) and spruce (*Picea abies*) have been thriving well in the Finnish conditions. The forest soils have been resistant towards erosion after large-scale shifting cultivation (Fig. 6, Photo 6) and clear felling. Also other ecological factors have been favourable for transition into sustainable forestry in Finland.

The northern location has, however, given relatively poor climatic and soil conditions for agriculture. This has decreased the opportunity costs of sustainable forestry. Agriculture has been favored more than forestry

by public subsidies and legislation, which, on the other hand, has artificially increased the opportunity costs of sustainable forestry. Finland became nearly totally covered by natural forests after the Glacial Age. Poor sites of peatlands and mountain tops, along with some bare rocks and beaches remained without forest cover.

The climate has also favored forestry in the way that cold winters with frozen soils and snow have facilitated timber extraction traditionally by horses (Photo 1) to the water-courses. Finland has nearly 200,000 lakes and hundreds of rivers and long shorelines of the Bays of Finland and Pohjanlahti, which facilitated long-distance transportation of timber by floating with minimal investments to improve the infrastructure.

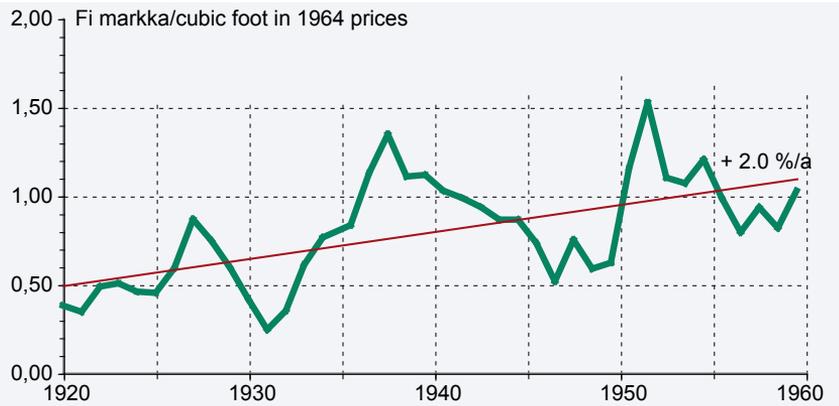


Fig. 13. Real stumpage prices of saw logs in Finland, 1920–1960 (data source: Sivonen 1970).

The two bays provided also good sites for harbours and access to the Baltic Sea and international oceans (Fig. 1). Finland has also enjoyed the proximity to Russia and especially to St. Petersburg, which played an important role in providing markets for pulp and paper among other goods during 1809–1917. Neither was Finland too far away from the most rapidly industrializing countries of Central Europe and from their expanding demands for forest products.

Water power was also readily available in Finland along the rapids of the numerous rivers, where all the water-powered sawmills as well as pulp and paper mills were established. Also fresh water availability for the pulping and paper-making processes was easy to organize.

Soil productivity with management impacts for tree growth has been second highest after Sweden in comparison with the other countries in the boreal zone (Kuusela 1990). The average current annual increment of the growing stock is 3.4 m<sup>3</sup>/ha as a national average. Temperature is the minimum growth factor in tree growing in Finland. Finland is 1100 km long from the south to the north, which allows a high variety in climate conditions and increment. One third of soils have been peatlands or bogs. The large scale of peatlands has been typical to Finland's geography. Until today one third of

them have been drained for improving tree growth, one third for agricultural purposes and one third have been legally protected for nature conservation.

## 52. Markets

The utilization of forest resources in order to sustainably satisfy human wants by forestry goods and services relies primarily on successful government policies and on the proper functioning of the market system (Figs. 2–3). The sawlogs in Finland have experienced a real stumpage price trend growth of 1% per annum from 1860 to 1920 (Kunnas 1973). Thereafter, for nearly a half a century the respective growth was 2% (Fig. 13).

This stumpage price increase facilitated even faster increase in the forestry incomes to forest-owner farmers and other rural people due to increasing industrial logging (Figs. 8 & 11–12). In fact, the net incomes from forestry and agriculture were about equal during the 1920s–1930s (Laine 2004). Forests could also be used as a collateral since the laws of 1901 and 1929 in support of borrowing money. Also forests could be insured against fire in two insurance companies since 1916. (Helander 1949) This increased the financial importance of forests to the farmers.



Photo: Finnish Forest Research Institute/Olli Heikinheimo

Photo 7a. A typical view of open shifting cultivated forest sites around a farm house at Heinävesi in Central Finland. (Heikinheimo 1915).

The continuous increase of real stumpage prices has been reflected to increasing values of forest stands and forest holdings. This has given an incentive and self motivation for forest owners to avoid deforestation and forest degradation as well as to intensify forest management. In Finland this “invisible hand”-mechanism has been operational since the latter half of the 19<sup>th</sup> century. This was possible due to clear and strong forest property rights (Fig. 3). This value creation was a driving force in terminating shifting cultivation until 1920 (Fig. 6, Box 6).

Shifting cultivation was terminated during the first decades of the 20<sup>th</sup> century – perhaps latest in any European country. Numerous government laws, decrees and orders had been launched through three centuries in order to control shifting cultivation (Fig. 7a) but with weak effectiveness. This time the termination arrived finally as a market

driven process, although the Great Land Reform and the establishment of the State Forest Service also played key roles (Box 6).

Construction of wooden ships and distillation of tar and their exports started to decline rapidly after a couple of technological innovations. Iron replaced wood and steam engines replaced the sails and also tar from coal replaced to a great degree tar from wood during the latter half of the 19<sup>th</sup> century. For centuries the governments had tried unsuccessfully to control tar distillation by various laws (Fig. 7a), but this termination was finally a market driven process.

In 1864 the sales of forest holdings were liberated. The demand for those holdings was strongly increasing along with expanding demand for forest products and the establishment of more companies to produce them. This led to increase in the value of forest



Photo 7b. The same site as in Photo 7a but in 1993. (Erkki Oksanen).

holdings along with increasing stumpage prices. However, under political pressure by the agrarian party, the government started to regulate forest holding markets in 1915 and 1924. This regulation continued in one form or another until 1998. Thereafter, the market for forest holdings became liberated again, even the foreigners were given a free access to purchase forest holdings in Finland.

The two forestry markets have played key roles in raising the value of standing forests. Low value forest resources and timbers are wasted still today in socialistic forestry countries and especially in the tropics, but there

is a tendency that high value resources are sustainably managed and conserved. "Goldsmiths never waste their raw materials." (Palo 1997)

In Finland exporting and importing of forest products have mostly been free or with periodical duties or quotas. This was the case during the exceptional times during and after the Second World War.

Most innovations in forest industries in early days were imported to Finland (Section 42 above). However, profit motivation also gradually created new domestic technology. Already towards the late 1800s the metal

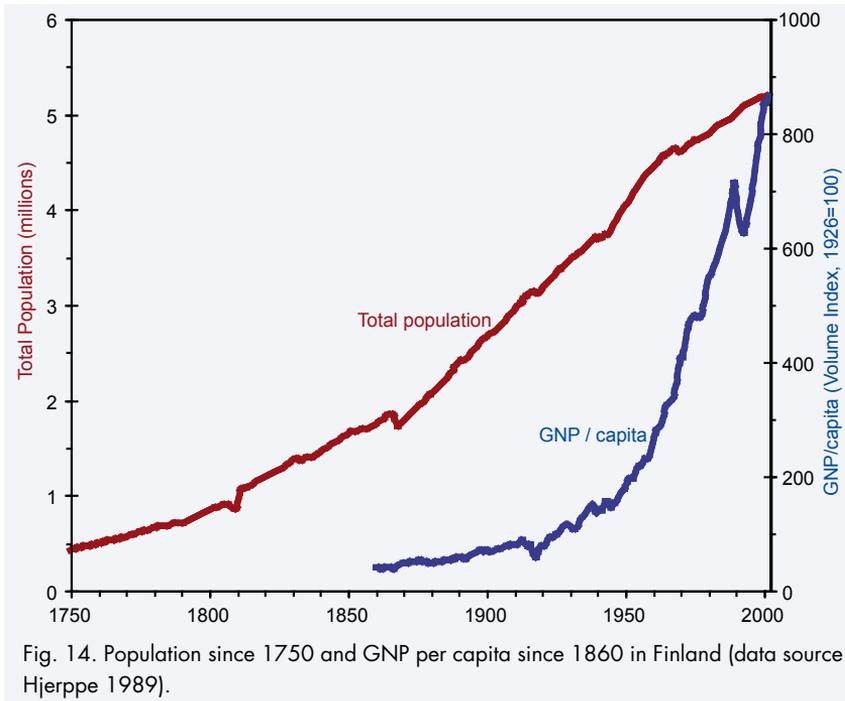


Fig. 14. Population since 1750 and GNP per capita since 1860 in Finland (data source: Hjerppe 1989).

manufacturers (e. g. Tampereen konepaja, Karhulan konepaja, Varkauden konepaja) or some forest industry corporations, however, started to manufacture machines for saw-milling, mechanical pulp and paperboard manufacturing (Kuisma 1993).

This activity has grown and expanded to cover all forest sectors. By the end of the 1950s Finland had also started to produce plywood machinery, chemical pulp and paper machines. State-owned Valmet Oy and four other firms were then constructing paper machines primarily for exports (Jokinen 1988). In this way Finland has arrived to a forest cluster: forestry and forest industries have induced machine and some other industries to be established and expanded based on the various linkage effects.

The Finnish corporations have been successful in exports of forest products (Fig. 8). The Finnish made forest products have been mostly exported to other European countries, but Finland has also benefited from the liberation of the international trade worldwide. Finland has followed an export-led eco-

nomical development for more than a century. In that respect the forest sector has played a key role, especially during 1920–1960, when the share of forest products exports from the value of the total commodity exports varied between 70–90% (Fig. 8).

The Finnish economy has grown second fastest after Japan during 1860–1990 (Fig. 14, Hjerppe 1989). Economic growth in Finland is unique among all the nations due to its heavy reliance on forest industries (Hjerppe 1989, Palo and Uusivuori 1999). The worst depressions took place around our civil war in 1918 and in the early 1990s. The last one was more severe in absolute terms but the former one in relative terms. The Great Depression in the early 1930s and the Second World War in the early 1940s were overcome more easily in terms of the setbacks in economic growth in Finland.

This kind of strategic importance of forest sector and the whole forest cluster to the national economy has brought some special favours to this sector by the government. The Finnish forest sector for a lengthy period



Photo 8. A horse-driven "plow" to prepare ground for sowing rye after burning the ground.

benefited from the devaluations of the Finnish currency markka. The Union of Farmers (MTK) and the Federation of Woodworking Industries (Suomen Puunjalostusteollisuuden Keskusliitto) were jointly so strong, that they could lobby the government and the Bank of Finland to make devaluations for their mutual benefits. (Ollonqvist 1998) In his way frequent benefits from the currency markets were available.

The Finnish financing systems were intensified during the latter part of the 19<sup>th</sup> century. A few commercial banks, a savings bank system, and a system of cooperative banks were established. In a similar way a number of insurance companies appeared.

Capital markets were protected in Finland until the middle of the 1980s. The Bank of Finland gave allowances for imports of foreign capital. The domestic banks and insurance companies favoured investments in forest industries due to relatively few investment opportunities available and the high know-how of this industry in Finland. Con-

sequently, for example in the 1950s all the pulp and paper machines became restored (Ollonqvist 1998) and several expansions took place.

Finland had until the end of the 1920s exported mainly sawnwood. Pulp exports were increasing in the following decades. In the 1950s both writing and printing papers, kraft papers and paperboards exports started to increase rapidly (Fig. 8). Later on Finland gradually passed Sweden, Canada and the United States in the share of these more value added products in their exports. (Petersen 2004)

Labour supply situation for forestry, floating and forest industries was favourable in Finland until the 1950s. Due to low degree of industrialization and centuries old colonization activities by the government the rural areas had a high number of small farmers, who needed additional work. Also numerous landless people were ready to migrate for part-time or full-time employment to the distant logging, floating and mill sites. The trade

union movement was weak until the World War II. While the forest industries had their strong cartels the level of wages remained low. Accordingly, there did not appear any strong motivation to increase labour productivity until the 1950s.

A private body Work Efficiency Association (Työtehoseura ry) established in 1942 a department for developing productivity in logging. The Federation of Finnish Woodworking Industries also established a logging research and development unit (Metsäteho) in 1945. Its aim was first to study work efficiency in logging and to find out objective criteria for tariffs for manual piece work in logging. Gradually mechanization studies were initiated especially during the 1950s. Then trucks, farm tractors and power saws appeared in logging, extraction and transportation indicating a revolution of mechanization to arrive more strongly later. In fact, the labour input in forestry was at its peak in the early 1950s (Fig. 12).

### 5.3. Social institutions

The systematic population data in Finland dates back to 1750. Population growth was fast especially during the late 18<sup>th</sup> and the 19<sup>th</sup> centuries (Fig. 14). It was accompanied with fast economic growth on the latter half of the 19<sup>th</sup> century or from the time we have national income data (Hjerpe 1989). We have good reasons to assume that economic growth was much slower during the earlier periods. During the 19<sup>th</sup> century the population grew 2.5 times and in the 20<sup>th</sup> century 2.0 times. A transition in population growth started to be visible already during the second half of the 19<sup>th</sup> century, but actualized more later. It was not before the second half of the 20<sup>th</sup> century that population pressure supporting forest degradation and deforestation started clearly to release.

Finland was a poor peripheral country during the 19<sup>th</sup> century comparable in many respects with poor developing countries today. The number of landless people was

growing. Landlessness and poverty were strongly linked during the agrarian society of those days. The skewed tenure situation accompanied by poverty was a driving force in shifting cultivation and tar distillation expanding forest degradation and deforestation. The Grand Land Reform and the establishment of the Forest Service made the toll of the poor even worse towards the end of the 19<sup>th</sup> century. (Ruuttula-Vasari 2004, Tasanen 2004)

Poverty to a great extent became gradually released by various mechanisms. Industrialization was expanded but at the same time also a mass emigration to North America took place especially from the western coastal area. In that part the previous exploitation of forests by wooden shipbuilding and tar distillation had exhausted the forest resources. While the central and eastern parts had ample remaining forests, forest-based industrialization could be mobilized there and in the south-eastern coast, where timber could be floated from those forest-rich provinces. This brought increasing stumpage incomes to forest owners (Laine 2004) and labour incomes to landless people as forestry workers (Helander 1949).

The labour and the tenant farmers were politically organized as a Social Democratic Party since 1903. Soon also labour and farmers unions were established and an Agrarian Party. Both parties grew up as strong economic, social and political countervailing powers to the previous political powers of the nobles, the clergymen, the bourgeois and the big farmers. Finland had a project of one century to remove the poverty by social and economic legislation, by mutual agreements of the labour unions with the federations of employers, by the Farmers' Union MTK via agreements with the government and so on. This project was also supported by the strong cooperative movements, which were active both in agricultural production (SOK) and consumer (OTK, SOK) fronts.

A forestry cooperative Metsäliitto was established first as a joint stock company in 1934, and after its bankruptcy again in

1947 as a cooperative. Its mission was to raise timber prices by exporting roundwood and by establishing its own wood processing mills. By roundwood exports during the Korean boom Metsäliitto cumulated enough cash to be able to buy Wärtsilä's pulp and paper mills at Äänekoski in central Finland. Metsäliitto was quite successful in its operations and in its mission until the end of the 1950s.

Transparency International has lately assessed Finland four times in successive years as the least corrupted country in the world. Corruption situation today is worse among the developing countries than in Europe. Our historians have not identified any past era, where corruption would have been widely spread in Finland. Even forestry history of the early times, when state owned nearly half of all the forests cannot illustrate corruption in any wider scale. This situation has supported closing down deforestation and transition to sustained yield forestry (Palo and Lehto 2006).

All the five Scandinavian countries have been found as a cluster at the lowest end of corruption. This helps in identifying factors which have contributed to this end. The countries share advanced democracies, not only today but already since one century and a half ago. A strong tradition has survived in supporting freedom for NGOs and the media. The prosecutors and courts have been independent and have shared strong democratic cultures. The civil servants have had a culture honouring legal procedures. The Scandinavian peoples have also shared the same religion - a Lutheran protestant one. It has always stressed honesty and fair play towards other people. (Palo and Lehto 2006)

#### 5.4. Political institutions

*Mercantilism* with mining interests dominated forestry in Finland until the 1850s. However, despite of its politically dominating position, the exploitation of forest for

mining purposes remained only local around the few mines in the south, while in Sweden, with much more mining activities, it must have had a wider impact. Some liberation of sawmill regulation took, however, place in Sweden and Finland in the 1730s as a consequence of the arrival of new foreign ideologies of *Enlightenment, utilitarianism and liberalism*.

Liberalism played a most important role during a couple of decades after 1856. *Socialism* was most important in 1917-1918 but played its role also later on in protecting the social conditions of the loggers (e.g. Tanner Government reforms later). *Neo-classical economics regime* with practically no government economic planning played its role during the inter-war period 1920-1939. However, some new laws to regulate forestry were launched (Fig. 7b). *Keynesian economics regime* started to have its impact from the 1950s in increased government planning, which matched also well together with the increasing impacts of social democratic influences in all Scandinavia and in Holland.

Since 1918 to 1998 the government regulated forest holding ownership in favour of farmers and to prevent the expansion of corporate forest ownership. In 1955 the non-industrial private persons owned 61%, and the corporations 9% of the forest area. The rest is owned mostly by the state but also by communes, parishes, and foundations. This pattern of the tenure has been important for socially and economically sustainable development, because of fair distribution of forestry incomes both functionally and spatially in comparison with primarily state or corporation ownership.

Private ownership of forests has also benefited both the state and the municipalities via forest taxation, which was based since 1921 on the basis of a potential average yield of timber and market prices and on average costs, but earlier on the basis of real net income.

Markets do not operate in a vacuum. Various political institutions must precede market institutions. The situation of "law and

order” is a fundamental requirement for the viability of the markets. Also open access to forests has to be closed by establishing property institutions. Already before the independence in 1917 many political institutions were created (Fig. 3). The Grand Land Reform, Forest Service administration, liberation of steam-powered sawmills, forestry laws of 1886 and 1917 were the most critical ones in support of markets and sustainability (Fig. 7a, Section 31).

A general compulsory primary education and the first few high schools were mobilized. A Forestry College was founded in 1858 and forestry ranger schools some years later. The College was later in 1907 integrated to the University, which had been established already in 1640. A number of government research institutes, including the Forest Research Institute were established in the early 20<sup>th</sup> century.

The 109 years of the Finnish political autonomy is the longest time of continuous peace in the history of Finland so far. It is called the era of *Pax Russica*. Income and other taxes were non-existing or low, but some duties were collected from foreign trade. The period was favourable for mobilizing new investments and entrepreneurship. Immigration favoured entering of entrepreneurs with know-how and capital, especially from Germany, Britain, Norway and Sweden.

The situation of Finland resembled the present membership in the European Union in the way of expanded duty-free markets covering finally all Russian Empire. Finland was more industrialized than Russia and it could export processed goods and import raw materials. If Finland had remained a part of Sweden this had never been possible, because Sweden was more industrialized than Finland.

Nature conservation (1922, 1938), scaling of roundwood (1938), colonization acts (1918, 1922, 1935, 1940, 1945, 1958) and many other aspects of forestry and land use have been safeguarded by legislation since the independence of Finland in 1917.

State Forest Service has been periodically reformed by new legislation after 1858, when the first independent state forest administration was created. (Fig. 7b)

The Finnish democratic system also survived happily through the difficult times of *The World War II*. Finland never became occupied by the enemies but especially the years after the war were risky for a communist coup. Since 1949 more stable political times arrived. Gradually Finland became integrated in international organizations and in special trade agreements in order to strengthen her political and economic bases. Finland joined the United Nations and the Union of the Nordic Countries (Denmark, Iceland, Norway and Sweden) in 1950, which was one stabilizing political factor.

The Keynesian regime to mobilize government interventions by expanding demand in order to increase employment and economic growth appeared clearly in Finland in the 1950s. Prime Minister, Dr Urho Kekkonen, President of Finland in 1956–1981, designed and published a program for development of northern Finland with support of government investments in hydropower, mining and forest industries. A Commission for promotion of industrialization in its report to the Government in 1951 recommended expanding investments in forest industries and those metal and machine industries with close linkages to the forest industries. In addition the recommendations included support by economic and financial policies for maintaining the technological competitiveness of the paper and paperboard industries. (Ollonqvist 1998)

An Economic Policy Council was established in 1951 for strategic planning of public economic policy. The Council had members not only from the Government but also from the unions of the employers and employees. It continued in one form or another to guide the economic policy through the 1950s and even until today. The Council has been supported by a team of professional economists as its secretariat. In line with the paradigm change in economic policy a Commission for



Photo 9. Metsätalo/Forest Building in 1939 just after its completion in the downtown Helsinki.

Planning Forestry was established. It was in session all through the 1950s. Its report was a landmark towards progressive forestry via increasing investments in intensification of forestry management, which started a new epoch in industrial forestry in the 1960s.

Perhaps internationally rather unique phenomenon in politics took place in Finland since the 1920s. Forest scientists and foresters became nominated in leading positions in politics and culture. Dr A. K. Cajander, Professor of Silviculture and Director of the Forest Service was the Prime Minister of the Republic twice in the 1920s and once in 1936–1939. In his capacity he was able to mobilize new law for forestry taxation and conservation of the northern timberline in 1922 and simultaneously financing for the first national forest resources inventory. At the same time Cajander established a committee to renew forest legislation under the chair of Mauno Pekkala. In the late 1930s Cajander led a coalition government composed mainly of the Agrarian and Social

Democratic Parties, which both were keen to advance forestry. A major financing of the second national forest resources inventory and the second survey of wood consumption were implemented.

Mauno Pekkala, a forester and department chief of the Forest Service, was the Minister of Agriculture in 1927–1928 and responsible for the most radical forestry legislation reform of all times (see above). He also allocated funding in 1928 for doubling the vacancies of Professors at METLA. Pekkala was also a Prime Minister in 1946–1949. Dr Eric Lönnroth, Professor of Forest Mensuration and Inventory, was a chairperson in the committee for the construction of the new Forest Building (Metsätalo) in downtown Helsinki, next door to the headquarters of the University and the Government. With the support of Prime Minister Cajander, Lönnroth created this modern and spacious cradle for forest sciences of the University of Helsinki and the Forest Research Institute (Photo 9). Later Lönnroth became also nominated as

the President of IUFRO and the Rector of the University of Helsinki.

Dr N.A. Osara worked in 1943–1944 as a Minister of Forestry and Fuels Supplies in the wartime government of Dr Edwin Linkomies, Professor of Latin (see Section 41 above). Dr Eino Saari, Professor of Forest Policy, became a member of the Parliament and the Minister of Social Affairs in the early 1950s. He was later on also nominated as a Chancellor of the University of Tampere. Some number of other foresters became members of the Parliament.

### 55. Cultural impacts

The chair of folklore was transformed into a professorship of economics in 1746 at the Academy of Åbo (Turku). A similar professorship had been established earlier also at another Swedish university of the time in Uppsala. *Pebr Kalm* was nominated as the first professor of economics at Turku. He was a disciple of Carl von Linné. In fact Kalm was a natural scientist, but a professor of economics at the time, when economics as a science was not yet created.

Anders Celcius along with von Linné achieved international reputation with their findings, which gave support to new scientific discoveries. The Royal Swedish Academy of Science was established in 1739. Linné himself as a botanist was also interested enough in forestry that he published some papers with guidance for sowing and planting trees. In the Academy also some other forestry papers, e.g. by C.W. Cederhjelm appeared in the 1740s. Also U. Rudenskiöld gave a lecture at the Academy in 1748 on the conditions and opportunities of forestry in Finland. (Tasanen 2004)

The Enlightenment and utilitarianism relied on science in promoting welfare for nations. In similar way Kalm and his colleague, Professor of Chemistry, *Pebr Adrian Gadd* supported their students to study mineralogy, agriculture and forestry. Eight forestry theses were prepared under Professor Kalm's

supervision and about the same number under Professor Gadd. The latter prepared a comprehensive forestry program for Finland in 1767. The language of the theses was changed from Latin to Swedish in order to allow the priests to extend the findings to the farmers and sawmillers. Gadd was even nominated as a Planter for Finland with a duty to travel around and inform the locals how to sow and plant useful plants including trees. A couple of study tours by prominent scientists were made in the middle of the 18<sup>th</sup> century. In the tour reports many observations were given about the conditions of forests in Finland and some proposals to improve the situation were launched. (Tasanen 2004)

*Anders Chydenius* was one of *Pebr Kalm's* disciplines. He worked as a minister at the parish of Kokkola on the western coast of Finland. Kokkola was a small town but already on the latter half of the 18<sup>th</sup> century a remarkable port for exports of tar, wooden ships and sawnwood. Chydenius was elected as a member to the Swedish Parliament. He was a productive writer and a recognised predecessor of Adam Smith in promoting liberalism to replace mercantilism as guidance to economic policies. Chydenius was able due to his writings and speeches in the Parliament to liberate access to foreign trade for the cities in the western coast of Finland. This was a real starting point for the vast expansion of wooden shipbuilding and tar production there with a subsequent expansion of subsistence among the commoners. (Virrankoski 1986)

The Academy of Åbo was relocated to Helsinki in 1828 and renamed as the Imperial Alexander's University. In the 1830s the professorship of economics was closed down. During the whole 19<sup>th</sup> century no forestry studies were carried out at this university. The professors were more engaged in the studies of Finnish language, culture and poetry leading an expanding school of Finnish identity.

A few learned people outside the university in Finland were following the evolution of

forest sciences in Germany and some other European countries. C. C. Böcker (1829) wrote a first major treatise on forestry and forest policy in Finland. C.W. Gylden (1853) published another major forestry handbook. His other major forestry contribution was a national assessment of forest resources (Fig. 15). This was implemented by the surveyors of the National Board of Survey and Forestry, where he was the Director.

The assessment by Gylden was more subjective than based on any systematic sampling, although the idea of systematic sampling in forestry had been already launched by a Swedish scholar af Ström in 1830. Anyway, the map indicated deforestation and degradation in most accessible locations and ample forest resources in more remote and economically non-accessible locations under then prevailing technology. As such the survey and the optimistic views of the book may have promoted economic policies towards liberalism. The book already introduced the concept of a normal forest – the nucleus of sustained yield of timber – and how to arrive there. The 1858 report by Edmund von Berg may have had a similar impact (See Section 42 above).

However, J.V. Snellman, an influential journalist, later Professor, Senator and Prime Minister, did not have any great vision of future forestry. He resisted publicly the establishment of a college for educating foresters and establishment of permanent State Forest Service. Gylden and Rabbe Wrede, a forester, criticised Snellman's views. Snellman's criticism could not prevent the coming major reforms: a college for forester education, new Forest Service etc. (e. g. Michelsen 1995)

A forestry college was established in the wilderness of Evo, 145 km northeast of Helsinki, in 1868. The teachers had been educated mostly in Germany. Since the 1850s some Finnish students completed their forester education also in Russia and Sweden. This way the paradigm of the sustained yield and industrial forestry started to reach Finland.

A.G. Blomqvist was one of the teachers and directors of the forestry college. When education there was closed for seven years he devoted his time for research. He became the first real forest scientist in Finland with contributions within growth and yield of the major tree species and in forest policy. Blomqvist later became decorated as an Honorary Doctor by the University in Helsinki, which was otherwise passive through the whole 19<sup>th</sup> century in promoting forest sciences.

P.J. Hannikainen was pioneering in writing and publishing forestry papers and books in Finnish, while earlier all forestry issues were published in Swedish. Hannikainen wrote also a book on forest policy parallelly with Blomqvist. Hannikainen became nominated as the Director of the State Forest Service in 1903 due his learned activities and his priority in Finnish language. Soon he established more forestry ranger schools and started experimenting own logging by the Forest Service to improve the profitability of timber sales and to increase revenues to the state.

A Finnish Forestry Association (Finska Forstföreningen), a NGO, was established in 1877 to advance forest research and extension as well as to improve practical forestry. It soon started to publish a forestry periodical. At the State Forest Service and at the University in Helsinki and partly elsewhere some forest research was already carried out but the main occasion in this front was the establishment of the Forest Research Institute in Helsinki (Metsäntutkimuslaitos METLA in Finnish) in 1917. Jointly these reforms produced the know-how and information bases for effective forest policies based on the forthcoming new forest legislation during the ultimate sovereignty of Finland (Figs. 3–4).

A new interest on forestry issues among the scholars of different non-forestry disciplines of the University appeared in the early 20<sup>th</sup> century. For example, Väinö Voionmaa studied the role of shifting cultivation and economic geography, Heikki Renvall analysed the exports of forest products and



Fig. 15. Scarcity of forests (=red) in Finland in 1850 as assessed by Gylden.

supported the forest ownership by industry corporations, and J. T. Hanho studied the development of sawmilling industry. Just about all of the scholars emphasized the importance of forestry in the national economy. A threat of expansion of deforestation and forest degradation also survived because no reliable knowledge existed about the sustainability of forestry under continuous expansion of forest industries. (e. g. Raumolin 1990)

The first symptom of nature conservation in Finland appeared in 1803 at Punkaharju in south-eastern Finland. Then Tsar Alexander I visited there and declared later on the beautiful ridge of a few kilometres length protected. A geographer and a later famous explorer Adolf Nordenskiöld innovated in 1880 an idea of nature reserves in order to preserve the image of the traditional nature to the future generations. The Society of Forestry organized a seminar on this topic one year later. A.G. Blomqvist favoured the proposal and referred also to the similar proposal by G.P. Marsch in the United States. A working group by four scientific societies and three other NGOs was established in 1903. It proposed the establishment of ten nature reserves. A state committee was set up in 1907 to make the formal proposals. (Helander 1949)

August Renvall studied in his doctoral dissertation the issue of the decline of the northern timber line in the 1910s. A law to protect from such a decline was launched in 1921. First official nature reserves were established in 1916 and the law of nature conservation in 1923. Finally, not before 1938 a Union of Nature Conservation, a NGO (Suomen Luonnonsuojeluliitto) was established by various scientific societies in Finland. For some time this NGO was chaired by foresters. (Helander 1949)

The Forest Research Institute played a decisive role for forest policy during 1920s to 1950s according to the model of Fig. 4. Finland became a pioneer in developing and implementing first in the world a systematic sampling-based national forest inventory in

1924 (Fig. 10). The first national wood consumption survey was completed in 1928 (Fig. 11). For the first time in history reliable assessment was made about the level and structure and spatial distribution of forest resources, comparison of increment and drain and about future allowable cut. This was replicated at the end of 1930s and by the middle of the 1950s. Then a good idea of the dynamics of forest resources was received (Figs. 9–11) for the basis of future forest policies. These findings with other relevant research supported Finland to plan for a massive expansion of forestry and forest industries in the late 1950s and 1960s.

The prevailing socio-economic-environmental importance of forestry and forests in Finland since the late 19<sup>th</sup> century has had many cultural impacts via arts. The foremost Finnish artists travelled around 1900 in the vast forests and made a number of famous paintings like the one of Photo 6 by Eero Järnefelt. Also Akseli Gallen-Kallela, Juho Rissanen and others made several paintings inspired by forestry works or forest nature. A statue of a logger was designed and carved by Kalervo Kallio in 1958 in Rovaniemi on the shoreline of Kemi river, which has been the major floating route until recently. Other similar statues are located in Joensuu and some other localities.

Aleksis Kivi was the first author to publish novels and plays in Finnish by the middle of the 19<sup>th</sup> century. His novel “The seven brothers” describes mostly the life in forest wilderness. The book is among the best-sellers in Finland. It has been translated into several languages. Also Johannes Linnankoski, Ilmari Kianto, Juhani Aho, Pentti Haanpää and others were inspired by forests and forestry in their novels and short stories. Teuvo Pakkala wrote in the early 20<sup>th</sup> century a novel “Tukkijoella”, which described the life of the loggers floating logs along a river. It became not only an evergreen book, but also an evergreen play and film in Finland. About a hundred films must have been produced in Finland until 1960 with major inspiration from forestry and floating of timber.

Jean Sibelius composed a series of piano pieces with such names as “Mountain ash”, “Pine”, “Spruce”, “Birch”, and “Aspen”. Many other compositions by him were also inspired by forests. Once around 1900 he travelled with his piano for inspiration to Koli, remote forested mountain accessible only by boat in eastern Finland. The other composers followed the famous suite. Also in light music we may have hundreds of forestry, timber floating and forests inspired pieces. (Reunala and Virtanen 1987)

## 6. Discussion and conclusions

### 6.1. Discussion

It is evident that the theoretical framework has had a strong influence on our findings. It has been like a microscope for genetists or a telescope for astronomers in selecting relevant observations guided by relevant theories. The reliability of our findings is dependant not only on the reliability of the historical facts and data but also on the quality and relevance of our theory and approach. If we compare the findings of this paper with those of Massa (1993), his findings about sustainability of Finnish forestry are quite opposite from ours. He chose a soft framework of “Raubwirtschaft” as his approach and applied only a few quantitative data. His approach covered also all economic sectors, why his analysis of forestry remained insufficient.

If Finland was able to transit to sustained timber yield in the early 20<sup>th</sup> century, there was an early deterioration of other goods and services by forests. Valuable game became intensively hunted since 16<sup>th</sup> century. Beaver and wild deer became totally extinct early in the 19<sup>th</sup> century. Wolf, bear, two eagle species, a few hawks and moose became also nearly distinct later on. The population of squirrel was also largely exploited, because it was the most common commercial commodity for many centuries. Salmon and other spe-

cies fisheries suffered from the expanding timber floating and finally salmon was terminated in the rivers after the World War II by hydropower constructions. (Åström 1978) Electricity consumption grew especially due to expanding forest industries. Accordingly, a transition to industrial forestry had also some other drawbacks in nature conservation, which started to become more actual later on along with the intensification of forest management since the 1960s.

Tasanen (2004) studied the advance of silviculture in Finland until the 1870s. According to him the Crown aimed towards sustainable forestry already since the forestry law of 1647. He continues that the state considered as its duty already then to guarantee the sustainability of forest resources for the multiple needs of the exporting industries, army, navy and commercial fleet as well as for the urban and rural populations. Tasanen did, however, mention that de facto implementation of this and later laws remained weak. It was not before in the 1886 law that the terminating of deforestation was made quite explicit as described in Section 31 of this paper.

Ruuttula-Vasari (2004) has convincingly demonstrated the long path and great problems in implementing a law of state forest administration in Finland in the latter half of the 19<sup>th</sup> century. When the law was restricting the immemorial user rights of the rural people and when they got support in the press and even in the parliament, it was understandable that numerous illegalities took place then in the Finnish state forests (cf. Fig. 5). Fritzboeger (2005) found that similar illegalities were prevailing in most European countries during the 19<sup>th</sup> century. A comparison of the findings by Ruuttula-Vasari with the contemporary tropical countries is also interesting: parallel illegal activities are still prevailing in their forests (Palo and Lehto 2006).

Finland experienced a parallel stage of take over of the private forests by professional foresters in 1918–1959. First, the state foresters were only implementing the 1917

law. Since 1928 the foresters were promoting also investments in forest management intensification and practicing extension of rational forestry management guided by the semi-official provincial forestry boards. Finally, since 1950 also the numerous local forestry management associations were integrated in this promotion of the industrial forestry paradigm to the farm forest owners. The diffusion of rational industrial forestry paradigm among the farmers faced numerous problems but gradually the level of silviculture was somewhat raised (see Leikola in this volume).

Fritzbøger (2005) is the only forestry historian in our references, who has recognized the key role of property rights in the way towards sustainable forestry. He concluded that the absence of private property induced overexploitation of forests and it was the main reason for deforestation in Denmark since the 12<sup>th</sup> century until the beginning of the 19<sup>th</sup> century. Traditionally in Denmark the rural people had common rights of five different kinds concerning cutting of big or small trees, and ranging of grasses and bushes etc. In sustainable forestry predictability of wood production was needed and this required monoculture instead of earlier multiple-use forestry. We share his views also concerning contemporary tropical deforestation (Palo and Lehto 2006).

Michelsen (1995) emphasized the role of research and know-how in organizing forestry management and administration in the 19<sup>th</sup> and early 20<sup>th</sup> centuries. Also according to our findings domestic R&D have been important in following up the international advances in forest sciences and policies. The transition to sustained yield of timber has also required a lot of new research in Finland to support the paradigm change. R&D has to be accompanied by effective education, training and extension activities. It appeared to be time-consuming to overcome the resistance for this kind of paradigm change.

Furthermore, more research and development (R&D) on both public and private funding have been needed (Hellström et

al. 1998). Also capacity building of human resources has a key role. In this way more value added in timber processing can be achieved. R&D has played key roles in identifying major forest policy issues. For example, the threat in the 1920s and 1930s for depleting timber resources in Finland would not have been observed fast enough without reliable forest inventory and timber drain information systems. (cf. Figs. 4 & 10)

Björn's (2000) environmental history study was interesting from the point of view that he was the only one to apply this three-stage typology of preindustrial, industrial and postindustrial forestry. His findings at the local level were to some degree parallel with our findings at the national level. However, he did not specify well enough the paradigm of industrial forestry and did not aim to study specifically the factors underlying the transition from preindustrial to industrial forestry.

## 62. Conclusions

*The first purpose of this paper* was to study the transition from preindustrial to industrial forestry. We may conclude that Finland has transitioned from preindustrial to industrial forestry during the first half of the twentieth century based on the transitions to de facto and de jure sustained yield of timber and finally on excess of the industrial use of timber in comparison with the non-industrial use. Unexpectedly, de facto transition preceded de jure transition. From a causal point of view the latter cannot be the cause of the former. Therefore, it is inferred, that the Great Land Reform jointly with increasing forestry incomes and increasing real value of forests were the primary causes of this historical transition.

*The second purpose of this paper* was to analyse the roles of wars, foreign technology and know-how in the transition to industrial forestry. The numerous wars, imports of technology and know-how and various foreign impacts of political and economic

regimes and scientific paradigms have also played a major role in the past transition of Finland to industrial forestry. The wars have promoted privatization of forests and increased demands for forest products. Private property rights are theoretically most efficient (Section 23 above) for sustainable management. Colonization by land reforms and privatization have been the longest trend of this study starting already from the 16<sup>th</sup> century. Forests have also supported the Finns in defending their country against enemies. Naturally, during the wars regular production of forestry and forest industries has often been periodically disturbed.

The motivations of the state to expand colonization have been to increase tax revenues, defence aspects and to avoid deprivatization due to the lost wars and high number of evacuated rural people.

During the most recent decades, Brazil and Indonesia are illustrative cases, which have strongly favoured the colonization of previously uninhabited forest wildernesses partly for the same motivations by the states. Under those tropical ecological, corruptive, open access, and low-level democracy conditions this colonization has led to expanded deforestation (Palo and Lehto 2006). In Finland 2.5 million ha of forests were transferred from the state to the farmers until 1959 (Holopainen 1968)

The forest industry corporations have benefited from the long-lasting colonization of forests in Finland. Due to the large-scale colonization the inhabitation became widely distributed among the vast forests. Therefore, the supply of loggers and horses for extraction of logs was accessible in most parts of Finland. Only in the most remote forests in northern and eastern parts specific logging camps had to be created with additional costs for the corporations. The labour input to forestry was about 200,000 man-years in 1950 at the highest peak ever in the Finnish forestry. Simultaneously, about 70,000 horses were recruited at the top season in extracting roundwood. (Fig. 12, Holopainen 1968)

The wartime depressions of exports have

increased the growing stock of timber. The post-war expansion of demand by wars means usually also increasing real stumpage prices and making forests more valuable. Low-value forest resources are mostly deforested and high-value forests sustained. *The key role of wars through centuries in support of transition to sustainable industrial forestry is regarded as our novel finding. However, wars alone cannot make this transition but a complex process of many simultaneous factors is required.*

Foreign technology and know-how have also been key factors in promoting Finland's transition to sustained yield of timber and industrial forestry. Imports of foreign technology especially before 1910 have expanded and diversified the capacity of forest industries to demand more timber and more varying dimensions and of varying tree species. In this way the stumpage prices, forestry incomes and the value of forests have increased in support of sustained yield and industrial forestry. Foreign know-how was needed in the application of the new technologies but also in comprehending the contents of the new paradigm of sustained yield forestry.

*The third purpose of this paper was to analyse the roles of ecological conditions, and market, social, political and cultural institutions. The ecological factors have been favourable by decreasing the opportunity cost of sustainable forestry. The primary idea in applying this development model of Fig. 4 as a framework was to find out how Finland overcame deforestation and forest degradation at a development stage similar to many of the contemporary developing countries. Stable governments with advanced democracy create one foundation for the success. Workable social, institutional and legal infrastructures are also needed. Corruption and other illegal activities have to be overcome.*

Clear and strong forest property rights establish one foundation for a future success. Open access can then be closed by overcoming transaction costs and consequently, com-

petitive markets can be established. Imports of technology and knowhow among other factors have a tendency to increase demand for forest products. This will increase the value of forest and decrease the opportunity cost of sustainable forestry. Also other market failures and government failures have to be corrected. An optimum mix of markets and policies (Fig. 2) has to be applied in control of production, distribution and consumption of forest goods and services.

The missing of this kind of “invisible hand” in support of public policies is still today a major problem for more than 80% of the world’s forests owned by the states. Artificially made low stumpage prices with consequent low value of forests makes the opportunity cost of sustainable forestry high. Therefore, and due to a high degree of corruption, typical to socialistic forestry, a large-scale deforestation is continuing in the tropics (Palo and Lehto 2006).

Forestry problems do not induce reforms in isolation by their sole existence. *The role of public discussion by scholars in promoting the agenda formation necessary for new forest legislation is one more novel key finding of this paper.* This took place in the 1730s and 1740s before the launching of the Great Land Reform and the liberalization of the access for sailing abroad, again in 1829 by Böcker before the two committees for the 1851 law, and again in the 1850s by Gylgén, von Berg, Snellman and Wrede before the major reforms of the end of 1850s and the 1886 law, and again in the early 20<sup>th</sup> century in advance of integrating the Forester College to the University, establishing the Forest Research Institute and the 1917 forestry act. A similar discussion was going on since 1914 (e. g. Pekkala 1922) to criticise the integration of forestry extension with agriculture (Helander 1949). A Committee for private forestry was set up in 1924 and in 1928 major reforms arrived.

The role of individual actors in key vacancies in the government is another precondition to forestry reforms. We may identify Jacob Faggot and Anders Chydenius in such

roles in the 18<sup>th</sup> century, Lars Gabriel Hartman and Fabian Langenskiöld in the 19<sup>th</sup> century, A. K. Cajander, Mauno Pekkala, N. A. Osara and Matti Lepistö (Piha 1975) until the 1950s in the 20<sup>th</sup> century. Naturally, vested interests and political parties have always played their own key roles both in the agenda formation and in the final implementation of these reforms.

Finland has had a peripheral geographic location and specific ecological conditions. They have jointly determined traditionally rather restricted investment opportunities in this country. Accordingly, Finland relied until the 1950s primarily on her forest resources in economic development. Therefore, Finland has implemented more intensive forest policy and management efforts to maintain her forest resources than most other countries.

In fact, Finland has already created a forest cluster until the 1950s to support forest-based development. In this cluster forest industries were connected with backward, forward, agricultural, investment and consumption linkages of materials, energy and information to a high number of other industries. This forest cluster gradually became a core of economic growth for the whole national economy. Even Nokia started as a pulp company in 1869. After the 1950s the diversification of the economy has led to a less pronounced role of the forest cluster in the society (Fig. 8).

The coevolution theory integrated our analysis concerning the interaction between forestry and society. The coevolution of forestry sector with the society via forest-based development and forestry regulation in Finland has been unique in the whole world (Hjerppe 1989, Palo and Uusivuori 1999). It may not be easy to replicate it in the developing countries or in the countries with economies in transition. The world context today is so different from the world Finland encountered in its earlier phases of development. However, some lessons can be learned from the Finnish experience.

The interplay and interaction of public

policies and market institutions has appeared highly interesting among our findings in this transition to industrial forestry. We may interpret our findings so that a continuous increase in the real value of forests has been a necessary but not a sufficient condition in the transition from open access to sustained yield forestry. The increase in the value of forests has decreased poverty and lowered the opportunity costs for sustainable forestry. In a parallel way public policies have been necessary but not a sufficient condition in this transition.

This research can be regarded as a pilot case study of the evolution and transitions of Finland from preindustrial to industrial forestry. As a next phase of this project the transition from the industrial forestry to postindustrial forestry in Finland will be studied as a coevolution of forestry and society and with similar theory and method as in this paper.

More structured research will be carried out until 2008 concerning the case studies in Costa Rica, Finland, Japan and Korea along with their comparative analyses (Palo et al. 2004). In case invariances in factors supporting overcoming deforestation among these four most different countries can be found, only then further and more convincing policy proposals for the tropical countries will be introduced. The theoretical framework and method of this paper need certainly further development but the findings of this paper are supporting the relevance of this approach.

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