INNOFORCE
EFI Regional Project Centre

Sectoral Issues of Integrating Environmental Policy and Innovation Policy

by KUBECZKO Klaus and RAMETSTEINER Ewald

Paper for the 5th BLUEPRINT Workshop for the Integration of Science, Technology and Environmental Policy, 3. – 4. April 2003, Brussels

EFI Regional Project Centre Innoforce
Gregor Mendel Str. 33
A – 1180 Wien

Abstract

The contribution presents a Sectoral Innovation System (SIS) approach for the primary sector giving an example of an innovation system geared towards sustainable development innovation. The SIS approach used is co-evolutionary by nature and links the firm level, inter-firm level aspects as well as the institutional level aspects both of market and non-market relations.

The approach was developed and empirically tested in the context of a project of INNOFORCE, a Regional Project Centre of the European Forest Institute on "Innovation and Entrepreneurship in Forestry in Central Europe to Enhance Sustainable Forest Management".

The empirical part consists of quantitative and qualitative surveys in forest holdings and in the SIS. Interestingly, the results of the survey for Austria show that the innovation activities of large forest enterprises are at the same high level or even above the level of innovation activities of Austrian SMEs in other sectors. A good portion of their innovations can be considered as sustainable development innovations, as many of these are moving towards environmentally integrated production systems. Some are clearly innovations supporting the environment. Small forest holdings, though representing half of the forest area, are innovating much less. Here the potential for sustainable development innovation is still very high and has not yet been well supported by the SIS.

Based on the empirical results, it is argued that SISs in the primary sector - to a large extent – can and should represent systems that also support sustainable development innovation.

Table of Content

1 Introduction

1.1 Objectives

The objectives of the paper are to describe the actual situation of innovation in forestry and potentials for further sustainable-development-innovations (SDIs) as an example for primary sector policy for sustainable development. The empirical work performed by INNOFORCE shows, how much and which kind of innovation is taking place today and how the different actors and institutions work together to foster innovation in forestry. It shall be discussed how to exploit the potential of a sectoral system of innovation in forestry and what relevance the empirical results have for policies related to environmental or other policies. Overlaps, synergies, coordination integration needed between these policies are identified and the organisation of coordination and integration is discussed.

1.2 Rationale

In forest sector policy, as in other sectoral policy discussions, innovation is specifically discussed in the context of improving the competitiveness of sustainable forestry vis-à-vis other sectors of the economy and vis-à-vis the forest sector of other countries.

On the EU-policy level, innovation is discussed in the context of increasing competitiveness of the European economy, creating economic growth, employment and the development of rural regions. It is also considered as a remedy for changes towards environmental improvements and sustainable development. It is therefore related to the Lisbon Strategy for employment, economic reform and social cohesion (March 2000) and the Gothenburg Strategy for Sustainable Development (June 2001) and is reflected in the structural indicators that, since the Second Commission Report on Structural Indicators in October 2001, include seven environmental indicators.

In recent years, innovation related to environmental issues were discussed calling for *institutional innovations towards sustainable development*, *eco-innovations*, *environmental innovations* or *sustainable development innovations*. In forestry the issue of sustainable development innovation was raised in the context of *sustainable systems of innovation* in developing countries (Segura-Bonilla 1999).

2 Theoretical Approaches

2.1 Defining Innovation

Very often innovation is used synonymously for technological innovation, considering new technologies related to products and services or new technologies in the production process. Nevertheless, for the purpose of the project the understanding in the literature on systems of innovation is shared, which distinguishes product and process innovation as the two main categories of innovation, considering tangible as well as intangible innovations (see Figure 1). Product innovations can be new material goods or new intangible services. Process Innovations can be either technological or organisational.

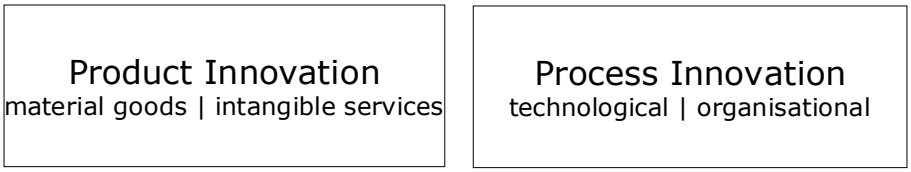

Figure 1: Categories of Innovation

For the INNOFORCE-project innovation is defined as discontinuous intentional change in inputs, processes or outputs of an enterprise. Innovations can be new to the market (to forestry) or new to the firm (the forest holding).

Sustainable development innovations are understood as cases of innovations geared towards sustainable forest management.

2.2 Systems of Innovation – An Institutional Economic Approach

In the academic discourse, to day, there is a divergence in opinions on the importance of technological and organisational innovation versus product innovations. Nevertheless, there is a growing consensus in the innovation system literature that innovation is an institutional process (Lundvall et al. 2001, Edquist 2001, Moulaert and Sekia 2000) and that it is not only the entrepreneur that is responsible for the innovativeness of the firm. They have to be embedded in a system of institutions that can support them.

The overall function of an system of innovation is to produce innovations new to the market, diffuse these innovations and use them (Edquist 2001).

The main components of the System of Innovation are considered to be the actors and the institutions: Actors are considered as organisations, which are seen as formal structures with an explicit purpose and which are consciously created (Edquist and Johnson 1997). Institutions are understood as a set of habits, routines, rules, laws or regulations that regulate the relations and interactions between individuals, groups and organisations (Edquist and Johnson 1997). In other words this are the rules of the game. Apart from this main components, the relations between them are important for innovation activities.

In recent years also the functions of the System of Innovations are increasingly discussed. This is especially important when evaluating the performance of an innovation system and for intentional planning of innovation policy (Johnson 2001). Edquist and Johnson (1997) summarize the functions of institutions in the process of innovation in three categories (see Fig.2):

- reduction of uncertainties by providing information,
- management of conflicts and cooperation, and
- the provision of pecuniary and non-pecuniary incentives.

The institutional system shall manage the competition and cooperation between individuals and groups necessary for a innovation friendly environment, e.g. by supporting networks and clusters. It shall provide knowledge for the enterprise to reduce uncertainties in its economic activities. Institutions (e.g. patent laws, norms for repayment periods etc.) reduce uncertainty, either by providing information about the behaviour of other people or by reducing the amount of information needed. The institutional system shall also provide a system of non-pecuniary incentives to engage in learning and to participate in innovation processes that can make innovation profitable on the long run. Finally, pecuniary incentives such as tax rules, government subsidies and allocation of resources to universities shall channel resources to innovation activities and also help to re-channel resources from unprofitable to new activities.

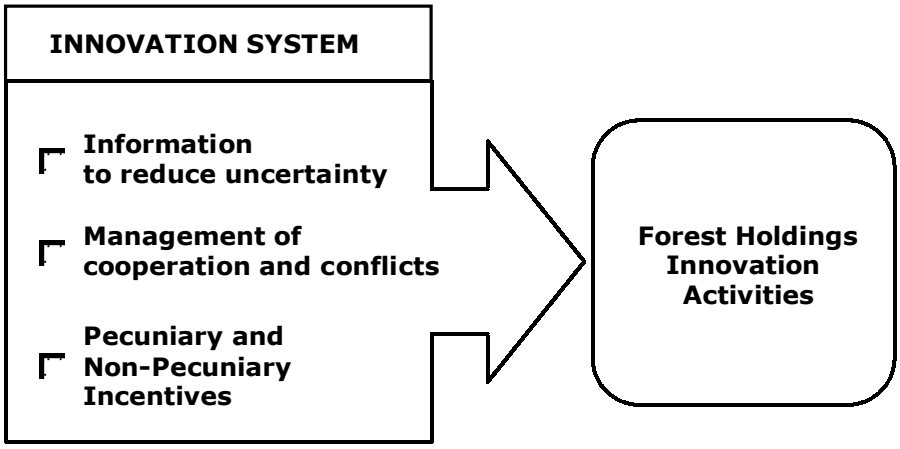

Figure 2: Functions to be provided by an innovation system to support innovation activities

There are many different approaches to analysing innovation systems. Two approaches seem to be of relevance in respect to the issue of innovations related to forestry and its multifunctional character of producing wood- and non-wood products and services as well as several environmental services like water protection, absorption of CO2 etc.. First of all, and this is the approach we concentrate on in this paper, the Sectoral-Innovation-System approach seem to be the most appropriate to foster innovation in forestry, as the institutional system of the forestry system is traditionally oriented towards the production of wood. Other products and services provided by forests to the society often seem not sufficiently recognised by the sectoral policy. Many of these have a regional territorial component. This means that a Regional Innovation System approach has to be kept in mind.

2.2.1 Sectoral Innovation System (SIS)

Breschi and Malerba (1997) define Sectoral Innovation Systems (SIS) as "system of firms active in developing and making a sector's products and in generating and utilizing a sector's technologies." This SIS approach looks at the firm level, inter-firm level aspects as well as the institutional level aspects both of market and non-market relations.
The key features of this approach are the importance of the knowledge base and the learning process, the role of non-firm organisations and institutions and the co-evolutionary process changing the sector.
The agents composing the SIS are, as in all innovation systems, individuals and organizations. These organizations may be firms (such as users, producers and input suppliers) and non-firm organizations (such as universities, financial institutions, government agencies etc.), as well as organizations at lower or higher level of aggregation (such as consumers, R-D departments or industry associations). Agents are characterized by a specific learning process, competence, structures and behaviour. They interact in a market and non-market way through processes of communication, exchange, cooperation, competition and command, and their interactions are shaped by institutions (rules and regulations)."

The SIS approach of Breschi and Malerba distinguishes five major types: SIS in traditional sectors, the mechanical industries, the auto industry, the computer mainframe industry and the software industry. Typically, more process innovations, especially related to reducing production cost, than product

innovations are introduced in traditional SIS. Especially, opportunities to introduce innovations related to reducing production cost are performed.

Additionally, SIS may also have different geographical demarcations. The SIS approach does not only look at networks of vertically and horizontally connected agents and organizations such as in cluster analysis, but it focuses also on competitive relationships among firms (Breschi and Malerba, 1997).

In studying the forest sector, it must be noted that path dependency and the institutional system are paramount in the formation of sectoral systems of innovation. The different natural resources and production conditions of a region may influence the path of development of firms and the whole sector. Firms therefore operate within this particular structure and establish routines and norms, which generally are stable for long periods of time. (Segura-Bonilla 1999),

2.2.2 Regional Innovation System

The Regional Innovation Systems (RIS) approaches are based on a territorial concept and look at the innovation process at the local or regional level. A RIS is often primarily defined by administrative rather than sectoral boundaries. Therefore, it is complementary to the SIS approach. Similar to the SIS approach, but without the explicit focus on the firm level, most of the contributions on the nature of innovation in the RIS refer to innovative dynamics based on technological change, organisational learning and path dependency. Organisational selection, learning processes, path dependency, networks, institutions, governance, etc. are distinct elements of the theories (Carlson and Jacobson 1997). It is explicitly recognised that learning and technological change are characterised by regional specificities. They are rooted in the structure of the economy and include strong elements of path dependency (Carlson and Jacobson 1997). Asheim and Isaksen (2001) describe RISs as regional clusters that are supported by surrounding organizations. They argue that a RIS is in principle constituted by two key actors, firms in the regional clusters and institutions that create an institutional infrastructure.

Due to the focus on territorial specificities they can be well applied to the development of rural areas. As forestry with its traditional SIS focusing on the core issues for the sector related to wood-production other functions of forestry, remain without support by the SIS. As RIS and SIS are both characterised, although with different emphasis, by a certain regional component, a linkage between a SIS of forestry and a RIS within the same region might be advantageous.

2.3 Defining Sustainable Development in the Forestry Sector

The first concepts of sustainability in forestry were developed out of the need for a control of wood exploration for mining, construction and charcoal production for the industry. This concept which forms one of the roots of the modern understanding of sustainability lies in the work of Carlowitz (1713). He already emphasised the relevance of economic and ecological aspects of sustainability in forestry, also mentioning aspects of social sustainability.

The discussion on sustainability in forestry in Europe in the 19th and 20th century concentrated on economic sustainability, although multifunctionality was also considered. The understanding of economic-sustainability lies in the simple assumption that wood, as the primary source of income must not be over-used (sustainable yield). The main indicator for forest policy is growing stock, for which various measurement systems were developed and a data reporting system was institutionalised. Other goods and services provided by forests are seen as joint

products "in the wake" of timber production. Ecological and social aspects came stronger into the picture in several regions due to the growing need for avalanche and erosion protection already in the early 20th century, firmly establishing the multifunctionality concept ot the sector.

The modern concept of sustainability in forestry, with a balance of economic ecological and social aspects started with the Bruntland Report and Rio 1992.

Several international policy processes exist today whose explicit aim is the promotion and implementation of SFM. In Europe the main forestry policy process is the Ministerial Conference on the Protection of Forest in Europe (MCPFE), comprising 44 European states. The European states, defined through the MCPFE, Sustainable Forest Management for Europe as "the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems." (Preamble D, MCPFE Resolution H1)

The definition of SFM is operationalised through Pan-European Criteria and Indicators for SFM. A set of six criteria, representing policy goals, 27 quantitative as well as descriptive indicators was developed by the MCPFE in the years 1993-1995 to form a coherent set of tools to assess and assist further progress in sustainable forest management. The European states represented in the MCPFE agreed upon this set of criteria and indicators for Sustainable Forest Management in 1998 (Resolution L2). The indicators were recently updated and will be endorsed by the states at the fourth conference in Vienna in April 2003. (see Table 1 for the criteria and the most important concept areas for indicators).

Criteria of Pan-European Sustainable Forest Management	Concept Areas
Maintenance and Appropriate Enhancement of **Forest Resources** and their Contribution to Global Carbon Cycles	1. land use and forest area 2. growing stock 3. carbon balance
Maintenance of **Forest Ecosystem Health and Vitality**	
Maintenance and Encouragement of **Productive Functions of Forests (wood and non wood)**	1. wood production 2. non-wood production
Maintenance, Conservation and Appropriate Enhancement of **Biological Diversity in Forest Ecosystems**	1. forest ecosystems variety 2. threatened species 3. biodiversity in production forests
Maintenance and Appropriate Enhancement of **Protective Functions in Forest Management (notably soil and water)**	1. soil erosion 2. water conservation
Maintenance of **other Socio-Economic Functions and Conditions**	1. significance of the sector in the economy 2. recreational services 3. provision of employment 4. public participation 5. cultural values 6. research and education 7. public awareness

Table 1: Overview of the most important Sustainable Forest Management-criteria and concept areas as defined by the Resolution L2 of MCPFE (2000)

As a result of this process, several countries are now annually reporting on SFM indicators and have already included the SFM-definition into their national law. This allows for a balanced view of the situation and development of forestry in these countries over time. Changes in the sector are made visible and society can react on that changes by continuous innovation to keep Sustainable Forest Management balanced.

3 Empirical Approaches

3.1 Levels of Actors of the Sectoral Innovation System of Forestry in Austria

For the Sectoral Innovation System of forestry in Austria, three level of actors are identified: (1) The institutional-level which encompasses the governance system including administration and interest groups, S&T institutions, education and training organisations and the consultancy services. (2) The second level is related to cooperation between businesses (b2b), and between the institutional-level and the forest holdings (i2b). This encompasses clusters, networks, horizontal cooperation between forest holdings, and vertical cooperation between forest holding and the related partners in the supply chain. (3) Finally, the enterprise level encompasses large forest holdings, strategic business units of rural enterprises (farms), and so called absentee forest owners who in most cases own only few hectares of forest and do not life near their property.

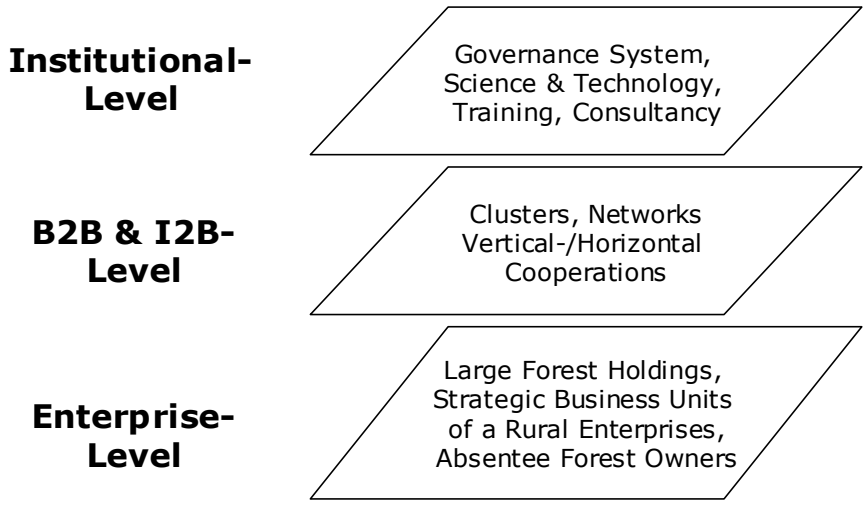

Figure 3: Three levels of actors of the Sectoral Innovation System in forestry

3.2 Method of Forest Holding Innovation Survey

The Regional Project Centre INNOFORCE of the European Forest Institute has conducted a forest holding innovation survey in Austria in the first quarter of 2002, based on 2449 questionnaires sent out by mail. The survey was conducted addressing a random sample of 2000 forest owners with forest properties below 500ha and the full sample of 449 forest owner (or mangers in the case of large forest holdings) of properties with 500ha and more. The response rate for forest holdings below 500ha was 12%. Of the forest owners and managers of properties with more than 500ha 27% returned the questionnaire. 359 valid questionnaires were analysed (66% from forest holdings smaller than 500ha / 33% from forest holdings larger than 500ha).

The questions asked ranged from type and degree of innovation and entrepreneurship behaviour, and aspects related to functions of the institutional system, including information, rules and regulations, and co-ordination and co-operation. Fostering and impeding factors for innovation and entrepreneurship were analysed using two different forms of questions. First, an open question was asked, then the interviewees were asked to quantify the importance of pre-selected factors including costs and financing, financial support, risk, rules and regulations, provision of information, support services, education and b2b and i2b cooperation. Factor analysis was applied to categorise the fostering and impeding factors.

3.3 Method of Institutional System Survey

The analysis of the relevant institutional system for innovation activities in forestry in Austria is based on the SIS approach.
The institutional system survey includes 18 expert interviews with representatives of relevant institutional actors on the national level, and a representative standardised mail-survey with 178 organisations on provincial and district-levels with a response rate of 28%. The expert interviews took place in March and April 2002, the standardised interviews were sent out during summer 2002. The survey puts light on the actors of the innovation system influencing innovation activity as well as on the relations between them. Furthermore the services of the innovation system are analysed following the functional classification as described in the theoretical part.

4 Actual Innovation Activities and Behaviour and Potentials for Sustainable Development Innovation - Forest-Owners/-Managers as SFM - Innovators

4.1 Actual Innovation Activities and Behaviour

10 % of forest holdings smaller 500ha introduced one or more new product or processes within the last 3 years (see Figure 4). Far more, i.e. 64% of forest holdings larger than 500ha introduced one or more new product or processes. Neither in large nor in small forest holdings innovations introduced were new to forestry.

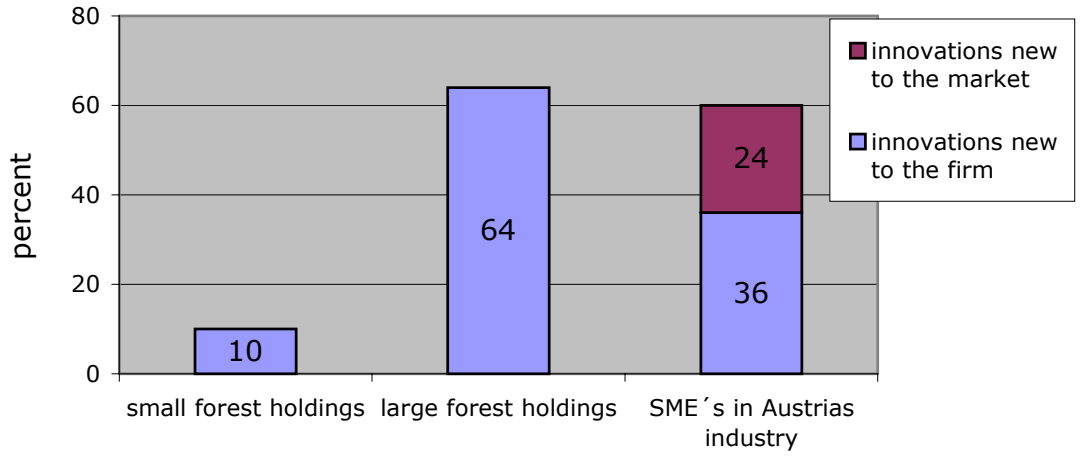

Figure 4: Innovation activity of forestry compared to SMEs in industry in Austria in percent

Comparing this situation in forestry with the innovation activities in SME's in the Austrian industry, large forest holdings are above the level of innovation activity of SME's, which was 60% according to the CIS2 (European Community 2001) for the years 1996 to 1997. Small forest holdings are far below that benchmark. Different to forestry where no innovations are new to the sector, according to CIS2 40% of innovations of SME's are new to the market (see Figure 5).

The successful innovations of the forest holdings are relatively even distributed between innovations in products (19%), services (28%), organisational processes (25%) and technological processes (28%). More than half of the product innovations are related to bio-energy-wood products (11% of all innovations named). One third of the service innovations are related to recreational services like mountain bike-routes, renting cottages etc.. Another third of service innovations are related to selling the use of rights like hunting, royalties for gravel quarries etc.. Other services introduced comprise environmental services (avalanche protection, natural regeneration), seminars for environmental education and various other services.

50% of organisational innovations are projects related to outsourcing, most often connected to the reduction of workforce (12% of all innovations named). One sixth of organisational innovations are related to some form of reorganisation. Other organisational innovation make up for the rest (1/3), including vertical and horizontal cooperation. One third of technological innovations refers to the infrastructure for harvesting, i.e. additional roads built and technologies to transport wood-logs in

mountainous areas. The introduction of fully mechanised harvesting with so called "harvesters" makes up for 20% of technological innovations. The rest of technological innovations is related to a wide range of technological changes from the introduction of computers to natural regeneration.

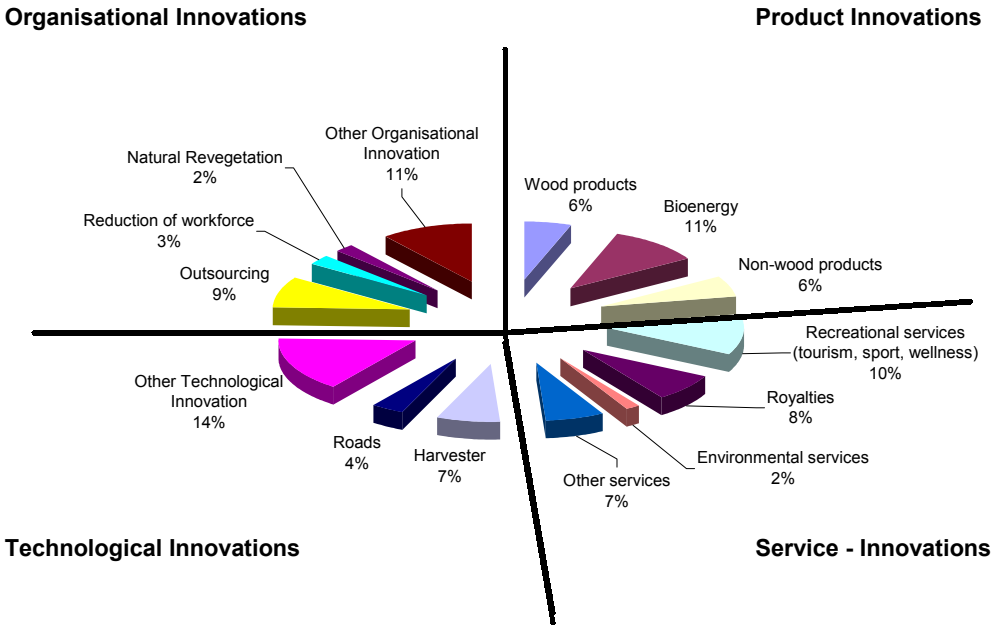

Figure 5: Kind of innovations in forestry in Austria [correction note: read *natural regeneration* instead of *natural revegetation*]

4.2 Potentials for Further Sustainable Development Innovation

Multiple objectives production systems such as defined by SFM comprise economic, ecologic and social goals. This inevitably leads to situations of conflicts between these objectives. From the point of view of the forest holding, innovation must be economically viable. The task therefore is to optimise ecologic and social goals of society while ensuring overall economic viability of the individual economic agent.

The above mentioned SFM C&I have the potential to relate the various aspects and consequences of innovations in sustainable forest management to each other. The consequences of innovations can be analysed in the face of the indicators available and weights can be put to the defined criteria.
To give an example, in the following table the trade offs between the major objectives of the innovative forest owners are related to the major and minor positive or negative effects of innovations on the SFM C&I [1].

[1] The evaluation is an example representing the subjective view of two experts, to show the trade offs. For a discussion of the trade off related to actual innovation policy, the relation would have to be evaluated by a team of experts taking into account the weights of different effects of innovations on indicators.

		main SFM aspect addressed		
		Economic	Eological	Social
Product Innovation				
wood products				
	bioenergy	☒	⇧	
non-wood products				
	spring-water	☒		⇧
environmental services				
	environmental education			☒⇧
	protected areas		☒⇧	⇧
	erosion-avalanche protection		☒⇧	⇧
recreational services				
	MTB-tracks	☒		⇧
	holidays in the forest	☒		⇧
	adventure holidays	☒		⇧
	hunting	☒		⇧
	rent of cottages	☒		⇧
royalties				
	gravel, limestone quarries	☒	⇩	⇧⇩
Process innovation				
technological innovation				
	use of harvesters	☒		⇩
	selective harvesting instead of clear-cutting		☒⇧	⇧
	change from monoculture to mixed forests		☒⇧	⇧
	natural regeneration		☒⇧	⇧
organisational innovation				
	outsourcing	☒		⇩

Main objective of enterprise ..... ☒
Major and minor positive effect on SFM C&I..... ⇧⇧
Major and minor negative effect on SFM C&I..... ⇩⇩

Table 2:Examples for the evaluation of relation between innovations and SFM C&I

The empirical results of the forest holding innovation survey show that innovations which are economically viable for forest owners have the potential for improving ecological or environmental criteria at the same time.

Innovation activities related to bio-energy are examples of product innovations that are leading to improvements for the environment in general as long as they are undertaken within the framework of SFM. They represent a high portion of all innovations taking place currently and are expected to be growing further. The potential for further innovations lies especially in small forest holdings which are partly owned by so called absentee forest owners. Only ¼ of small forests below 10ha are run as strategic business units of rural enterprises. Here the potential for increased use of growing stock and multifunctional use of forests is very high, largely without negative consequences on ecological or social dimensions of SFM.

The creation of protected areas to maintain biodiversity and new measures in erosion and avalanche protection are examples for service innovations in SFM that are intended to improve the environmental situation.

Examples for process innovations in SFM that are introduced to improve production conditions by improving the situation of the ecosystem are selective harvesting that

replaces clear-cutting, the change from monocultures to mixed forests as well as natural regeneration.

4.3 Fostering and Impeding Factors to Sustainable Development Innovation

4.3.1 Fostering factors for innovative forest holdings

When asked about the fostering factors for innovations, very often, forest owners or managers of large forest holdings claim that their personal attitude is most important. This reflects the way large private forest owners see themselves as being independent of state interventions. But, the analysis of results verifies the hypothesis of innovation system theory that institutional factors play a mayor role, especially in the diffusion of innovation. Other often named fostering factors reflect the wide range of services of an institutional system that are involved in successful innovation projects.

By means of a factor analysis, four independent components were identified that are relevant for innovation activities. Of these components, three concur with the functions of an institutional system as listed by Edquist and Johnson (1997). We therefore categorise the fostering factors ranked by more than half of the forest owners to be of importance for their innovation projects according to these functions.

1. Information (to reduce uncertainty) is provided successfully to 73% of innovators by informing them on examples of successful innovations. Also the opportunities for education and training are fostering factor for almost half of the innovators.

2. Management of conflicts and cooperation is almost equally important, as vertical and horizontal cooperation are fostering for more than 2/3 of innovators. The availability of services to support innovators in process innovation and the cooperation between actors on the institutional level and the forest holdings, are also fostering for 57% of innovators.

3. For 51% of the innovators the provision of pecuniary incentives are supportive for their innovation activities.

The factor-analysis suggests that innovation strategies could indeed follow the functional classification of the services provided by actors and institutions. Factors related to all three function are considered to be supportive of the innovation activities of the majority of forest holdings. For the development of strategies it might therefore be useful to follow the functional categories.

4.3.2 Impeding factors of forest holdings without innovation

The reasons for forest owner not to innovate are mainly related to factors on the enterprise level. 59% see high introduction cost as a main factor, 56% of non-innovators see the lack of capital as a main factor for their behaviour and 56% perceive the risk to find markets for innovative products as a main impeding factor. The lack of information on support schemes for the diffusion of innovations is of influencing 51% of these forest owners in their behaviour. The ownership structure of forests in Austria with a majority of small size of properties, the production conditions in mountainous regions and the related lack of profitability are the most important impeding factors for forest owners with less than 10ha.

Often important impeding factors are related to the lack of entrepreneurial attitude of risk taking and proactive seeking of opportunities. Larger entities of jointly managed forests, as promoted by the sectoral policy by supporting forest owner associations, are considered as remedies for scaling problems. They are increasingly popular and form a recognisable part of the organisational innovations.

5 The Sectoral Innovation System (SIS) in Forestry

5.1 Actors of the SIS

The Sectoral Innovation System (SIS) in forestry can be characterised as a system that is very closed. It has strong boundaries towards other sectors even against those who are partners in the supply chain and to actors that form part of territorial defined innovations systems on national and regional level. As an example, no institutionalised interaction exists between the growing sector of forestry services that are provided to the forest holdings due to the outsourcing activities in recent years. The SIS consist of relatively few actors on national level compared to other sectors. We have identified 3 main groups of actors involved in fostering innovation in the forestry sector which are (1) the core actors of forest policy, (2) actors of knowledge production and management and (3) other actors relevant to the sector.

1. Core actors of forest policy are the forest administration and the interest groups of large and small forest holdings. Forest administration on national level forms part of the Federal Minister for Agriculture, Forestry, Environment and Water Management. Each province has its forest administration on provincial and district level which are executing national forest law and are providing certain consultancy services to the forest holdings. For forest owners membership in the chamber of agriculture is obligatory which is organized on provincial and district level. At national level the chamber is represented by the so called conference of presidents of the provincial chambers which is coordinating the activities of national concern including lobbying for farmer friendly forest legislation.

   The chamber is providing information on all issues of importance to its members and is providing a wide range of consultancy services and supports the setting-up and management of forest-associations. It is also involved in most provinces in the management of EU funds for rural development. The interest group of large forest owners is voluntarily but the vast majority of forest holding larger than 500ha are members of it. The work of the interest group comprises information of the members on EU-regulations, benchmarking between forest holdings and lobbying for forest owner friendly national legislation.

2. Actors of forestry specific knowledge production and management are the University of Natural Resources and Life Sciences in Vienna with forest related research and academic education and a state owned research institution for forestry research and technical education. It also includes the forestry specific consultancy sector represented by the chamber of certified engineers with obligatory membership.

3. Other actors relevant to forestry are administrative bodies and actors of knowledge production and management from other fields than forestry. This actors deal with matters related to rural development, technological innovations in several fields, innovation policy and sustainability. None of these actors

consider themselves as being involved in forest related policy issues. There are only few links between these actors and singular actors within the core of forest policy, e.g related to EU-funding or research that is not in the expertise of the university specialized on forestry matters.

5.2 Services Provided by the SIS and their Functions

All the above actors are providing, in one or another way, concrete services to the forest holdings that are related to the functions a SIS can provide. It must be mentioned that most of the services are related to the diffusion of innovation. No introduction of innovation could be identified in the last three years that would support innovations new to forestry, although some research projects at University level have the potential to lead to innovation in the supply chain of wood products.

- The actors provide information to the forest owners that reduce their uncertainty in several forms. The interest groups, as well as the administration are providing information on issues of innovation as well as regulations on national and EU-level which are effecting innovation. They also provide information on funding especially for those funds that are coming from other sources than those managed by the forestry administration (e.g. subsidies for activities related to the use of bio-energy from forests).
  The sector has a well established system of technical conferences that include excursions to successful forest holdings. Technical journals and sector specific periodicals are very often named as source of information or even as giving the impulse for innovation. This information media can profit from the formal and informal networks within forestry that allow for a coordinated way of spreading information on innovation.

- By management of cooperation and conflicts that support innovation activities the chamber of agriculture provides support for the setting-up and running of forest owner cooperation. The forest administration is managing the cooperation between state owned and private organisations dealing with plant breeding. University of Natural Resources and Applied Life Sciences Vienna provides applied research on supply chain management in cooperation with large forest holdings and forest owner cooperatives that shall result in process innovations to improve logistics of getting wood-logs to the industry. The University is also involved in projects on natural regeneration, avalanche-protection by forest and other projects related to ecological and social functions of forest.

- One explicitly defined non-pecuniary incentive for innovation is a state-price which is awarded annually to innovative forest owners of all size categories.

- Pecuniary incentives that are funded via the forestry administration are available from EU-programs like those for rural development which are managed by the administration and the chamber of agriculture in the provinces. Although, the rural development program is not designed to support innovation more than one third of the actors on provincial and district level mentioned this as the source for innovation projects. The EU-program "Leader +" that focuses more on innovation in rural areas is not perceived as source of funds for forestry and was only mentioned once as major source of funds for innovative projects.

5.3 Interactions in the SIS

On the national level, due to the small number of actors in forestry, formal and informal relations are interwoven. Most decision makers have studied at the same University and are organised in a society of forest academics with annual conferences and influence on forest research policy. Some of the decision makers are involved in different organisations at the same time which makes coordination complex and easy at the same time.

The above mentioned state-price for innovative forest owners is managed by the national administration in cooperation with the other central actors in forestry.

Direct interactions between institutional actors and forest holdings take place on district level. From the data of the institutional actors on provincial and district level, it becomes clear that most of their activities are focused on forest holdings below 200ha which are owned by farmers. Although the majority of forest owners are no full-time farmers, only 10% of the actors consider small absentee forest owners as their main clients.

A new form of interaction is now introduced to Austrian forestry in April 2003. A national forest program (NFP), shall define new strategies for sustainable forest management (SFM) that are deliberated with a wide range of stakeholders. The process leading to the NFP is organised as a participatory dialog open to all actors in the sector and to NGOs dealing with environmental issues related to forestry.

5.4 How to Exploit Potentials by a SIS?

Although no accurate numbers are available, some of the innovation activities of the forest holdings like bio-energy products, selective harvesting, natural regeneration, fully mechanised harvesting or the outsourcing of labour intensive work can be identified as having been supported by the SIS. Some of these innovations are actually quite related to the improvement of the environment and contribute to the improvement of ecological criteria of SFM. Analysing the fostering factors for innovation activites of forest holdings, we have seen that the SIS often influences the diffusion of innovation. There is considerably further potential to exploit especially small forest holdings innovation potentials to contribute to environmental as those outlined above through focused support by the SIS.

More generally, a SIS operating in a sector with existing and commonly agreed criteria and indicators of sustainable development as a reference has the potential to contribute to the improvement of any sustainable development criteria by directing its innovation orientation and support explicitly towards this goal. In that way a SIS can contribute to environmental policy, embedded in the wider sustainable development goal. This integrative and more holistic approach requires the effective integration of environmental goals into sectoral policy. In the forestry sector in Austria as well as in quite many other countries in Europe, such as Finland and Germany, such a step is not a complete utopia, as forest policies are currently indeed go through multi-stakeholder consultation processes to define sector goals and strategies. To exploit the potential for sustainable development innovation would require to put exactly this high on the list of agreed goals and strategies.

6 Discussion

6.1 Relevance of the Empirical Result in Forestry for Environmental Policy

Forestry is a key sector in respect to environmental policy. A large part of the landscape is covered by forests, and biodiversity is usually considerably higher in forests than in agricultural or urban land. Forestry is a key influencing factor on topics like the provision of renewable resources, eco-system health, quality of life. It plays a role in various environmental policy fields like, biodiversity, carbon sequestration, renewable energy resources, protection of cultural landscape, natural reserves, water resource management. Innovations in forestry happening today have many positive effects regarding the environment. The SIS in forestry today is able to support the diffusion of innovation for the environment in respect to innovation issues that are accepted to be of importance by the central political actors. Compared to other sectors, innovations that are new to the sector are rarely introduced and non was identified in the survey. The reason for this might be explained by the special production conditions in forest management. This SIS is not putting emphasis to all aspects of SFM, and therefore potential fields of innovation support are not covered by it.

The empirical results presented show that Sectoral Innovation Systems can produce and in the case of forestry actually do produce win-win situations for ecological and social sustainability wished for by the society. At the same time it is important to note that there can be trade-offs caused by innovation activities that do not take into account all the dimensions of sustainable development. It is therefore important to anchor the SIS in a wider strategy of sustainable development.

6.2 Relevance of the Issue for other Policies

As other sectors, forestry is in need for innovation strategies that can improve the competitiveness of the sector vis-à-vis substitute producing sectors.

Rural development will get higher on the agenda of EU policy with the accession countries. The tendency towards more productivity in sectors based in rural regions and the consequent reduced demand for human resources, as well as the attractiveness of cities and their environment are depopulating some rural areas. Consequently, on the one side, the quality of life is threatened for people remaining in this regions, on the other side also the society as a whole which has an interest in the maintenance of cultural landscape is loosing quality of life. Forestry with its high percentage of land cover in many European countries is influencing the quality of a large part of the cultural landscape and therefore should be aware of its role in rural development. Employment as the major problems in rural areas has to be faced by various measures. One of the findings of innovation system literature is the impact of innovation on employment (Edquist et al. 1998). As a general rule product innovations tend to create or maintain employment whereas process innovations tend to increase overall unemployment. Forestry has been an important source of income for forest owners and for employees in rural areas. The restructuring of forest enterprises and the development of wood prices tend to have a negative impact on employment. To compensate for the negative impacts, product innovations based on the multifunctional use of forest and the efficient use of the growing stock (of wood) can provide new opportunities for the employment situation in rural areas.

From the perspective of environmental policy a forestry SIS geared towards sustainable development is highly relevant for a number of reasons. However, the real benefits lie in its holistic, more integrative approach of sustainable development. First, the sector is producing a truly renewable resource. Second, this sector has made further progress in developing, operationalising and implementing the sustainability concept than most other sectors have. The sectoral policy processes are currently involving broad stakeholder communities in their strategy formulation towards sustainable development. Third, developments are under way to link the sustainable development concept of the forestry sector with those of the subsequent wood- and fibre-based industries and with consumption, progressing towards a showcase of an operationalised and real life integrated sustainable production and sustainable consumption model.

6.3 Overlaps, Synergies, Coordination and Integration needs between these Policies

Assuming that only those innovations will be supported by an SIS that follow the internal logic of the sector the SIS must be capable of dealing with the above mentioned policy fields like competitiveness, rural development, employment and environmental or ecological sustainability. If the internal logic of a sector is based on criteria of sustainable development, win-win situations in respect to economic, ecological and social criteria can be internalised into innovations strategies and trade offs can be avoided. In the case of forestry the existence of an established and widely accepted system of SFM C&I can be used as a reference for SFM-innovation strategies and strategies for other policies. A national forest program has the potential to coordinate and integrate the policy issues. It can also use synergies with national programs on sustainability and rural development programs (although these are focused on agriculture).

However, sectoral innovation policy has its limits. Depending on the restrictions, that might, be related to an emphasis on competitiveness, the balance in the weights that is given to economic, ecological and social criteria is changing. Here complementary policies are needed. The geographical overlap of Sectoral Innovations Systems and Regional Innovations Systems might e.g. help to compensate for the pressure in one sector to reduce employment by supporting labour intensive service innovations by the RIS.

6.4 Organising Coordination and Integration

The participatory process in forestry to develop a national forest program (NFP)[2] can become a model to integrate sustainable development policy including innovation policy into sectoral policy. Integrating the development on innovation and research strategies for the sector would be an spill over effect of this process. The whole process can draw upon two main factors, (a) the existence of a working SIS and (b) the SFM concept including the reporting system for national SFM criteria and indicators (SFM-C&I). The SIS has the potential to operationalise an innovation strategy to foster SFM. The set of SFM C&I allows for the perception of the actual situation of SFM in the three dimensions of sustainability economic – ecological – social which can help to focus strategies. The strategies developed in a participatory process can draw upon the results of socio-economic research on innovation activities in the sector relating them to the SFM-C&I. This would allow to focus strategies based

[2] The incentive for starting the process is the need for a NFP to participate in rural development funding of the EU.

on institutional system knowledge and on the periodical national reporting system. At the same time such a design allows to evaluate the outcome of SIS activities vis a vis the relevant SFM criteria. The advantage of such a participatory process would lie in the coordination of actors in the SIS that has a potential to lead to SFM-innovation.

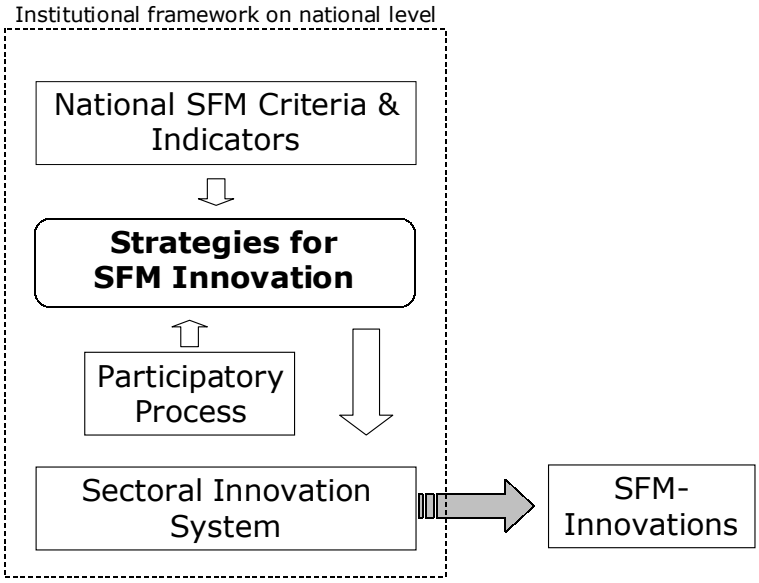

Figure 6: Framework to develop strategies for SFM innovation

Three aspect of the above described process for a sectoral innovation strategy that is based on sustainable development principles seem to be of importance for a blueprint of sustainable development innovation policy.

- Any strategy must be related to a set of sustainable development criteria and indicators that represents both natural and social systems in a way that is acceptable for all actors.

- A participatory process to develop innovation strategies has the potential to stimulate the institutional actors to actively form a SIS that can support sustainable development.

- The existence of a SIS can support innovation activity that can lead to sustainable development in its economic, ecological and social dimension, although emphasis will lie on the economic aspects.

Parallel to this sectoral approach to SFM innovation, a coordination with a Regional Innovation System seems to be necessary that would complement a SIS where necessary (e.g. by fostering innovations regarding the further development of bio-energy-products or recreational services). In this respect many questions remain open on how to coordinate and integrate innovation policies.

Bibliography:

Asheim B. and Isaksen A.(2001): Regional Innovation Systems: The Integration of Local 'Sticky' and Global 'Ubiquitous' Knowledge. *The Journal of Technology Transfer* 27(1): 77-86; Jan 2002

Carlowitz, H.C. (1713): Sylvicultura Oeconomica - Die Naturmäßige Anweisung zur Wilden Baum-Zucht, Leipzig.

Breschi S. and Malerba F. (1997): Sectoral Systems of Innovation in Edquist, Ch. (ed.): Systems of Innovation – Technologies, Institutions and Organisations; Cassell Academic, London, 1997

Edquist, Charles (2001): The System of Innovation Approach and Innovation Policy – Am account of the state of the art. Lead paper at the Neslon Winter Conference, DRUID, Aalborg, June 12-15, 2001. draft version of paper downloaded from http://www.druid.dk/conferences/nw/ on 10.02.2003

Edquist (ed.) (1997): Systems of Innovation – Technologies, Institutions and Organisations; Cassell Academic, London

Edquist, Charles; Hommen, Leif; McKelvy, Maureen (1998): Innovation and Employment in a Systems of Innovation Perspective. Project Report 4thFP-TSER, System of Innovation Research Program (SIRP), University of Linköping

European Communities (2001): Statistics on Innovation in Europe - Data for 1996 to 1997. Luxembourg

Johnson, Anna (2001): Functions in Innovation System Approaches: Paper at the Nelson Winter Conference, DRUID, Aalborg, June 12-15,2001, paper downloaded from http://www.druid.dk/conferences/nw/ on 10.02.2003

Kubeczko K. and Rametsteiner E. (2002): Innovation and Entrepreneurship – A New Topic for Forestry Related Research? EFI-INNOFORCE-Discussion Paper 1, published as IFSPE-Discussion Paper P/2002, Institute for Forest Sector Policy and Economics, University of Natural Resources and Life Sciences in Vienna. Paper available from http://www.efi-innoforce.org

Lundvall B-Å, Johnson B., Andersen E.S. and Dalum B. (2001): National systems of production, innovation and competence building. Paper at the Nelson Winter Conference, DRUID, Aalborg, June 12-15,2001, paper downloaded from http://www.druid.dk/conferences/nw/ on 10.02.2003

Lundvall B-Å. Ed. (1992): National Systems of Innovation – Towards a Theory of Innovation and Interactive Learning, Pinter Publishers, London

MCPFE (2000): Ministerial Conference on the Protection of Forests in Europe: General Declarations and Resolutions - Adopted at the Ministerial Conferences on the Protection of Forests in Europe - Strasbourg 1990 - Helsinki 1993 - Lisbon 1998; Liaison Unit Vienna, Vienna 2000

Moulaert F. and Sekia F. (2000): Innovative regions, social regions? An alternative view of regional innovation. paper downloaded from http://www.barlett.ucl.ac.uk/course/Go13/moulaert.htm on 21.05.2001

Segura-Bonilla, O. (1999), Sustainable Systems of Innovation: The Forest Sector in Central America, SUDESCA Research Papers No 24, PhD dissertation, Department of Business Studies, Aalborg University.