Social and technological innovations in forestry

This is an Accepted Manuscript of a book chapter

published by Routledge/CRC Press in "Forestry in the Midst of Global Change" on 7 December 2018,

available online: https://www.routledge.com/Forestry-in-the-Midst-of-Global-Changes/Farcy-Rojas-Briales-Arano/p/book/9780367570736 or https://www.taylorfrancis.com/books/9781315282374

Chapter 18. Social and technological innovations in forestry

Laura SECCO, Elena PISANI, Mauro MASIERO and Davide PETTENELLA

18.1 Introduction

In Europe, when referring to innovation in forestry, the dominant discourses mostly deal with technological innovation based on large-scale industrial investments. "Innovation is rather often used synonymously with technological innovation (Kubeczko et al. 2006:706)". This is supported by a biased (limited) interpretation of the bioeconomy strategies, where attention is almost completely focused on the development of bio-refineries, i.e. on innovative plants that produce power, heat, a potentially large set of bio-chemicals and in some cases pulp, normally using huge amounts of low-value biomasses from agriculture, forestry or organic wastes (McCormick and Kautto 2013; Scarlat et al. 2015; Fund et al. 2015.). Also in the case of plants producing just bio-energy, the needs for industrial scale economies are creating a demand for woody biomass that is frequently not covered by the potential local supply, so industrial plants are located in proximity to port facilities with a process of internationalization not only of the investment capital, but also wood procurement (Pülzl et al. 2017). Moreover, although it has been pointed out "the need to focus on innovation as a socially embedded phenomenon that should stretch across all economic sectors, [this concept] has mostly been applied in policy practice in high-tech fields, often with a technological focus or bias (EU 2003; von Tunzelmann and Acha 2003)", rather than in forestry (Rametsteiner and Weiss 2003: 692).

Other emerging and innovative initiatives, like for example the creation of nature-based businesses connected with the establishment of payment schemes for ecosystem (or environmental) services (PES) that try to obtain value from the management of public goods such as water, biodiversity, human wellbeing and others (e.g., Wunder 2005), are often not considered as strategic choices to be invested in for the development of national economies[1], despite their potential in rural development (e.g., by means of income generation and employment creation) and innovation[2] (Matilainen et al. 2011; Slee 2011; O'Driscoll et al. 2017; Tyrväinen et al. 2017). However, it was recently stressed that a new policy narrative is needed, that "should emphasise a sustainable and socially inclusive forest-based bioeconomy (Winkel 2017:153)", i.e. a holistic bioeconomy […] "that recognises and mobilises the entire spectrum of ecosystem services that Europe's forests can provide for the benefit of Europe's societies (Winkel 2017)".

This chapter introduces and discusses the various implications of social and technological innovation on the forestry sector, especially in Europe. In the first section, links are made with the various components of globalization. In the second, both approaches are presented based on commonly used definitions. In the third, the two approaches are illustrated by means of concrete examples, while their pros and cons (in terms of positive and negative consequences) are pointed out and briefly compared. In the fourth section, insights into how to integrate the two approaches are proposed and discussed in relation to the current perspectives of globalization and future development. The special role that information technologies can play in the two cases is highlighted.

18.2 Innovation and globalization

[1] Insights into these issues are provided in chapter 15
[2] Fostering knowledge transfer and innovation in agriculture, forestry and rural areas has been established as one of the six priorities for the rural development policy 2014–2020 (e.g., Aggestam et al. 2017).

Innovation is understood in this chapter in its common definition, i.e. “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organisation or external relations (OECD, 2005: 46)”. The concept has drastically evolved over the last 50 years. In the Sixties it was considered as the product of a discrete event uprising from isolated individuals that developed technical solutions to identified problems. Nowadays, it is considered as a process, involving different social actors, and based on a combination of tangible (physical, technological, financial) and intangible forms of capital (human, social). As suggested by Landry et al. (2002) this evolution depicts different features of the knowledge based innovation process: innovation is specifically a problem-solving process that occurs primary in firms and is based on the interactions of the organizations with the different actors of their environment. These interactions are based on formal and informal networks where different learning processes are taking places (learning by doing, learning by sharing, learning by using). Additionally, the learning processes involve the exchange of tacit and codified knowledge, and the interactive process among actors generate a system labelled in different ways (innovation system, *milieu innovateur*, innovation cluster). These general concepts - mainly deriving from economic and institutional theories - have been explored in relation to forestry by a specialized literature on innovation and policy-related issues (e.g., Rametsteiner and Weiss 2006; Ollonqvist et al. 2011; Weiss et al. 2011).

18.2.1 Globalization of markets, finance and economy

The dominance of technological innovation in the forestry sector, pushed by industry-oriented forest countries like the Nordic ones, has traditionally been driven by globalization of markets, finance and economy. On the one hand, concentrating production geographically, investing in technologies that increase the efficiency of wood harvesting and processing, and

improving the dimensions of companies - eventually creating clusters or networks of enterprises (both horizontally and vertically) is considered the best way[3] - not only in a capitalistic neo-liberal-oriented economic world - to improve the efficiency of the forest-biomass value chain and production process, reduce wastes, increase profits and profitability of investments (e.g. Weiss et al. 2011) and - more recently - contribute to EU member countries' 2020 energy goals.

Moreover, trans-national corporations are assuming a key role in dominating global finance and the economy, not always acting in a socially responsible and environmentally sustainable way (Chomsky 2016)[4]. Corporations and large companies investing in biomass and paper production, energy and forest plantations are no exception. Rather, they follow the same internationalisation trend that is criticized by social and environmental movements, blaming trans-national large-scale forestry corporations for causing environmental degradation, natural resources depletion and overexploitation, land grabbing, social conflicts and social exclusion (Fenton 2017).

18.2.2 Globalization of social and environmental problems

Indeed, although there can be various drivers or determining factors, in parallel with the globalization of markets, finance and economy, there is also a globalization of social and environmental problems. Together with the depletion and overexploitation, climate change pressures, social and political instability, unbalanced distribution of resources, new and larger migration flows, and conflicts will affect the forestry sector in the immediate and long-term future.

In this context social inclusion, social capital, social innovation are increasingly considered key intangible factors to guarantee successful and effective policy implementation and

[3] Even if recent trends show rather the emergence of regionalization processes (Winkel 2017) and cluster strategies (Rimmler et al. 2011).

[4] Insights into these issues are provided in chapter 17

business development in the field of rural development and agriculture (Pisani et al. 2017), but also in forestry. In the EU 2020 Strategy, social innovation is identified as a core element to promote smart, inclusive and sustainable growth in the region.

18.2.3 Globalization of information

A crucial role in supporting this development path can be provided by information technologies applied to forestry. Indeed, in parallel with the globalization of economy, forestry is today also influenced by the globalization of information, taking advantage of the advances in both forest- and non forest-specific information technologies. Forest information technologies are increasingly recognized as useful tools for remote sensing and monitoring at the forest management unit level (Watson and Dal Bosco 2014). Collecting data and sharing information can assist in monitoring phenomena that are globally relevant, such as for example forest fires, illegal logging or forest degradation. Depending on the target users and goals, data collected and information provided are used to support internal management decisions or communicated worldwide, as a marketing tool to increase the reputation of the company or country with respect to its commitments to sustainable forest management and timber supply from legal sources. Timely sharing of data and information through communication technologies can result in a reduction of information asymmetries. The use of these technologies is connected to an increasing demand[5] expressed by society for more responsible forest management, greater visibility of harvesting operations (via satellite images and GIS) and of forest degradation, improved tracking of raw materials associated to the need to monitor and stop illegalities. Information handling and spreading is also a political matter connected to advocacy responsible forest management and to getting the consensus and

[5] It was found that, despite increasing demand, the supply of these technologies and related software is still insufficient (Watson and Dal Bosco 2014).

support by politicians. The empowerment of environmental and social NGOs[6] based on just-in-time knowledge sharing is one of the consequences of the globalization of information, while companies can use information sharing and reporting to reduce risks of boycotts or conflicts.

It is also worth noting that information technologies, in general, provide new options for social networking and civil society involvement in forest policy making, as well as in citizens' science initiatives. A number of new apps have recently been created and launched to allow the pro-active participation of citizens in scientific data collection or field monitoring activities, also in forestry and related fields (e.g., biodiversity, urban forestry, pests and disease monitoring, monumental trees identification[7]). Social networks have proved to be effective tools in spreading information worldwide, thus raising the attention of the global community on a specific site or issue ("shame mobilization") and the support of international public opinion, and related coalitions, to protect specific forests, as proved by the recent case of the Białowieża forest in Poland (The Guardian, various articles in 2017). Several international organisations are based on strong networking for creating or consolidating their coalitions and/or lobbying capacities[8].

The globalization of information and related information technologies in forestry contribute nowadays, and will continue in the coming years, to shape future development of the forestry sector. In addition to their traditional applications in forestry, e.g. to facilitate the collection of data on large and remote forest areas, these instruments can play a key role in supporting innovative solutions for the development of forest-based local economies in rural areas, grounded on the creation of new small-scale social relationships, networks and civil society

[6] Examples of NGOs using reporting, mass media information and campaigning are the Environment Investigation Agency; Forests Monitor; Global Witness; World Wildlife Fund, Greenpeace, Friends of the Earth and many others.

[7] An example can be seen at URL: www.treezilla.org

[8] Examples are the World Conservation Union (IUCN); Forests and the European Union Resource Network (FERN); World Rainforest Movement; Taiga Rescue Network, and others.

engagement rather than on large-scale industrial technological investments. In other cases, data collected by researchers through sensor and positioning technologies associated to the use of social media from an emerging big data perspective, are used to measure the use of urban green infrastructures and the time-spatial distribution of urban park users, thus providing valuable information to support decision making (e.g., Chen et al. 2018). However, while recently it has been observed that the most important sources for forestry sector specific information are websites and blogs, together with professional publications and specialized media, conventional face-to-face contacts have been found to be the most important communication and marketing channel to promote services and products (Rametsteiner and Weiss 2006; Watson and Dal Bosco 2014). While public forest administrations, especially in Eastern European countries, plays a strong role, it was reported that "less than 10% of innovators considered information from government or private non-profit research institutes and from universities or other higher educational establishments as a very important source of information (Rametsteiner and Weiss 2006: 696)". Lastly, it is important to remember the extremely high power of social media and dominant discourses in driving public opinion and politicians, and the potential negative consequences (e.g., dramatic oversimplifications, misinterpretations, fuzzy topics of discussion) of any debate that might be related to important forestry issues (e.g. a national forest reform) based mainly on an improper and/or violent use of Facebook posts, Twitter tweets, and other media that can host "hate speeches". Social media are recognised as not always being effective tools for promoting constructive dialogue and building reciprocal trust (Hakansson and Witmer 2015). These considerations suggest the idea that technological tools alone cannot completely replace social processes, but also that social processes can become drivers of a new (or rediscovered) role of forests for the benefit of the whole society.

18.3 Technological and social innovations: what are they?

18.3.1 Technological innovation

The concept of technological innovation is primarily grounded on business and business consulting contexts. It was defined as a non-trivial change in products and processes where there are no previous experiences (Nelson and Winter 1977, as cit. in Rametsteiner and Weiss 2006), and it is commonly applied at an enterprise or company level. This definition seems to encompass both product innovation and process innovation (OECD 2005)[9]. According to the interpretation of Kubezko et al. (2006), technological innovation is a sub-category of process innovation. Indeed, in forestry, technological advancements are traditionally connected to the mechanisation of wood harvesting and wood processing processes (e.g., the use of new technical equipment and machines in manufacturing/treating wood). However, technological advancements regard products too, with the manufacturing and commercialisation of engineered new wooden-based products (e.g. nanocelluloses from wood waste). As noted by previous research[10], innovation policies mainly supported diffusion of new technologies in timber production and processing.

As mentioned, one of the dominant areas for technological innovation investments is currently the bio-based economy, in particular biorefineries. Biorefineries are "increasingly at the core of the bioeconomy vision at the EU level and worldwide (Sauvée and Viaggi 2016)", while the development of a biorefinery system is "a key factor in the transition to a bio-based economy (Scarlat et al. 2015)". According to 2017 data collected by the Nova Institute on behalf of the Bio-based Industries Consortium (BIC), 224 biorefineries[11] have been identified and mapped across Europe (21 countries). However, several other biorefineries are currently

[9] Other types of innovation, i.e. marketing innovation, organizational innovation (OECD 2005) and institutional innovation (Weiss et al. 2010) are not in the scope of this Chapter.

[10] Particularly relevant have been the EFI Project Center INNOFORCE "Towards a Sustainable Forest Sector in Europe: Fostering Innovation and Entrepreneurship" (2004-2008) and the COST Action E51 "Integrating Innovation and Development Policies for the Forest Sector" (2006-2010).

[11] Most biorefineries in Europe are oil-/fat-based (53% of total), mainly producing biodiesel or oleochemicals. Sugar-/starch-based bio-refineries are also relevant (28%) and mainly produce bioethanol but also products for use in food or feed or biochemicals (Nova Institute 2017).

planned and/or under construction and the list of those existing is probably not exhaustive. Within this framework, biorefineries are defined as integrated production plants using biomass or biomass-derived feedstocks to produce a range of value-added products and energy. Wood-based biorefineries (not including facilities for production of pulp just for paper) correspond to 25 plants, i.e. about 12% of the total. Roughly 60% of these are concentrated in Finland (33%) and Sweden (25%), while the contribution of Southern European countries is limited: Italy, France and Portugal together total just 4 plants. Countries with the larger investments are also amongst those where forest sector provides a high contribution to the national Gross Domestic Production (GDP) (Figure 18.1).

<place figure 18.1 here>

Wood-based biorefineries mainly produce pulp, tall oil, specialty cellulose, bioethanol and energy. Figure 18.2 reports the geographical location of wood-based biorefineries in Europe in 2017.

<place figure 18.2 here>

18.3.2 Social innovation

The concept of *social innovation* is an emerging one, especially in its application to the field of forestry. Its main initial focus was to address social disadvantage and exclusion in a wide range of contexts, more often urban than rural (Moulaert et al. 2005; MacCallum et al. 2009). Social innovation provides a renovated role to "society", being considered - at a time of major budgetary constraints - an effective way of responding to social challenges by mobilising people's creativity, promoting an innovative and learning society and creating the social dynamics behind technological innovations (BEPA 2011: 7). So far, a few scholars have proposed how to interpret the concept in the rural arena (Neumeier 2012). Bosworth et al. (2016) identified the key elements of social innovation in the case of the EU LEADER

programme by using the Schumpeterian approach and framework to analyse innovation (Schumpeter 1934)[12]. Bock et al. (2016) worked more on theoretical conceptualisation.

One recent proposal that draws from a wealth of research and work in a variety of fields, including economics, sociology, ecology and political sciences, and that tries to integrate the previously existing approaches while focusing on rural areas, is suggested by Polman et al. (2017)[13]: "the reconfiguring of social practices, in response to societal challenges, which seeks to enhance outcomes on societal well-being and necessarily includes the engagement of civil society actors". A catalogue of 50 examples of social innovation, which have been identified according to this definition within the fields of agriculture, forestry and rural development in marginalized rural areas in EU and extra-EU Mediterranean countries (Price et al. 2016), has been compiled and published online by the SIMRA project[14]. The catalogue is neither fixed nor comprehensive. Rather, it provides an initial overview on how wide the variety of social innovation cases can be, already implemented in practice, although a commonly accepted definition and theoretical conceptualisation are still under construction and specific policy instruments are still lacking.

Social innovation in forestry is probably more widespread than reported so far by the scientific literature, as the concept refers *de facto* to a wide range of initiatives dealing with different societal challenges: from the new social uses of forests (e.g., "forest bathing" for the disabled, elderly people or children), to the creation of new public-private partnerships to produce, transform and commercialise new types of wild forest products (e.g., insects), the inclusion of migrants/refugees in forest management activities as a means for social and multi-cultural integration, and others. While a number of social innovation examples are

[12] The contribution of LEADER+ to the implementation of innovative forest-related projects was explored by Feliciano et al. 2011.

[13] Specifically, innovation theory, endogenous and neo-endogenous development, social capital, socio-ecological systems, regional development and social enterprises and entrepreneurship are considered prominent precursors to social innovation in marginalised rural areas (see Kluvánková et al. 2017; Polman et al. 2017; Slee et al. submitted).

[14] More information about the EU-funded Horizon 2020 project SIMRA (Social Innovation in Marginalized Rural Areas) that is at the basis of this definition is available at: www.simra-h2020.

likely to exist in Europe and other regions, it seems that data and information are so far available only as spots or case studies, not having yet been systematized or collected in a structured way. Recently, Rogelja et al. (2018) note that so far EU policies have emphasized market-economic features of social innovation, such as efficiency and effectiveness of social investment and budgeting, consequently prioritizing social business over social movements (European Commission 2013; Jenson 2017; Moulaert et al. 2017) and undermining the relevance of the broader socio-political context for the development of bottom-up initiatives (Demming 2016; Moulaert et al. 2017).

18.4 The technological vs. social approach: pros and cons.

The technological approach is typically based on a one-way, top-down process of innovation, where the knowledge is created by one actor (and intellectual property is strictly protected by means of patents). The social approach is likely based on inter-sectoral network-based interactions, where the knowledge is shared and emerges from a more collaborative learning process. While the first approach is linked to the "linear concepts of innovation, […] [which] continue to be widely applied in research, business and business consulting contexts, especially in a firm level context (Rametsteiner and Weiss 2006: 692)", the latter is connected with "innovation systems", conceptualized as "a complex non-linear process" involving a range of actors and institutions, which do not necessarily belong to the same sector, interact each other and contribute to the development and diffusion of innovations in forestry (Rametsteiner and Weiss 2006: 693). Figure 18.3 visually represents the two approaches. Both have pros and cons, positive and negative consequences on various aspects.

<place figure 18.3 here>

While it is clear that there are positive consequences of investing in industrial plants technology advancements from an economic point of view in terms of corporations'

efficiency and profitability, the adoption of a strategy of development based only or predominantly on industrial technological innovation has several limits, and often an unbalanced distribution of costs and benefits for the local rural communities with an high number of small forest ownerships. Table 18.1 compares the two approaches, obviously simplifying and taking the issues under discussion to the extreme.

<place table 18.1 here>

First of all, any concentration of industries and corporations leads to concentration of power (on the market, but also - through powerful industrial lobbies - on politicians and thus on decisions taken). The increasing international flows of raw materials, and growing competitive advantages by highly efficient-large-scale forest industries determine a progressive marginalization or exclusion from the international timber market of less specialized countries such as Southern EU countries, with the marginalisation of the forestry sector in the national economy and disconnection of national timber industries from domestic sources. One consequence, also having other drivers such as urbanization (see chapter 9), is forestland abandonment (e.g. in Italy). An increasing level of mechanization/automatic wood-processing processes can lead to a reduction of labour, sometimes having as a consequence less demand for low qualified forestry workers. The focus of national bio-economy strategies mainly on timber and paper/pulp production is an indicator of the limited interest or inappropriate recognition of the importance of other forest functions, products and services, such as non-market ecosystem services (Pülzl et al. 2017). Large-scale investments are typically needed (see the two examples in Box 18.1) but only large-scale investors and transnational corporations have the financial resources to support these investments, often with a high share of contribution by public funds. It has been found that the larger forest

holdings have a higher level of innovative activity with respect to smaller forest holdings[15] (Rametsteiner and Weiss 2006). Governments often participate by co-funding large private investments, with the justification that they will have positive impacts on the national Gross Domestic Product (GDP) and will contribute to reaching the national commitments on renewable energy and emissions reduction. These are excellent justifications from an industrial point of view at national level, and might be proper drivers of policy making and investments in those countries where forests contribute significantly to the national GDPs with their products and processes.

<place box 18.1 here>

However, public co-financing large scale, single plant investments raises the problem of equity in cost-benefit distribution, these industrial investments having less positive impacts on local development of rural communities than those that would derive from more widespread small-scale investments involving larger numbers of forest managers and small-scale enterprises. According to the Forest-based Sector Technology Platform (FTP), the current R&D investments in Europe reach an amount of 2.5 billion € in total, with the total public funding contributing with 1.7 billion € (68% of total). However, R&D is focused mainly on technical problems, creation of new licenses and a linear top-down approach to innovation, not always able to grasp the social aspects (e.g., potentially excluding workers who are not highly qualified, latent social conflicts and protests against the industrial plant that can create potential risks for the reputation of companies and investors). The implementation of the Strategic Research and Innovation Agenda 2020 (SRA), released in 2006 and revised in 2013, resulted in the launch of more than 230 research projects relevant for the European forest-based sector and an amount of over € 1 billion of EU funding (FTP 2017). The SRA introduces 19 Research and Innovation Areas (RIAs) identified as key to unlocking the

[15] In particular, in the Central European countries, "the percentage of innovative forest holdings larger than 500 ha is at least 4 times higher than that of forest holdings with properties smaller than 500 ha (Rametsteiner and Weiss 2006: 695)".

potential of the forest-based sector and ensuring its future competitiveness. However, looking at the list of RIAs titles, the orientation appears clear: 12 out of 19 RIAs are mainly technologically-oriented (e.g. Enhanced biomass production, Secured wood supply, forest operations and logistics, Cascade use, reuse and recyclying systems, Resource efficiency in manufacturing, Biorefinery concepts, New biobased products, Intelligent packaging solutions, etc.), only 3 out of 19 are mainly socially-oriented (e.g., Citizen's perception of the sector, Policies and good governance, New business models and service concepts), while 4 out of 19 can be considered as mixed (e.g., Multi-purpose management of forests, Forest ecology and ecosystem services).

The traditional technological innovation obviously includes investments in information and communication technologies, which play a fundamental role in collecting, processing and analysing large amounts of technical data to support and monitor the internal industrial processes; tracking (Tzoulis and Andreopoulou 2013) and organising the distribution of products and in general solving logistic issues; marketing and managing relations with satellite activities, suppliers and clients; managing internal and external communication. But innovative information technologies (e.g., GPS-devices, drones) (see Figure 18.4) and software are also increasingly needed for remote sensing control of large-scale forest and plantation areas, to create large datasets or improve the quality of data for internal uses, to update forest inventory by limiting costs and other applications. Data collected by means of these technologies are often sensitive, owned privately by the company, and used for internal managerial purposes. However, they can also be (and are) used for periodic reporting and marketing, providing evidence on the achievements of the company in terms of sustainable

forest management, increasing transparency[16], and contributing to raise public awareness about forestry and forest-resources management issues.

<place here figure 18.4>

In our opinion, while the traditional technological approach seems to have really good opportunities in well-connected and industrially developed areas, e.g. coastal areas in Scandinavian or Nordic countries, there are limited chances for the remote mountain regions, especially those located in the Southern (Mediterranean) countries in Europe to be competitive in the mass products market based on the large-scale use of wood for industrial purposes; this is the case, for example, of the bio-fuel production supported by the bioeconomy strategies that have recently been launched by the EU (Pülzl et al. 2017). The social approach, whose efficiency should be highlighted by its integration in a strategic landuse planning and development scheme at regional level, might be more effective than the vertical approach in supporting job expansion and in taking advantage of the diversified forest resources available at small scale in remote rural areas. These areas (e.g., Alentejo, Catalonia, Provence, Trentino, Tuscany, Istria) are often characterized by small-scale multifunctional forest activities, considered essential elements of a diversified rural development, timber being just one of the several territorial ecosystem services that can be delivered by forest management (e.g., Vuletić et al. 2010; Slee 2011; Gatto et al. 2014; Tyrväinen et al. 2017). Moreover, the social innovation approach is increasing frequently adopted by the urban greening movements, in urban forestry and in new social uses of urban green areas (e.g. green care initiatives, urban gardening, urban social horticulture, etc.) (Schicklinski 2017) (see examples in Box 18.2).

Unfortunately, the social approach has had a too limited political visibility for many reasons:

[16] Outside Europe, an interesting case is the use of remote sensing control instruments by monitoring organisations in charge of keeping very large forest areas and a high number of companies under control, like in the case of the Cameroonian government initiative to contrast illegal logging (Verhegghen et al. 2016).

- This sector of the economy is a constellation of niche markets: diversification is the key-element but often it is difficult to reach a critical mass of products-services to satisfy the potential consumers; the market organization is complex and fragmented (cross-sectorial and interlinked products and services);
- Also for these reasons, only a few statistical data are available;
- Social capital (i.e. trust, relations and other typical elements of social innovation) is far from being main component of the dominant R&D culture;
- Products and services should be promoted with strong investments in technical assistance and communication innovation services, exactly the opposite of what is happening in many Mediterranean countries where these services are the first to be exposed to budget cuts, or where the initiatives are too small for enough funds and resources being allocated to special forest information and communication technologies (despite recognition of their potential usefulness).

< place box 18.2 here>

18.5 Possible interactions between technological and social innovations

Even if we argue that the technological approach is predominant in the Nordic and Central European countries and the social one is promising and emerging in the South and Mediterranean area, the two approaches are obviously interlinked. They do not necessarily exclude one another, and they co-exist *de facto* in many countries (e.g., in a Scandinavian wood-industry-oriented country like Finland there are examples of social forestry; UK is one country with both the approaches very well developed; the large number of examples of social innovations in Italy does not mean that investments in technological innovations with the creation of medium-scale industrial plants producing innovative bio-chemicals is not possible[17], or increase the efficiency of wood-harvesting and processing is not useful). If properly coordinated, both approaches can contribute to support an "inclusive, smart and

[17] See for example the the Chimica Verde associated members at the URL: www.chimicaverde.it

sustainable growth" as required by the Europe 2020 strategy and the new Sustainable Development Goals. The two approaches, and their reciprocal interactions in dealing with regional or global socio-economic challenges, are outlined in Figure 18.7.

<place figure 18.7 here>

On the one hand, technological innovations (in their Schumpeterian meaning of product innovation, market innovation, etc.) are typically designed to be applied in a single company, or group of companies, to obtain profits directly benefitting investors and industrial owners (and only indirectly benefitting the local communities by means of employment opportunities or provision of funds to support social events - as a compensation for their environmental impacts). Technological innovation is typically oriented towards tangible outputs, such as new products (e.g., nanocellulose-based fibres and hydrogels used to rebuild human bodyparts - see for example Syverud 2017), that used by company's clients and/or final consumers bring positive outcomes on the whole society (e.g., re-constructed bodyparts, medical applications). On the other hand, social innovations are specifically designed to seek to determine positive social benefits, i.e. broader benefits on human wellbeing that influences the quality of life of various members of the local community but also other people and networks. As outcomes, social innovation might have an increased capacity of collaborating, or the improvement of other human or social capacities, that in a long term perspective bring positive impacts on the community. While we observe that technological and other innovations are qualitatively different than social innovation, given the social intended goals of the latter and the non-material nature of the innovation, we also recognise that technological innovation can lead to social innovation (Neumeier 2012; Cajaiba-Santana 2014). The overlapping areas in Figure 18.7, both in the process and in the outcome boxes, represent the potential reciprocity in supporting each other. Outputs from technological and social innovation can both contribute to the impacts on the society. However, this is an oversimplification of the various possible

interactions: we can also find examples of social innovation internally to a firm, designed for solving personal attitudes and behaviours of firms' employees and co-workers when they impede the firm's innovation project implementation (Rametsteiner and Weiss 2006). Or, vice versa, we can find examples of technological innovations (e.g., creation of high-tech products and applications) used in social-oriented and network-based innovation projects.

More recently, there has also been increasing interest in social innovation from the point of view of investors, not necessarily at local scale. In fact, the financial sector of the so-called impact investing[18] is looking at social innovation as a core field of action. However, even if social innovation is, in principle, designed to have positive impacts on society, trade-offs are often unavoidable: while some people will be positively affected, others will be negatively (Kluvánková et al. 2017; Slee et al. forthcoming).

Such integration is not easily realized in practice. If we start from a technological-based approach and want to integrate it with social issues, several challenges have to be considered:

- Ethical values, with respect to both the community where the raw material is exploited and the community where the industrial activity is carried out;
- Efficiency vs. participation dilemma, well-known and old but still valid;
- Social inclusion of more vulnerable and disadvantaged groups, such as newcomers, disabled people, unqualified youth. The question here is whether this perspective is possible or should rather - more realistically - be considered as a "mission impossible", the involvement of disadvantaged groups being a cost and an organisational challenge for large-scale industry-oriented investments that seek to increase efficiency and profitability.

[18] Impact investing is a type of investing (that can be made in or by companies, organizations and funds) that aims to generate a measurable, beneficial social or environmental impact alongside a financial return. This emerging finance sector was initially developed by the intervention and pioneer applications of some institutional investors (e.g., European development finance institutions)

If we start from a social-oriented approach and want to integrate it with technological advancements, different challenges have to be considered, none less relevant:

- Investments in social-oriented R&D are obviously needed, probably with the involvement of private sponsorships;
- Scaling-up, out-scaling and replicability is an issue, as social innovation is often local-specific and happens at local level (Secco et al. 2017);
- There is undoubtedly a potential for an improved role of citizens' science, but this needs to be regulated and have more investments to make it possible and workable in practice (by means of coordination, open platforms for collecting, cleaning and interpreting data, Apps);
- Social exclusion issues risk arising when innovation projects refer to groups of people and/or areas that are less developed or advanced in technologies and in particular information technologies.

One option is to try to support their interconnection and integration by spreading or reinforcing the use of information and communication technologies, both specific to forestry and not. On the one hand, involving people in a technological innovation process will increase the capacity of industrial-oriented investments in the more advanced industrial countries and businesses to be legitimated and supported. On the other, linking small-scale and fragmented socially-oriented initiatives in larger networks, for example through a smart use of social networks and the media, will give them higher visibility and recognition by policy makers, as well as more capacity to create a critical mass able to influence future development paths. As previously mentioned, integration of the two approaches can both be useful to support growth of the European economy and society and a more inclusive and sustainable development of forestry.

Large-scale technological investments often involve stakeholders only for consultation on very general issues (e.g. environmental impacts of industrial activities), and stakeholders do not always have a real capacity to influence decision making at the higher jurisdictional levels. In the technological approach, science-expert based knowledge is predominant over non-expert-based and local knowledge (thus missing a lot of potentially valuable information). The potential role of citizens' science is underestimated and there are risks of new asymmetry of information. However, several examples exist of very successful small-scale (social) innovations in forestry that do or can have positive impacts. They are progressively increasing, with a growing involvement of the public, not just of stakeholders (Kleinschmit et al. 2018), also in funding innovative solutions to support local investments (e.g., crowdfunding). Some examples found in Italy are given in Box 18.3.

<place box 18.3 here>

To summarise, we think that the main reason for technological innovation dominating the discourses and policy choices so far is that they are able to obtain high visibility, as large-scale projects often with significant co-funding from public resources, and derive from power concentrations, so are becoming well-known examples worldwide of technological progress in general terms - even if social and environmental costs are often disregarded. On the one hand, in most cases confidential information (e.g., business-finance models, licenses for special technological solutions of product processing, profits and their distribution along the value chains) are not open and publicly accessible, i.e. shared with public opinion. On the other, examples of social innovation have a very limited visibility (if any), small-scale projects are often acting in isolation/individually (apart from a few examples like the Model Forest Networks), they are *de facto* a large number of micro- or medium-scale examples barely interconnected to each other. In the EU, industrial interests are much more politically

relevant than the interests and political strength of private forest owners-managers (small, weak and poorly represented) and, when forest owners' interests are represented, as in the case of the Confederation of European Forest Owners (CEPF), the large and industrial-oriented landowners from the Nordic countries play a major role, because of their critical mass and recognised key role in national economies.

Clearly, there is a need to increase the capacity to use the information and communication technology to consolidate, enlarge networks and let the fragmented small-scale examples become more visible to the public and also more influential. However, in this case, it must be clear that technology is not enough, if intangible factors like reciprocal trust, willingness to collaborate and share information and/or organizational innovations such as new types of public-private agreements and re-negotiation of forest ownership rights are lacking.

18.6 Conclusions

So far, technological approach is largely predominant in implementing a bioeconomy development strategy in Europe while very limited attention and investments in R&D are linked with the social dimension of future alternative models of economic development. However, several examples of the social innovation approach do already exist in forestry in those countries with fewer industrial investments. These investments are more relevant in terms of provision of ecosystem services like wellbeing, recreation and health rather than biomass production. Quite obviously, a possible reasonable and feasible path is to pursue integration of these two approaches, rather than think of them as alternative mutually exclusive solutions.

However, such an integration is not easy to realize in practice. Two different development paths and innovation models should probably be chosen, depending on the area, cluster and

region's prevailing characteristics. Indeed, this is what can be observed taking place in practice.

In those areas with rich forest resources, high industrial investment capacity and interest and good logistical connections, the path should be to continue to pursue technological innovation models. Technologies (new materials and new industrial processes, forest information technologies, etc.) will remain the most important instruments for industrial advancement, but transnational and large-scale industrial corporations should integrate them with social issues, finding a way to introduce mechanisms of equity, social inclusion, stakeholders involvement, social and environmental responsibility reporting. This will help wood-based companies to create more consensus, increase their reputation, reduce the risk of conflicts and potential international campaigns against their business goals, and thus increase their attractiveness to new investors searching for "impact investments".

In those areas with rich forest resources and limited industrial investment capacity and interest, and/or with limited connections (i.e. with higher logistical costs), or in those areas with poor forest resources, it would seem better to pursue social innovation models based on local endogenous resources, small-medium scale enterprises and networks, social capital (trust, shared social values and norms, traditional knowledge), civic society engagement and willingness to be part of the change. They are likely to have more positive and significant impacts on the resilience and productive capacity of forestry based on local communities and economies. Here technology can be seen as an operational instrument for consolidating social relationships (e.g. social networks for social capital building, social cooperatives based on a short value chain able to commercialize their high-quality products worldwide via the web/online shops, social science to increase the knowledge and awareness of non-experts, public opinion about the importance of forest resources for human well-being). This approach

also seems to be valid in supporting the path towards increasing interest in urban forestry and urban greening.

In both approaches, powerful and useful instruments can be information and communication technologies, in their current trend of globalization. However, the social processes and direct social relations are (and will remain, or will return to being) the glue of forestry societies at local level in both rural and urban areas.

References

Aggestam, F., Pulzl, H., Sotirov, M. and G. Winkel. 2017. The EU Policy Framework. In What Science Can Tell Us Series 8, Towards a sustainable European forest-based bioeconomy – assessment and the way forward, ed. G. Winkel, 19-35. Joensuu: European Forest Institute.

BEPA. 2011. Empowering people, driving change: Social innovation in the European Union. Brussels: European Commission.

Bock, B. 2016. Rural Marginalisation and the Role of Social Innovation: a Turn Towards Nexogenous Development and Rural Reconnection, Sociologia Ruralis 56(4):552-573.

Bosworth, G., Rizzo, F., Marquardt, D., Strijker, D., Haartsen, T. and A. Aagaard Thuesen. 2016. Identifying social innovations in European local rural development initiatives. The European Journal of Social Science Research 29(4):442-461.

Demming, K. 2016. Making Space for Social Innovation: What we can learn from the midwifery movement. Ontario Institute for Studies in Education of the University of Toronto.

Cajaiba-Santana, G. 2014. Social innovation: Moving the field forward. A conceptual framework. Technological Forecasting and Social Change 82:42-51.

Chen, Y., Liu, X., Gao, W., Yu Wang, R., Li, Y. and W. Tu. 2018. Emerging social media data on measuring urban park use. Urban Forestry and Urban Greening 31:130-141.

European Commission. 2013. Guide to Social Innovation. Brussels: European Commission.

EU. 2003. Innovation Policy: Updating the Union's Approach in the Context of the Lisbon Strategy. COM(2003) 112 final.

Feliciano, D., Slee, B., Weiss, G., Matilainen, A. and T. Rimmler. 2011. The contribution of Leader+ to the implementation of innovative forest-related projects. In Innovation in Forestry: territorial and value chains approaches, eds. Weiss, G., Pettenella, D., Ollonqvist, P. and B. Slee, 87-100. London: CAB International.

Fenton, E. 2017. Snake oil or climate cure: The effect of public funding on European bioenergy. FERB Bioenergy and forests Briefing Note 2. http://fern.org/sites/default/files/news-pdf/snake%20oil%20or%20climate%20cure.pdf (Accessed March 26, 2018).

Forest Europe. 2015. State of Europe's Forests 2015.

FTP. 2017. Forest-based Sector Technology Platform. Database and Strategic Research and Innovation Agenda 2020. http://new-www.forestplatform.org/#!/pages/6 (Accessed March 26, 2018).

Fund, C., El-Chichakli, B., Patermann, C. and P. Diechoff. 2015. Bioeconomy Policy (Part II). Synopsis of National Strategies around the World. Berlin: Office of the Bioeconomy Council.

Gatto, P., Vidale, E., Secco, L., and D. Pettenella. 2014. Exploring the willingness to pay for forest ecosystem services by residents of the Veneto Region. Bio-based and Applied Economics 3(1):21-43.

Hakansson, P. and H. Witmer. 2015. Social Media and Trust - A Systematic Literature Review. Journal of Business and Economics 6(3):517-524.

Illuminati, R. 2015. Innovazione in agricoltura e capital sociale. Impatto della Misura 1.2.4 del PSR 2007-2013 in Umbria. MSc Thesis, University of Perugia.

Jenson, J. 2017. Modernising the European Social Paradigm: Social Investments and Social Entrepreneurs. Journal Soc. Pol. 46:31-47.

Kleinschmit, D., Pülzl, H., Secco, L. Arnaud, S. and I. Wallin. (in press). Orchestrating in political processes: involvement of experts, citizens, and participatory professionals in forest policy making. Forest Policy and Economics. https://doi.org/10.1016/j.forpol.2017.12.011.

Kluvánková, T., Gežik, V., Špaček, M. et al. 2017. Transdisciplinary understanding of SI in MRAs, Deliverable 2.2, Social Innovation in Marginalised Rural Areas (SIMRA).

Kubeczko, K., Ramesteiner, E. and G. Weiss. 2006. The role of sectoral and regional innovation systems in supporting innovations in forestry. Forest Policy and Economics 8:704-715.

MacCallum, D., Moulaert, F., Hillier, J. and S. V. Haddock. 2009. Social innovation and territorial development. Ashgate: Farnham.

Matilainen, A., Weiss, G., Sarvašová, Z., Feliciano, D., Nastase, C., and M. Prede. 2011. The role of cooperation in enhancing innovation in nature-based tourism services. In Innovation in Forestry: territorial and value chains approaches, eds. Weiss, G., Pettenella, D., Ollonqvist, P. and B. Slee, 169-188. London: CAB International.

McCormick, K. and N. Kautto. 2013. The Bioeconomy in Europe: An Overview, Sustainability 5:2589-2608.

Moulaert, F., Martinelli, F., Swyngedouw, E., and S. González. 2005. Towards alternative model(s) of local innovation. Urban Studies 42(11):1969-1990.

Moulaert, F., Mehmood, A., MacCallum, D. and B. Leubolt. 2017. Social Innovation as a Trigger for Transformations - The Role of Research. Luxembourg: Publications Office of the European Union.

Neumeier, S. 2012. Why do Social Innovations in Rural Development Matter and should they be Considered More Seriously in Rural Development Research? - Proposal for a Stronger Focus on Social Innovations in Rural Development Research. Sociologia Ruralis 52:148-169.

Nova-Institut GmbH and Bio-based Industries Consortium 2017. Biorefineries in Europe 2017. http://news.bio-based.eu/map-of-224-european-biorefineries-published-by-bic-and-nova-institute/ and http://biconsortium.eu/sites/biconsortium.eu/files/downloads/MappingBiorefineriesAppendix_171219.pdf (Accessed March 26, 2018).

O'Driscoll, C., Leonardi, A. and M. Masiero. 2017. Are Nature-based Businesses Really Innovative? An assessment of European entrepreneurial initiatives. Report by ECOSTAR Natural Talents, EU Erasmus+ project. http://www.ecostarhub.com/wp-content/uploads/2017/05/ECOSTAR_WP3_Innovation-Report-2017-1.pdf (Accessed March 26, 2018).

OECD. 2005. OSLO Manual: Guidelines for Collecting and Interpreting Innovation Data. 3rd Edition. Paris: OECD Publishing.

Ollonqvist, P., Nord, T., Pirc, A. et al. 2011. Networks and local milieu as a furniture industry innovation platform. In Innovation in Forestry: territorial and value chains approaches, eds. Weiss, G., Pettenella, D., Ollonqvist, P. and B. Slee, 233-253. London: CAB International.

Pisani, E., Franceschetti, G., Secco, L. and A. Christoforou, A. 2017. Social Capital and Local Development: From Theory to Empirics. Palgrave Macmillan.

Polman, N., Slee, W., Kluvánková, T. et al. 2017. Classification of Social Innovations for Marginalized Rural Areas, Deliverable 2.1, Social Innovation in Marginalised Rural Areas (SIMRA).

Pülzl, H., Giurca, A., Kleinshmit, D. et al., 2017. The role of forests in bioeconomy strategies at the domestic and EU level. In Towards a sustainable European forest-based bioeconomy - assessment and the way forward, ed. Winkel, G., 36-51. Joensuu: European Forest Institute.

Rametsteiner, E. and G. Weiss. 2006. Innovation and innovation policy in forestry: Linking innovation process with systems models. Forest Policy and Economics 8:691-703.

Rimmler, T., Coppock, R., Oberwimmer, R., Pirc, A., Posavec, S. and G. Weiss 2011. How to Support Firm Competitiveness in Timber Industries? Clusters as Policy Means in Four European Countries. In Innovation in Forestry: territorial and value chains approaches, eds. Weiss G, Pettenella, D., Ollonqvist, P. and B. Slee, 101-113. London: CAB International.

Rogelja, T., Ludvig, A., Weiss, G. and L. Secco. 2018. Implications of policy framework conditions for the development of forestry-based social innovation initiatives in Slovenia. Paper presented at the 2nd International Forest Policy Meeting.

Secco, L., Pisani, E., Burlando, C. et al. 2017. Set of methods to assess SI implications at different levels: instructions for WPs 5 and 6. Deliverable D4.2, Social Innovation in Marginalized Rural Areas Project (SIMRA), Demonstrator to the European Commission.

Slee, B. 2011. Innovation in Forest-related Territorial Goods and Services: an Introduction. In Innovation in Forestry: territorial and value chains approaches, eds. Weiss, G., Pettenella, D., Ollonqvist and B. Slee, 118-130. London: CAB International.

Slee, B., Burlando, C., Nijnik, M., Pisani, E., Polman, N. and L. Secco, L. forthcoming. Social innovation: searching for a workable definition and conceptual clarity. Local environment.

Sauvée, L. and D. Viaggi. 2016. Biorefineries in the bio-based economy: opportunities and challenges for economic research. Bio-based and Applied Economics 5(1):1-4.

Scarlat, N., Dallemand, J., Monforti-Ferrario, F. and V. Nita. 2015. The role of biomass and bioenergy in a future bioeconomy: Policies and facts. Environmental Development 15:3-34.

Schumpeter, J. 1934. The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle. Harvard Economic Studies, vol. 46. Cambridge: Harvard College.

Schicklinski, J. 2017. The Governance of Urban Green Spaces in the EU. Social innovation and civil society. Oxford: Routledge.

Syverud, K. 2017. Building Human Bodyparts From Wood: Innovative Use of Nanocellulose. Paper presented at the EFI 2017 Annual conference Seminar.

Tyrväinen, L., Plieninger, T. and G. Sanesi. 2017. How does the forest-based bioeconomy relate to amenity values? In Towards a sustainable European forest-based bioeconomy – assessment and the way forward, ed. Winkel, G., 92-100. Joensuu: European Forest Institute.

The Guardian, 2017, EU court orders Poland to stop logging in Białowieża forest. Various articles: https://www.theguardian.com/environment/2017/jul/28/eu-court-orders-poland-to-stop-logging-in-bialowieza-forest (Accessed March 26, 2018).

Tzoulis, I. and Z. Andreopoulou. 2013. Emerging Traceability Technologies as a Tool for Quality Wood Trade. Procedia Technology 8:606-611.

Verhegghen, A., Hugh E., Desclée, B. and F. Achard. 2016. Review and combination of recent remote sensing based products for forest cover change assessments in Cameroon. International Forestry Review 18(2):2016-2017.

von Tunzelmann, N. and V. Acha. 2003. Innovation in 'low-tech' industries. TEARI Working Paper no. 15. Oslo: University of Oslo.

Vuletić, D., Posavec, S., Krajter, S. and E. Paladinić. 2010. Payments for environmental services (PES) in Croatia - public and professional perception and needs for adaptation. South-East European forestry 1(2):61-66.

Watson, A. and G. Dal Bosco. 2014. Use of Forest Information Technologies & Marketing of Forestry Services and Products. Bonn: OpenForests.

Weiss, G., Ollonqvist, P. and B. Slee. 2011. Innovation in Forestry: territorial and value chains approaches. London: CAB International.

Winkel, G. 2017. What Science Can Tell Us Series 8, Towards a sustainable European forest-based bioeconomy – assessment and the way forward. Joensuu: European Forest Institute.

Wunder, S. 2005. Payments for environmental services: Some nuts and bolts. CIFOR Occasional Paper 42. Bogor: CIFOR.

Figure legend

Figure 18.1. Contribution of the forest sector to the GDP in selected countries - % of the GDP 2010 (Source: Forest Europe 2015)

Figure 18.2. Map of wood-based biorefineries in Europe in 2017 (Source: Adapted from nova-Institut GmbH and Bio-based Industries Consortium, 2017)

Figure 18.3. Two models of innovation (Source: Adapted from Illuminati, 2015)

Figure 18.4. Drones used to collect forest data (Photo credit: (a) OpenForests 2018 and (b) ETIFOR 2017)

Figure 18.5. Eraclea Mare pine forest (Photo credit: Eraclea Mare @Park Hotel Pineta 2017)

Figure 18.6. Activities in periurban lowland forests (Photo credit: Associazione Forestale di Pianura 2017)

Figure 18.7. Possible links between technological and social innovation (Source: own elaboration inspired by the SIMRA Research Team)

Sample tables

Table 18.1. The dominant, traditional technological approach vs. the emerging, modern social approach: a nut-shell comparison related to forestry (Source: own elaboration)

	Technological approach	**Social approach**

Focus on	- Technological innovations (towards a low carbon emissions economy) - Large-scale investments (capital intensive) - Industry-based forest economy	- Social innovations - Small-scale enterprises (labour intensive) and networks - Rural-based forest economy - Urban forestry and greening
Vertical vs. horizontal relations	- Value chain perspective - Sectorial development - Vertical integration	- Network economy - Inter-sectorial development - Horizontal integration
Inputs and outputs diversification	- Low quality woody biomass as the unique, cheap raw material - Specialization in high added value outputs (→ weaker resilience to financial/economic global crises and other unpredictable events)	- Diversification in inputs (industrial wood, biomass, Non Timber or Wild Forest Products, other Ecosystem Services) - Diversification in high added value outputs (→ stronger resilience to financial/economic global crises and other unpredictable events)
Market power	Increased market power of the industrial companies controlling the advanced technologies (→ higher risks connected to the companies consolidation trends)	Balanced market power among the various diversified operators (→ lower risks due to higher diversification)
Measure of performance (examples)	Eco-Innovation Scoreboard (national level assessment approach), by the EU Eco Innovation Observatory (http://www.eco-innovation.eu/)	Spot, site-specific (e.g., ongoing pilot cases by H2020 SIMRA project: www.simra-h2020.eu; those carried out by some Local Action Groups within the EU LEADER approach: http://enrd.ec.europa.eu/enrd-static/leader/en/leader_en.html)
Model regions	Nordic and central European countries, coastal areas	South European and Mediterranean countries, mountain regions
Stakeholders and public involvement	- Risks of lack of public consensus around the industrial investment (NIMBY effect) and need for addressing the process of social inclusion	- Potential for social inclusiveness, both in Research & Development (R&D) processes (citizen's science, network-innovation) and co-funding that can increase the stakeholders and public empowerment in forestry.
Drivers	- Patented (private) R&D initiatives, with public support/funds - Top-down, linear transfer and creation of innovation.	- Public-private initiatives in education, training and non-patented innovations - Network-based transfer and creation of innovation.

Sample boxes

Box 18.1 - The technological approach to the bio-economy in forestry: two examples.

1. *The Tees Renewable Energy Plant (REP),* a planned power plant in the UK, will be located in the Port of Teesside, Middlesbrough and will have a capacity of 299 MW, thus becoming the largest biomass power plant in the world. The project's engineering and construction is expected to cost more than €600 million and create around 1,100 jobs during the construction

phase. The renewable energy generated is anticipated to be equivalent to the power consumed by 600,000 households in the UK. The company (MGT Teesside Ltd.) website says the plant will help meet the UK's nationwide renewable energy goal of 15% of all energy consumed by 2020. The company also projects that the plant will save approximately 1.2 million tonnes of CO_2 each year. MGT Teesside Ltd. reports that the project is expected to break ground as soon as funding is secured by early 2016, and the plant will be operational by 2019 - just in time to help offset coal and gas usage and contribute to the UK's 2020 energy goals. Wood pellets and chips from sustainable forestry sources will fuel the Tees REP. A tentative forecast of the wood biomass consumption is 1.2 M tons chips/year, which will be imported by ship mainly from the United States. In terms of environmental statement, the website reports that "the wood pellets are produced from the co-products of the saw-timber industry and are sourced entirely from commercial forestry, which does not contribute to deforestation because forestry is always re-establishing after removals". The company also states that its suppliers of pellets and chips "will be subject to regular third party audits to ensure the ongoing sustainability" of the supply chain.
(Source: website of Tees REP - http://www.power-technology.com/projects/tees-renewable-plant-teesside/ and of MGT Teesside Ltd. - http://www.mgtteesside.co.uk/#tees-rep)

2. *The Metsä Group bio-plant:* Metsä Group is planning the biggest investment in the forest industry in Finland, about €1.1 billion to convert and expand a traditional large pulp mill into a bioproduct mill. The project plans to refine wood into biomaterials, bioenergy, biochemicals and fertilizers sustainably and with great resource efficiency. The planned annual pulp production is 1.3 million tonnes, with an annual wood consumption of 6.5 million m^3. The consumption of wood will approximately triple, as current consumption is 2.4 million tonnes. This will contribute to wood mobilization. According to the project, over 2,500 jobs will be

created throughout the whole value chain in Finland, including new jobs in harvesting and wood transport, and there will be the need for a competent workforce. Internal financing is approximately 40%. The project is expected to help Finland reach its targets for the use of renewable energy, as it contributes 1400 GWh/a electricity generation, 7000 GWh/a district heating and steam and 1200 GWh/a wood energy. The necessary technological innovations will allow the use of raw materials and 100% side streams as products and bioenergy, without using fossil fuels, and the choice of equipment and machinery will emphasise the criterion of energy efficiency. The stated advantages are "efficient production of high-quality pulp", "integrated production of new bioproducts" and "resource-efficient way of using all production side streams". However, organizational innovation is also needed. According to the project, "the operating model will be based on an efficient partner network", where "new products will be created in collaboration with various experts joining the network" and "create opportunities especially for small and medium-sized enterprises to produce innovative bioproducts with high added value". These last elements are coherent with cluster-based strategies and regionalization processes, where the linearity of the technological innovation model remains internal to each industry/corporation or their clusters.
(Source: website of Metsä Group - https://www.metsagroup.com)

Box 18.2. The social approach to the bio-economy in forestry: two examples

1. *The International Model Forest Network (IMFN),* (see chapter 3) for more than 20 years, has been implementing a participatory-based approach at landscape-level to the sustainable management of natural resources, included forests. The approach was not pioneering in its international networking goals, but it was innovative at that time in proposing and adopting principles and governance mechanisms able to promote a voluntarily-based partnership and collaborative work among local stakeholders. Although the principles and attributes required

for becoming a Model Forest recognised at international level are quite general and aspire to sustainable forest management and good governance concepts, they include aspects that are also characteristic of social innovation. For example, the options set in principle 1 (Partnership) for a neutral forum where both private organisations (often businesses), public administration (typically, local municipalities) and civic society representatives (e.g., NGOs) of interests and values are welcome to participate. Moreover, according to principle 5 (Program of activities), the activities undertaken have to reflect the landscape vision and stakeholder needs and challenges. In short, we can argue that even if in the IFMN the single Model Forests were not conceptualized as social innovations, it is likely that some of them are *de facto* social innovations (e.g., in terms of innovative partnerships and governance procedures, voluntary engagement of stakeholders and forest-based activities that are designed to solve socio-economic needs and societal challenges). Nowadays, the IMFN includes more than 60 large-scale landscapes in 6 regional networks, covering a total of ca. 84 million hectares in 31 countries. One of the regional networks active in Europe, established in 2008, is the Mediterranean Model Forest Network, which includes 12 landscapes in 8 countries (Spain, France, Italy, Croatia, Greece, Turkey, Tunisia and Morocco). Each single landscape is a local network, so that the regional one is a larger network of local networks, where ideas, best practices, knowledge and information are exchanged.
(Source: http://imfn.net/mediterranean-model-forest-network)

2. *Associazione Forestale di Pianura (Italy).* Urban and peri-urban forests in lowland areas of the Po Valley in the North of Italy are often crucial for recreational activities. In addition, they can be catalysts for social aggregation. Forests located near densely populated or intensively visited areas, if planned and managed for being accessible to a broad range of visitor categories (e.g., families with children, the disabled, elderly people with mobility limitations,

sportspersons passionate about outdoor activities like biking or running, birdwatchers, etc.), may be relevant resources to invest in. They can attract visitors and initiatives, thus contributing to the growth of the local economy. The areas and patterns can be set up in a way that is functional for different social uses of the forest, providing support to various recreational services, give options for employment opportunities and contribute to the wellbeing of local communities. If this implies voluntary engagement of the civil society, new types of relationships between private and public actors and/or new governance procedures, it can be a social innovation in forestry (figure 18.5).

<place figure 18.5 here>

One example is a lowland forest area in Veneto (North-East Italy), located close to Venice and famous beaches along the Adriatic Sea (e.g., Jesolo, Eraclea). The area is visited by about 3 million tourists every summer and, starting from 35 years ago, has been subject to a large afforestation programme.

There are currently 24 forests that are owned by 8 local municipalities. The areas are managed for use by different target groups, included disabled people and families. The management activities are carried out through various forms: direct management by municipalities, management agreements with private companies or not-for profit entities, private rentals, etc. Since 2002, forest owners and managers are aggregated in and supported by the Lowland Forest Association (*Associazione Forestale di Pianura*, AFP), which collaborates with various environmental and social organizations (e.g., Legambiente, WWF Italy, the Italian Association of Forest Sciences Students) and plays an active role within the Local Action Group Venezia Orientale (a local development agency, VEGAL) of the EU LEADER programme. AFP and its network are a unique case of this type of private-public cooperation in lowland coastal forest management in Italy (Figure 18.6).

<place here figure 18.6>

Management operations are not just financed through municipal budgets, but also through funds raised by the AFP via other sources, such as the EU Rural Development Programme, private investors (including "AzzeroCO_2" - a broker of carbon credits, "E-on" – a renewable energy agency, and Alí – a supermarket chain) and crowdfunding. In the period 2009-May 2017, the area attracted in total ca. €1.7M (€200,000/year): it has been estimated that €1.0 invested by each AFP member resulted in €7.1 of resources available for management. With the innovative approach of attracting donors and actively involving the local civic society (for example, by means of the crowdfunding project), the AFP determined a key change: while in the past resources were mainly represented by regional and public funds, in the last few years funds have started to be mainly international and private. In 2017, the forests got the FSC forest management certification, joining the WaldPlus group. This, together with an improvement in the investments made in communication, has significantly contributed to increasing the visibility of the area. In 2016, as a preparatory activity to the forest certification process and audit, a new forest management plan was developed, focused on interventions to increase the capacity of the forests to deliver ecosystem services. They include products and services that are already sold to the investors (e.g., pine nuts for ca. €200-300/ha/year; carbon sequestration, ca. 5.99 tCO_2eq/ha/year, at a price of €17-24/tCO_2eq); and products and services that are potentially relevant, such as biodiversity enhancement and wild truffle production. Recreation is one of the cultural services that are planned to be enhanced with investments in the coming years: while in the period 2009-2011, 255 ha (70% of the total forest area) have been restored and made accessible for nature-based recreation, the 2025 target is to have 100% of forest areas restored and accessible, also with a diversification of the services (for example, it is planned to test the establishment of a kindergarten or school in the forest, and various types of green care programmes).

(Source: own elaboration based on Secco et al. 2017)

Box 18.3: Public participatory platforms and initiatives regarding forestry in Italy (Source: own elaboration)

Public participatory initiatives regarding forestry in Italy, such as mass science initiatives, are still limited and can be summarised in five main groups:

- Online forums aim to inform people about on-going initiatives and collect comments/feedback or facilitate interactions among users. Relevant examples are those provided by the forums for the discussion of national forest certification standards, but they are applied in many other circumstances.
- Storytelling initiatives are more recent and try to deliver scientific research to non-specialists by adopting a simplified language and appropriate communication channels. Although not specifically intended for forestry, the recently launched start-up Learnscapes[19] is a good example.
- Information Capturing from Social Networks is becoming increasingly frequent, also by scientists, and forestry is no exception. Examples include the use/statistical elaboration of geo-referenced photos gathered from social networks like Panoramio, Flickr etc. to assess recreational services provided by natural resources, including forests.
- Social Networks and blogs also play a role in forestry and related fields, functioning as platforms for sharing information, ideas, contacts, experiences among media, groups of stakeholders and individuals at various levels interested in forest resources and their management. An example in Italy are the social networks and related online communities managed by the technical/professional national journal '*Sherwood – La Compagnia delle Foreste'* (more than 2,300 Facebook and 1,200 Twitter followers as of February 2018). Professional social networks might also be relevant (e.g., ResearchGate, Academia, Linkedin).

[19] www.learnscapes.co

- Citizen science initiatives, with the active cooperation of citizens and scientists in collecting, delivering, validating and sharing information, are still marginally implemented in Italy. Examples mostly refer to environmental/biodiversity monitoring initiatives that in some cases also took place in forest areas. The list includes specific projects (e.g. Citizen Science Monitoring – CSMON Life[20], Monitoring of insects with public participation – MIPP Life[21], U-SAVEREDS[22] for the conservation of red squirrels, GESTIRE Life[23] for the collection of fauna and flora data regarding Natura 2000 sites) and other (mostly voluntary) initiatives, such as I-naturalist Italia groups (alien species[24], butterflies[25], and amphibians and reptiles[26]), Bioblitz[27] experiences and activities promoted within the Italian Long-Term Ecological Research Nework (LTER)[28] as a member of the European Citizen Science Association (ECSA).
- Crowdfunding is used to collect funds from private organisations and individuals. It is particularly effective in collecting funds for socially-oriented initiatives (e.g., support for disabled people, arts development), but some relate to forest or forest-based initiatives. There are nowadays several platforms managing crowdfunding in Italy, but *Produzioni Dal Basso* (https://www.produzionidalbasso.com/) (in English, the meaning would be Bottom-up Productions) was one of the first launched, currently having 350 projects funded, with a total of €170,600 collected so far. Out of 2,600 projects currently open for funds collection, about 30 are directly linked to forest and forest resources (e.g., green care initiatives in forest sites, like forest schools; creation of protected areas with a bottom-up approach), while ca. other 120 are indirectly linked to them (e.g., they refer to

[20] www.csmon-life.eu
[21] http://lifemipp.eu/mipp/new/index.jsp?language=en_US
[22] http://usavereds.eu/en_GB/
[23] www.naturachevale.it/en/
[24] www.inaturalist.org/projects/osservatorio-italiano-specie-aliene
[25] www.inaturalist.org/projects/farfalle-d-italia
[26] www.inaturalist.org/projects/italian-herps-betha
[27] www.bioblitzitalia.it/index.html
[28] www.lteritalia.it/it/content/citizenscience

documentary films on forests or artistic installations inspired by forests). Crowdfunding is an effective way of engaging people, who feel they are being part and driver of change.

- Online petition platforms are other forms of citizens' self-engagement in topics that might have forestry-relevance. As an example, from 2007 until March 2018, the well-known Italian petition platforms *Firmiamo.it* and *Change.org* have promoted respectively 68 and 28 petitions related to forestry issues (included for example petitions for the protection of Nordic forests and wild animals like wolf and bear, for the reduction of the number of forestry workers in the South Italian regions, the protection of forests against fires, or against the use of forest biomasses to produce energy). While some petitions have only a few number of signatures (less than 50), others were able to collect more than 12,000 signatures in few weeks.