

Untangling the different shades of green of the Italian forest-based sector towards a sustainable energy transition

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Abstract

This study aims at mapping and assessing, through the lens of a multi-level perspective, in what extent the sources of pressure exerted at landscape and regime level, on one hand, and internal barriers at niche level on other hand, hinder the transition of the Italian forest sector towards a sustainable energy shift. For operationalizing our theoretical approach, we employed the single case-study method, which draws on an-in depth literature review and a SWOT analysis of the Italian forest sector. Results show that the multi-functional role of the forest and the transition towards a sustainable energy regime, recognized and incentivized both at national and international level, risks not to represent an added value for the Italian companies in the sector. But rather to result in a bureaucratic burden, as it implies more rules and constraints with increasing costs and administrative times that reduces the competitiveness of the companies, unless a series of SWOT-strategies are developed. Implementation of such SWOT- strategies can strengthen the inter- sectoral networks relations, especially under prerequisites of small-scale forests, promote business models able to improve the economic performance, and support the dialogue and collaboration between actors in the wood-energy value chain.

Keywords: sustainable energy transition, forest sector, MLP , SWOT

1. Introduction

Unlike the transition from a coal-based chemical industry to petrochemicals, where the availability of raw materials enabled the change, the forest-based sector presents the challenge of identifying the innovative paths that reconcile trade-offs regarding conservation of biodiversity, simultaneously use of wood-based resources. Ensuring a sustainable and balanced environmental, social, and economic development of the forest-based sector implies a parsimonious use of bio-based resources in a perspective of circular bioeconomy (Antikainen et al., 2017; Venkata Mohan et al., 2016), based on structural and functional changes of the system occurring at various levels (e.g. policy, industry, market, consumption, etc.). The biomass use for energy generation represents an important EU policy, aimed at allaying the effects of climate change by reducing greenhouse gas emissions from fossil fuels on the one hand, and improving the energy supply by means of energy sources diversification on the other (Nassi o di Nasso et al., 2010).

Against this background, this study aims at mapping and assessing, through the lens of a multi-level perspective (hereafter MLP), in what extent the sources of pressure exerted at landscape and regime level, on one hand, and internal barriers at niche level on other hand, hinder the Italian forest-based sector transition towards a sustainable energy shift. “New ideas and tools are slowly entering the Italian forest policy arena as a result of international driving forces like the global dialogue on forests and the growing demand for responsible behaviour and transparency”(Secco et al, 2011: 104).

Both the choice of the analytical framework - MLP, and the unit of analysis - Italy, for our study are not random. Specifically, MLP allows capturing the complexity of interlinked relationships which affect socio-technical transition processes as well as their underlying driving forces, and thus serves the purpose of our study. While Italy, being characterized by strong environmental and socio economic differences represents an interesting case for investigating complex socio-environmental systems which reflect the long-term interaction between natural landscapes, production systems and rural communities (Ferrara et al., 2017).

For operationalizing our theoretical approach, we used the case study of the Italian forest-based sector, which draws on an-in depth literature review and a SWOT analysis.

The choice of the single case-study method—a within-case analysis- will allow us to gain an in-depth understanding of the framework conditions influencing the transition, untangling the different shades of green (i.e. obstacles, limitations) for the Italian forest-based sector transition towards a sustainable energy regime.

The remainder of this paper is as follows: section 2 presents the theoretical framework and the research aim, whereas section 3 introduces the methods and the data, along with a brief description of the forest sector in Italy. Section 4 outlines the results of the SWOT analysis, and discuss them through the lens of MLP. Section 5 summarizes and discusses a series of SWOT- strategies that can foster the Italian forest-based sector transition towards a sustainable energy regime.

2. Theoretical framework and research aim

In the context of the transition towards a circular bioeconomy (i.e., an economy in which low-cost and greener carbon sources such as agricultural residues and industrial waste are the core of the production processes) understanding the structural and functional changes of the system occurring at various levels (e.g. policy, industry, market, consumption, etc.) is paramount of importance. Transitions towards sustainability are generally characterised by a high degree of uncertainty among vested parties, giving rise to possible failures for conventional policy approaches (Markard, 2012). In this context, one of the major challenges is capturing the complexity of interlinked relationships which affect socio-technical transition processes as well as their underlying driving forces. The multi-level perspective approach (MLP), first introduced by Rip and Kemp (1998) and then refined by Geels (2002), provides an comprehensive system view for exploring the relationship between dynamics occurring at various level of analysis (Mattes et al., 2015). More specifically, the approach is based on a theoretical model that entails of three main components: (i) socio-technical regime, (ii) socio-technical landscape, and (iii) niche-innovations (Berkhout, 2002). The socio-technical regime is the meso-level of the model and includes the whole of institutions, techniques, rules, practices, etc., that determine the normal development and use of technologies (Geels and Schot, 2007). The socio-technical landscape is the macro-level of the model and consisting of different variables (such as material infrastructures, political culture, social values, paradigms, etc.) that influence activities carried out by the socio-technical regime (i.e. meso-level) (Rotmans et al., 2001). It refers to set of institutional rules, technical knowledge, and social interaction patterns shaping the fundamental configuration of technologies (Geels, 2004). The niche-innovations (i.e. micro-level) can be conceived as ‘incubation rooms’ where promising technologies are developed and used although protected against the mainstream market selection (Geels and Schot, 2007). Despite niche-innovations may perform poorly in more conventional terms, such as price, they are given the opportunity to be appreciated, evaluated, and matured through gradual experimentation and learning by producers, users, researchers, etc.

Following the MLP, transition towards sustainability occurs as a results of particular co-evolutionary dynamics regarding the three aforementioned levels. Particularly, a regime shift happens when there is a niche-technology adequately developed together with appropriate pressures exerted at the landscape level. The niche-innovations have, thus, the chance of breaking through and competing with the current regime. However, the possibility for a niche-innovation of emerging and replacing the current regime might be heavily hampered by external factors characterizing the regime level and internal factors at niche level.

Within the set of scientific techniques potentially able to evaluate all possible factors acting as bottlenecks or opportunities for setting up prioritization of strategies towards the forest sector development, SWOT (strengths, weaknesses, opportunities and threats) analysis is used most

commonly (Rauch et al, 2015). Essentially, it reviews internal strengths and weaknesses on the one hand, and external opportunities and threats on the other hand, by providing punctual strategies with reference to the potential combinations of different strengths, weaknesses, opportunities or threats (Lombriser and Abplanalp, 1998).

The purpose of this study is to ascertain drivers and barriers of the forest sector in Italy to gain an in-depth understanding of the framework conditions in order to draw potential strategies for an effective transition towards a greener and more sustainable economy.

3. Methods and data

For operationalizing our theoretical approach, we used the case study of the Italian forest-based sector (briefly illustrated in sections 3.1), which draws on an in-depth literature review and a SWOT analysis. The choice of the single case-study method—a within-case analysis—is not random, and is coherent with our aim: an in-depth understanding of how and under what extent the sources of pressure exerted at landscape and regime level, on one hand, and internal barriers at niche level on the other hand, hinder the Italian forest-based sector actors to engage in the transition towards a sustainable energy shift.

Firstly, we carried out the literature review on the Italian forest-based sector by employing the Scopus database (www.scopus.com), and using as anchor keywords: “forest sector”, “forest-based energy transition”, combined with other search strings like “forestry governance Italy”, with reference to the timeframe 2009 - 2017. About 70 scientific articles were found potentially relevant for the investigation.

In a subsequent stage, we further refined this pool of articles by carefully examining the text of the article, in order to ascertain the presence of a well-defined idea or value judgement with regard to the area of investigation. The number of selected documents was much smaller and amount to 25 studies. Secondly, after the literature review, we proceeded with the analysis of strengths, weaknesses, opportunities and threats of the forest sector in Italy, using the SWOT analytical method.

SWOT analysis was summarized with the assistance of a matrix that consisted of the four above mentioned areas.

3.1 The forest sector in Italy

Despite the fact that more than a third of the national Italian surface is covered by forests, and that in the last century is witnessed an increase in the area and the wood supply, the Italian forest production chain is dependent on foreign countries for the supply of the raw material (more than 2/3 of its needs are covered by imports). This can be explained by a series of factors such as: high fragmentation of the forest ownership land, complexity of the national and regional regulatory framework, scarce organization of the wood supply chain, inadequacy of vocational training policies for rural

populations living in the mountain areas, lack of an adequate increase of investments in utilization and production activities (Ministry of Agricultural, Food and Forestry Policies, 2013, p.7).

The "multi-functional" role of the forest, recognized and incentivized both at national and international level, therefore risks not to represent an added value for companies in the sector. But rather it results in a bureaucratic burden, as it implies more rules and constraints with increasing costs and administrative times that reduces the competitiveness of the companies.

The forest sector in Italy comes traditionally divided into three strands closely related to each other, namely:

(i) *forest production (harvesting phase)*, carried out by owners and companies of exploitation, which is accompanied by the forest management phase, carried out by owners, tenants and their individual and associated structures and / or enterprises;

(ii) *the first transformation* that includes the production of semi-finished materials, the companies in the wood-based panels and packaging sector;

(iii) *the second processing*, consisting of the paper and furniture industry, and other wood productions. Among the second processing, companies with a high level of process specialization in terms of production and products, joinery and carpentry are the most represented. From the processing of semi-finished products, companies in the sector are concentrated in the industrialized plain areas, they work for the production of wooden furniture, panels and finished products for the mechanical and manufacturing industry, mainly using material coming from the foreign market.

Of particular importance are the traditional craft enterprises active in the production of furniture, characterized by the reduced manpower that mainly uses wood from broad-leaved trees coming from the local market. These entrepreneurial activities rooted in the territory, in many of the country's mountain contexts constitute the latest occupational realities and play an important role in the enhancement of human, cultural, professional and forestry resources of Italian territory.

To the three strands recalled above adds the emerging wood biomass- energy chain, with wide margins of development. As a matter of fact, this latter strand represents an investment opportunity for territorial, industrial and employment development and of income integration for businesses.

Currently, for this strand the level of second processing is low and the products come sold almost raw (firewood) or with very limited levels of industrial processing (wood chips and pellets) (Ministry of Agricultural, Food and Forestry Policies, 2013, p.14).

According to the Italian Producer of Renewable Energy Federation (FIPER) 780.000 tones of woody biomass have been used in the 84 existing biomass district heating plants (data refers to 2016). Moreover, an expansion of the network of biomass district heating plants will help to reactivate the active management of the forest in 801 Italian municipalities (CTI Energia Ambiente, 2017, p.21).

Furthermore, a resilient energy strategy with respect to geopolitical changes, which allows Italy to improve its competitiveness at international level, it cannot be done without the implementation of the

European forestry strategy with the aim of "mobilization" of the wood resources for production and energy purposes (CTI Energia Ambiente, 2017, p.16).

4. Results

Our analytical framework SWOT- MLP grounded on an in-depth literature review provides interesting hints both on the internal driving forces and barriers at the niche level of the forest-based sector in Italy, and the external sources of pressure exerted at the regime and landscape level (Table 1).

Table 1. SWOT analysis of the Italian Forestry sector

Strengths	Weaknesses
1. High level of compliance with environmental certification 2. High volume of wood resources 3. Widely diffused wood craft culture 4. High mechanization of harvesting, processing, and transporting 5. Leading exporter of finished products (i.e. furniture, window frames, special-use papers). 6. Existence of intra-sectoral networks 7. Strategic Framework Programme for Forests at national level	1. Inconsistent framing conditions 2. Decreasing trend in terms of number of enterprises and employees 3. High fragmentation of forests ownership 4. Very limited representation within European Confederations/ Associations 5. Very weak (sometimes conflicting) inter- sectoral networks relations 6. Excessive bureaucratization of the sector 7. Abandonment of silvicultural practices 8. Lack in horizontal integration among the forest owners 9. Limited entrepreneurship of the forest managers. 10. Low level of domestic production 11. High level of imported biomass (80%) 12. Lack of forestry culture in the local communities 13. Low levels of highly skilled professionals
Opportunities	Threats
1. High demand for solid biomass fuels, bioenergy, etc 2. Development of innovative wood-based value chains 3. Land availability for increasing forests 4. Building infrastructure to access internal forests 5. Increasing EU policy scientific and technological interest on forest management 6. Increasing lobbying activities by NGOs, traditional and new stakeholders' groups 7. The Rural Development Programme 2014–2020 at European level 8. Increasing emphasis on the achievement of SDGs	1. Land use change (LUC) 2. Climate change effects 3. Decreasing attention towards forest management in favour of other activities 4. Low level of international timber prices 5. De-localisation of wood-processing industries 6. Irregular work and employment of non-professional 7. Lack of long-term planning by local governments 8. Lack of political priority in support of forest management

Specifically, from the analysis emerged that the driving forces of the Italian forest-based niches are related to abundance of resources and the engagement of actors in a sustainable production. The Italian forests cover about 37% of the national surface, ensuring a high volume of wood resources

for the development of the forest-based sector (Paletto et al., 2017; Maetzkea and Cullotta, 2016). Furthermore, forestry companies in Italy use these resources following ethical values and moral responsibility, and not only to maximize their profits (Galati et al., 2017; Faggi et al., 2014; Bouslah et al., 2010; Maon et al., 2009; Johansson-Stenman, 1998). On the one hand, in order to meet the high demand for certified wood products, solid biomass fuels and bioenergy (Calfapietra et al., 2015; Maetzkea and Cullotta, 2016), companies are inclined to comply with environmental criteria. Indeed, the Italian forestry industry is one of the most advanced in terms of certified companies respectively to the European level and internationally. There are 2024 voluntarily FSC certified companies, of which 2009 have a Chain of Custody certification, and 963 voluntarily PEFC certified companies, all related to their Chain of Custody. The driver for the accomplishment of sustainability criteria in the forest-based niches in Italy is generated by an alignment of internal struggles at the regime level and refers to a decrease of fossil fuel resources and its increasing costs. On the other hand, there is a widely diffused wood craft culture in Italy, which is reflected in a leading position of the Italian wood-based companies in the production and exportation of a wide range of finished wood products, e.g. furniture, window frames, special use papers (Pettenella et al., 2011). Moreover, as usual in the sectors of the bioeconomy, the forestry sector in Italy is characterized by dynamic inter-niches networks (Secco et al., 2017) as a result of the Strategic Framework Programme for Forests at national level (Secco et al., 2011). This evidence emphasises the competitiveness of the Italian forestry industry in the quality market and its potential to trigger the bio-based economy.

Notwithstanding, the Italian forestry sector suffers from numerous barriers ranging from a decreasing trend of the number of enterprises and employees to an excessive bureaucratization of the sector. The diminishing number of enterprises and employees is coupled with their very limited role with respect to enterprises and employees in other sectors (Secco et al., 2017). Hence, the domestic production of the forest-based sector is not able to satisfy the industrial demand due to several reasons (Pettenella et al., 2011). For instance, the limited entrepreneurship of forest managers (Paletto et al., 2017; Tedim et al., 2016) has generated an abandonment of silviculture practices damaging forests resilient capacities and the quality of the biomass (Marchetti et al., 2014), causing a low level of employment of the available domestic biomass with 80% of the wood imported from other countries (Italian Presidency of Council of Ministers, 2016; Secco et al., 2017). Moreover, there are very few highly skilled professionals and a lack of forestry culture in local communities (Martire et al., 2015). This is due mainly to the pressures exerted by the regime actors who have generated inconsistent framing conditions, reflected in incoherent policy and financial tools and a lack of coordination among different local policies (Maetzkea and Cullotta, 2016). In addition, the forestry industry in Italy is characterized by a large number of small scale private land owners who have difficulties in integrating horizontally due to an excessive

bureaucratization of the sector (Paletto et al., 2017; Secco et al., 2017; Pettenella et al., 2011). As a matter of fact they are less coordinated and cannot influence the political level. The latter is reflected in an under representation of the Italian forest companies within European Associations and Confederations (Secco et al., 2017), as well as in very weak, sometimes conflicting, intersectoral network relations.

“Windows of opportunity” at the landscape level coupled with struggling elements at the regime level create the premises for a further development of forest-based innovative niches. For instance, in Italy there is land availability for increasing forests; if equipped with adequate infrastructures to access internal forest areas generate more available biomass (Martire et al., 2015). This has raised an increasing scientific and technological interest on forest management at the European policy level that paves the way for the development of innovative wood-based value chains (EFIMED, 2015). In addition, The Rural Development Programme 2014–2020 has been developed in order to: (i) foster knowledge transfer and innovation among the actors of the forestry sector, and (ii) preserve the forestry ecosystem in compliance with the Sustainable Development Goals.

The latters have to deal with two main global threats that affect also the Italian forestry sector: land use change (LUC), concerning the extension of forests over agricultural land, and climate change effects related to deforestation (Marchetti, 2016; EFIMED, 2015; Vizzarri et al., 2015). These threats combined with a decreasing attention towards forest management in favour of other activities (e.g. mushrooms, truffles, herbs, cork) (Italian Presidency of Council of Ministers, 2016) have resulted in an international low timber prices (Paletto et al., 2017; Pettenella et al., 2011). Moreover, lack of political priority at national level in support of forest management (Secco et al., 2011; Martire et al., 2015) and an insufficient long-term planning by local governments (Martire et al., 2015; Secco et al., 2017) have boosted important de-localisations of wood-processing industries and the employment of non-professionals and irregular workers (Pettenella et al., 2011).

5. Discussion and concluding remarks

The analysis conducted allowed us to obtain a fine grain level of the framework conditions characterizing the forest sector in Italy. As argued in Section 2, SWOT analysis is a valuable tool for providing detailed strategies on the basis of the potential combinations of different strengths, weaknesses, opportunities and threats.

Developed SWOT strategies are listed in Table 2. The strategies have been derived with the aim to propose adequate actions, both in terms of policy and private initiatives, to promote an effective development of the Italian forestry sector.

Table 1. Developed SWOT-strategies for the Italian Forestry sector

Factors	Strengths (S)	Weaknesses (W)
Opportunities (O)	S-O Strategies: • Promote innovative forest-based value chains (O1/2/5 - S1/2/4) • Investments in forest infrastructure (e.g. transshipment points, biomass trade centers) and afforestation (O3/4 - S5/6) • Improve environmental and forest planning tools (e.g. SFPP) (O6/8 - S7) • Support vocational training programmes for rural populations (O7 - S3)	W-O Strategies: • Design new business models to improve the economic performance and strengthen the inter- sectoral networks relations, especially under prerequisites of small-scale forests (O1/2 - W1/2/3/5/8) • Design new organisational structures to reduce complexity of the national and regional framework and build the necessary infrastructure for accessing internal forests (O3/4 - W1/6) • Support training programmes on silvicultural practices that can further contribute to a better exploitation of the land availability and reduction of the volume of biomass imported (O3/4 - W7/11) • Promote entrepreneurship programmes for forest professionals (O5/7 - W9/13) • Support the dialogue and collaboration between academics, high-level forest officials, practitioners, and representatives of civil society (O6 - W3/4/5/8/12) • Promote business models that supports the achievement of SDGs and further support the domestic production of biomass (O8 - W10/11)
Threats (T)	T-S Strategies: • Improve certification schemes based on LUC indicators (e.g., carbon payback time) (T1/2 - S1/7) • Promote new business models (e.g. craft based) to increase the economic performance of forest-based value chains. (T3 - S3) • Sharing technological advancements between companies to compete with international markets (T4 - S4) • Establishment of wood processing industries networks to improve supply chain domestic integration (T5 - S6) • Issue social sustainability certification schemes along the whole supply chains (e.g. human right and working conditions)(T6 - S1) • Design innovative policy strategies to improve also the policy performance of local governments (e.g tax relief, subsidies, feed in tariffs, research projects, etc)(T7/8 - S5/7)	T-W Strategies: • Support the development of domestic value chains, e.g. increase harvesting areas and improve silvicultural practices to produce domestic biomass (T1/2 - W7/11) • Simplify administrative procedures and support highly skilled professionals in forest management (T3 - W 6/9/13) • Promote a domestic wholesale market in order to monitor prices (T4 - W3/10) • Develop horizontal networking and common projects for promoting the “made in Italy” (T5 - W8/12) • Implement training courses and incentives tailored to forest management and related industries (T6 -W2/9/13) • Promote the organisation of consortia which are able to influence politically at national level and be representative at the european level (T7/8 - W1/4/5/6)

As emerged from the SWOT analysis, weaknesses and threats of the forestry sector in Italy are conspicuous; consequently, identifying strategies that tackle all of them can be challenging. However, weaknesses and threats in the Italian forestry sector are intrinsically connected, hence the identification of few interconnected structural strategies can trigger a sustainable development of the forestry industry. For instance, a strategy that supports the development of domestic value chains, e.g. increase harvesting areas and improve silvicultural practices to produce domestic biomass, coupled with a simplification of administrative procedures and support of highly skilled professionals in forest management can generate: (i) better management of forests and an improvement of silvicultural practices, (ii) increase of domestic biomass and decoupling of domestic production from international timber prices, (iii) increase in domestic production, and (iv) decrease in bureaucratization of the sector with consequences on inter-sectoral coordination.

Bearing this in mind, addressing accurate strategies to each weakness and/or threat paves the way for long-term inclusive and smart policies at all levels of government for a durable and sustainable development of the forestry sector and related industries in Italy.

Strategies proposed on the basis of the combination between external threats and internal strengths (T-S) allows to exploit the sector performance to tackle external threat impacts such as: climate change; policy failures; international market conditions; technological changes; etc.

Forests have a relevant role in fighting climate change. Specifically, they produce woodfuels as a valuable alternative to the highly pollutant fossil based fuels and have the potential to absorb about one-tenth of the overall CO₂ emissions. Forest certification is becoming increasingly important as it represents a guarantee of sustainable production, processing and consumption processes of forest-based products. In this context, improving forest certification schemes based on LUC indicators (e.g., carbon payback time) could provide relevant information on current characteristics of a land use.

The concept of rural development is oftentimes stated as an intention of policy makers. This is particularly true for the forest sector given the relevance of its contributions to the rural economy. As it seems the policy assistance for the development of rural craft industries in forest sector could help providing new business models (e.g. craft based) to increase the economic performance of the forest-based value chains.

The low level of international timber prices is reducing the competitiveness of the forest sector and its internal demand for forest based products. In this context a collective endeavor is necessarily required to meet this challenges. The innovation and the high level of mechanization

of harvesting, processing, and transporting technologies in forest sector in Italy will indubitably be an necessary path to pave for increasing competitiveness. Policy strategies should help firms negotiating licenses and other forms of access to current technologies possessed by others to have chance of compete with international markets. Moreover, policy strategies aimed at enhancing the network integration and cooperation of wood processing industries networks could favour stable employment growth and foster investments into rural areas and in doing so will help to prevent firms delocalisation.

Increasing technological advancements (i.e. mechanization of harvesting, processing, and transporting) have resulted in decreasing rates of physical injury. However, the presence of irregular and non-professional still expose workers to dangers. In this context, issuing social sustainability certification schemes along the whole supply chains (e.g. human right and working conditions) or implementing workplace strategies based on worker could help providing more productive and resilient industry workforce (Mylek and Skyrmer, 2015).

References

- Antikainen R., Dalhammar C., Hildén M., Judl J., Jääskeläinen T., Kautto P., Koskela S., Kuisma M., Lazarevic D., Mäenpää I., Ovaska J-K., Peck P., Rodhe H., Temmes A., Thidell Å., 2017. Renewal of forest based manufacturing towards a sustainable circular bioeconomy.
- Berkhout, F. (2002) 'Technological Regimes, Path Dependency and the Environment', *Global Environmental Change*, 12.1: 1-4.
- Calfapietra, C., A. Barbati, L. Perugini, B. Ferrari, G. Guidolotti, A. Quatrini, and P. Corona. 2015. Carbon stocks and potential carbon sequestration of different forest ecosystems under climate change and various management regimes in Italy. *Ecosystem Health and Sustainability* 1(8):25. <http://dx.doi.org/10.1890/EHS15-0023>
- Carbone, F., Savelli, S., 2009. Forestry programmes and the contribution of the forestry research community to the Italy experience, *Forest Policy and Economics* 11 508–515.
- CTI Energia Ambiente, 2017. La sostenibilità della filiera legno-energia. "Winter package", sottoprodotti, nuovi biocombustibili, soluzioni innovative per uso Industrial, Mostra Convegno mcTER FOREST, retrieved online <https://www.cti2000.it/utis/downloadfile.php?table...id=36405>, Accessed 03 May 2018
- European Forest Institute Mediterranean Regional Office (EFIMED), 2015, The bioeconomy as an opportunity to solve the structural problem of forest fires in southern Europe
- Ferrara C., Carlucci M., Grigoriadis E., Corona P., Salvati L., 2017. A comprehensive insight into the geography of forest cover in Italy: Exploring the importance of socioeconomic local contexts. *Forest Policy and Economics*. 75. 12-22.
- Italian Presidency of Council of Ministers, 2016, Bioeconomy in Italy: A unique opportunity to reconnect economy, society, and the environment, <http://www.agenziacoesione.gov.it/opencms/export/sites/dps/it/documentazione/S3/Bioeconomy/BI v4 EN.PDF>
- Galati A., Gianguzzi G., Tinervia S., Crescimanno M., La Mela Veca D. S., 2017, Motivations, adoption and impact of voluntary environmental certification in the Italian Forest based industry: The case of the FSC standard, *Forest Policy and Economics*, 83, 169-176
- Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Res. Policy* 31, 1257–1274.
- Geels, F.W., 2004. From sectoral systems of innovation to socio-technical systems: insights about dynamics and change from sociology and institutional theory. *Res. Policy* 33 (6–7), 897–920.
- Geels, F.W., Schot, J., 2007. Typology of transition pathways. *Research Policy* 36, 399–417.
- Kovalcik M., et al., 2013, SWOT strategies for forestry logistics in six european regions, *Forestry Journals*, 59(2), 130-138

Krott, M., Bader, A., Schusser, C., Devkota, R., Maryudi, A., Giessen, L., Aurenhammer, H., 2014. Actor-centred power: the driving force in decentralised community based forest governance. *For. Policy Econ.* 49, 34–42.

Lombriser, R., Abplanalp, P.A., 1998. Strategisches management. Visionen Entwickeln, Strategien Umsetzen, Erfolgspotentiale Aufbauen. Zürich, Versus.

Marchetti M., 2016, La questione delle Aree Interne, sfida e opportunità per il Paese e per il settore forestale, *Forest@*, 13, 35-40

Marchetti M., Vizzarri M., Lasserre B., Sallustio L., Tavone A., 2014, Natural capital and bioeconomy: challenges and opportunities for forestry, *Annals of Silvicultural Research*, 38(2), 62-73

Maetzkea, F.G., Cullotta, S., 2016. Environmental and forest planning in Italy: conflicts and opportunities, *Agriculture and Agricultural Science Procedia* 8 (2016)332 – 338

Markard, J., Raven, R., Truffer, B., 2012. Sustainability transitions: an emerging field of research and its prospects. *Res. Policy* 416, 955–967.

Martire, S., Castellani, V., & Sala, S. (2015). Carrying capacity assessment of forest resources: Enhancing environmental sustainability in energy production at local scale. *Resources, Conservation and Recycling*, 94, 11-20.

Mattes, J., Huber, A., Koehrsen, J., 2015. Energy transitions in small-scale regions – what we can learn from a regional innovation systems perspective. *Energy Policy* 78, 255–264.

Mylek, M.R., Schirmer, J., 2015. Beyond physical health and safety: supporting the wellbeing of workers employed in the forest industry, *Forestry: An International Journal of Forest Research*, Volume 88, Issue 4, 1. Pages 391–406, <https://doi.org/10.1093/forestry/cpv011>

Ministry of Agricultural, Food and Forestry Policies, 2013. Fabbisogno di ricerca e innovazione nel settore forestale italiano, Report retrieved online at http://www.aalsea.it/filevari/notizie/2013/Rapporto_sulla_Ricerca_Forestale-Maggio-2013.pdf, Accessed 03 May 2018

Nassi o Di Nasso N., Angelini L. G., Bonari E., 2010. Influence of fertilisation and harvest time on fuel quality of giant reed (*Arundo donax* L.) in central Italy. *European Journal of Agronomy*. 32(3). 219-227

Paletto A., Giacobelli G., Matteucci G., Maesano M., Pastorella F., Turco R., Scarascia Mugnozza G., 2017, Strategie di valorizzazione della filiera foresta-legno in Calabria: il punto di vista dei portatori d'interessi, *Forest@*, 14, 34-48

Pettenella, D., Klöhn, S., Brun, F., Carboni, F., Venzi, L., Cesaro, L., Ciccarese, L., 2011. Economic integration of urban consumers' demand and rural forestry production, Italy's country report, COST Action E30. Available on line at: <http://www.isprambiente.gov.it/contentfiles/00005900/5911-italy-report.pdf>

Rauch P., et al., 2015, SWOT analysis and strategy development for forest fuel supply chains in South East Europe, *Forest Policy and Economics*, 61, 87-94

Rip, A., Kemp, R., 1998. Technological change. In: Rayner, S., Malone, L. (Eds.), *Human Choice and Climate Change*. Batelle Press, Washington D.C, pp. 327–399.

Rotmans, J., Kemp, R., and van Asselt, M., (2001). More evolution than revolution: transition management in public policy. *Foresight* 3, 15–31.

Secco L., Pettenella D., Gatto P., 2011. Forestry governance and collective learning process in Italy: Likelihood or utopia?. *Forest Policy and Economics*. 13. 104-112.

Secco, L., Favero, M., Masiero, M., Pettenella, D.M., 2017. Failures of political decentralization in promoting network governance in the forest sector: Observations from Italy, *Land Use Policy* 62 (2017) 79–100.

Scolozzi, R., Schirpke, U., Morri, E., D'Amato, D., Santolini, R., 2014. Ecosystem services-based SWOT analysis of protected areas for conservation strategies, *Journal of Environmental Management* 146 (2014) 543 -551.

Tedim, F., Leone, V., Xanthopoulos, G., 2016. A wildfire risk management concept based on social-ecological approach in the European Union: Fire Smart Territory. *Int. J. Disaster Risk Reduct.* 18, 138–153.

Venkata Mohan S., Modestra J.A., Amulya K., Butti S.K., Velvizhi G., 2016. A Circular Bioeconomy with Biobased Products from CO₂ Sequestration. *Trends Biotechnol.* doi:10.1016/j.tibtech.2016.02.012.

Viaggi, D. 2013. Developing Improved Tools for the Economic Analysis of Innovations in the Bioeconomy: Towards a Life Cycle-Strengths-Weaknesses- Opportunities-Threats (LC-SWOT) Concept?. - *Journal of Management and Strategy*, 4: 17.

Vizzarri M., Sallustio L., Tognetti R., Paganini E., Garfi V., La Mela Veca D.S., Munafò M., Santopuoli G., Marchetti M., 2015 - Adaptive forest governance to face land use change impacts in Italy: a review. *L'Italia Forestale e Montana*, 70 (4): 237-256. <http://dx.doi.org/10.4129/ifm.2015.4.01>

Vizzarri, M., Tognetti, R., Marchetti, M., 2015. Forest Ecosystem Services: Issues and Challenges for Biodiversity, Conservation, and Management in Italy, *Forests* 2015, 6, 1810-1838; doi:10.3390/f6061810

Wolfslehner, B., Linser, S., Pölzl, H., Bastrup-Birk, A., Camia, A., Marchetti, M., 2016. Forest bioeconomy – a new scope for sustainability indicators, *From Science to Policy* 4. European Forest Institute.