



Provision of public goods by agriculture and forestry: Economics, policy and the way ahead

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ABSTRACT

The provision of public goods by agriculture and forestry has taken increasing importance in the policy debate. The objective of this editorial is to set the scene for the special issue, to provide a summary of the main messages from the papers therein, highlight the most relevant lessons learnt for policy and generate insights for future research. The results highlight that there is a need to investigate further both the micro-mechanisms of decision-making, value creation and coordination among actors, including the micro-level issues in policy design, and to address the topic of public goods, taking a holistic view of how agriculture and forestry systems work. In order to meet these real-world requirements, different research approaches need to be better integrated, promoting cross-fertilisation and synergies among different methodological perspectives, able to complement one another in meeting policy challenges.

1. Introduction, policy context and objectives

The provision of public goods by agriculture and forestry has taken increasing importance in the policy debate all around the world (OECD, 2015). The Common Agricultural Policy (CAP) of the European Union (EU) is a clear example of this as, since the nineties, greening has gradually taken a stronger importance within the policy agenda (Louchichi et al., 2018). The recent Green New Deal and the Farm to Fork Strategy have emphasised this issue, putting public goods at the centre of the EU policy strategy, with a focus on climate change and biodiversity. The Farm to Fork Strategy also sets clear targets in this direction, which will inform both the new objectives of the CAP and the way instruments are designed (e.g., with an emphasis on result-based and chain-related approaches). Problems related to the provision of public goods are linked to the well-known lack of incentives for public provision and markets functioning when goods are non-rival and non-excludable. In addition, understanding agriculture- and forestry-related public goods must deal with various specificities, including the geographical dimension, the cultural side of their production, and the complementarity/competition with private goods, including some fundamental for human life, such as food (OECD, 2001; Villanueva et al., 2014; Westhoek et al., 2013).

This editorial introduces the special issue on “Public goods by agriculture and forestry”. The objective of the editorial, besides setting the scene for the special issue, is to provide a summary of the main messages from the collected papers, to highlight the most relevant lessons learnt for policy and develop insights for future research.

The special issue was inspired by (and part of the papers come from) the project Providing smart delivery of public goods by EU agriculture and forestry (PROVIDE), funded under the H2020 program of the EU Commission (Grant Agreement: 633838), 2015–2018. Given this

background, the papers collected in this special issue focus almost exclusively on the European context, providing an account of the different geographical and institutional conditions within this context. The papers can be broadly organised into four main topics: a) supply side studies; b) demand side studies; c) meeting demand and supply; and d) governance. The first three groups cover the classical economic structure of a production problem, based on demand, supply and their interaction. Demand and supply analyses are mostly valuation studies, while topic c) entails both valuation and modelling exercises. Finally, the governance topic looks at the issue from the wider perspective of how actors can interact to increase the provision of public goods by agriculture and forestry.

The editorial is organised in three main sections in addition to this one. Section 2 provides an overview of papers included in this special issue. This is followed by an overall discussion (Section 3) and some concluding remarks (Section 4).

2. Papers and topics in this special issue

2.1. Supply side studies

Studies focusing on the valuation of public goods provision by agricultural and forestry systems from a supply-side perspective provide relevant information for policy-making. This includes information on not only land managers' willingness to accept (WTA) participation in the related policy schemes, but also enabling factors and barriers for such participation. The papers included in this issue are good examples of this type of studies, as they provide sound estimates of WTA for the design of payments for ecosystem services of public goods in different contexts: extensive agriculture with woody crops in Spain (Salazar-Ordóñez et al., 2020, this issue) and with livestock and cereal crops in Poland

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(Czajkowski et al., 2019, this issue), both with high risk of abandonment and/or public goods damaging intensification, peatlands agricultural management in Germany (Häfner and Piorr, 2020, this issue), and forestry systems in a winter-sports popular resort in Finland (Tyrväinen et al., 2020, this issue). All these studies use discrete choice experiments (DCE) to estimate WTA values, also evidencing a high level of heterogeneity of land managers' preferences connected to the different general sources of heterogeneity related to the activity per se (i.e. a biophysical basis determining where the activity locates because of resource availability), the agricultural and forestry system; the production techniques used for the overall farm management; the specific practice used (Villanueva et al., 2017b, 2016) and farmer characteristics and attitudes. In addition, the main specific contributions are highlighted for each paper below.

Salazar-Ordóñez et al. (2020, this issue) aim to estimate the compensation farmers would need to receive to adopt environmentally friendly practices aimed at incorporating the provision of biodiversity into food production. The paper responds to the need for innovative instruments to complement the current schemes aimed at improving farmland biodiversity. Some of the most promising innovations include market-based instruments relying on what is known as the commodification of biodiversity. The analysis relies on DCE that estimate farmers' WTA, both per unit of output and per unit of land, for improving the levels of bird biodiversity in olive groves. It relies on a case study of mountain olive growers in Andalusia (Southern Spain). Results show that the higher the level of provision of farmland biodiversity, the higher the farmers' WTA, with high-yield farms generally showing higher WTA values compared with low-yield farms. Comparing the average farm-gate prices of both regular and organic extra virgin olive oil, the results suggest a high potential for the commodification of biodiversity through olive oil markets. In addition, it is worth highlighting the farmers' low sensitivity to including a results-based bonus to be generated by the end of a scheme aiming at the provision of farmland biodiversity.

Czajkowski et al. (2019, this issue) use DCE to analyse farmers' preferences towards agri-environment and climate schemes (AECS) for the case of Biebrza Marshes (north-eastern Poland) – a complex wetland and one of the largest wildlife refuges in Europe. It focuses on the use of extensive farming practices, in different agricultural land-uses. This is actually one of the main novelties of this study compared with the existing, rapidly growing literature using a supply-side DCE to analyse AECS, as it simultaneously analyses farmers' preferences towards AECS with different configurations, tailored to different agricultural systems (namely related to arable land, peatlands, meadows, and livestock). While the results mirror previous evidence on farmers' preferences toward flexible and shorter contracts (Christensen et al., 2011; Espinosa-Goded et al., 2010), they also show the influence of farmers' knowledge on participation in AECS. Previous literature also shows the importance of this factor (e.g. Villanueva et al., 2017a); on top of that, the study finds differences between subjective and objective knowledge, proving that: (i) respondents who subjectively declare higher knowledge levels of protected bird species (related to farmland biodiversity provision) have higher WTA participating in AECS including extensive meadow use, lower WTA for lengthier contracts and value the possibility of contract-cancelling less; and (ii) respondents with higher objective levels of bird knowledge are more likely to accept most of the considered AECS contracts (i.e. having lower WTA) and also value the possibility of contract-cancelling less, although requiring higher compensations for longer contracts. The results underline the need for a better communication of actual knowledge on public goods provision.

Häfner and Piorr (2020, this issue) assess which farm and farmers' characteristics determine differences in the perception of different co-ordinating institutions by applying a DCE on their willingness to participate in a hypothetical AECS targeted at climate friendly peatland management. While previous DCE assessments have analysed collaborative participation in these schemes (e.g. Villamayor-Tomas et al.,

2019), they add to the existing knowledge by evidencing heterogeneity of farmers' preferences towards the attribute "support for co-operation" and which institution offers this support. They show how part-time farmers and those without formal agricultural training perceive support for co-operation as beneficial, while more professional farmers (full-time, with formal agricultural training and receiving professional advice) tend to reject support for co-operation. However, results show that these differences are more dependent upon the characteristics of the farms than of the farmers themselves. While the authors do not find a general pattern for or against an institution, the preferences differ across farm types and farmers' characteristics.

Tyrväinen et al. (2020, this issue) study forest owners' attitudes towards – and willingness to participate in – a Payments for Ecosystem Services (PES) initiative called Landscape and Recreation Value Trade (LRVT). They also investigate the acceptability of forest management alternatives sustaining landscape qualities, the relative importance of different features of LRVT for landowners, and the magnitude of overall compensation claims of alternative LRVT models. The analysis, a DCE survey, was conducted in Kuusamo, a popular nature-based tourism destination, located in North-Eastern Finland. The results show that landowners' willingness to participate was strongly dependent on the amount of compensation as well as on other terms of the contract, such as the duration and severity of harvesting restrictions. The landowners' preferences for LRVT were somewhat heterogeneous, suggesting that private forest owners have quite diverse motivations and objectives for their ownership. Given the heterogeneity in landowners' preferences, a LRVT model, offering flexibility to join the system, is needed to attract landowners of forests in hotspot locations for tourism that would help in designing a cost-efficient model for practical application.

2.2. Demand side studies

There is a large body of research focusing on the valuation of public goods provided by agricultural and forestry systems (Acharya et al., 2019; Madureira et al., 2013). Estimates provided by this type of studies are useful to identify and assess highly demanded public goods, trade-offs in their consumption, and factors determining the heterogeneity in individuals' values attached to these goods (Bateman et al., 2011; Pascual et al., 2011). In addition, a key outcome from these studies is to express these value changes in commensurable units (e.g., monetary) able to be integrated in governance decision-making processes. The papers included in this special issue are clear examples of this, with the first one (Osseni et al., 2019) using a revealed preference method in French rural areas, two more (Iversen et al., 2019; Mäntymaa et al., 2019) using stated preference methods (DCE and contingent valuation, respectively) in Scandinavian forestry regions, and the fourth using an uncommon valuation approach relying on the individual's economic rent in a case study in Poland (Czyżewski et al., 2020). The contributions of each of these studies are detailed below.

In Osseni et al. (2019, this issue), the negative externality (public bad) associated with harmful algal bloom is analysed by applying a hedonic pricing valuation assessment to the case study of Breton rural housing market (north-eastern France). This externality is very much generated by non-point agricultural pollution and affects the welfare of the population by decreasing the accessibility of beaches for several professional and recreational users (anglers, walkers, joggers, etc.). The study extends the knowledge of the extent of negative externalities resulting from harmful algal bloom pollution for residents, by confirming that this pollution is a major driver of house prices for not only lake environments, as previous literature has repeatedly highlighted, but also marine waters and beaches. It also reveals that that such negative impacts are not spatially concentrated around the source of pollution, but that the effects may spread over the region, e.g. finding statistically significant negative effects of harmful algal bloom pollution on the inland rural housing market. This study also significantly adds on from a methodological perspective, by underlining the need for controlling

potential sources of endogeneity, namely the agricultural characteristics of upstream watersheds, the spatial unobserved heterogeneity, and the adjacency effects on house prices due to housing market functioning.

In Mäntymaa et al. (2019, this issue), the importance of public goods (mainly recreation, aesthetics, and biodiversity) provided by forest systems for nature-based companies is assessed, together with the potential for implementation of a PES system funded by these companies. As a case study, as for Tyrväinen et al. (2020, this issue) Ruka-Kuusamo is used, employing an online survey to compare views from two groups of companies: nature-based tourism companies that produce most services for tourists, and general service companies that produce services for both tourists and local people. The study proves that nature-based tourism companies see forest landscape beauty as being more important for their business than do general service companies. In addition, it posited that if the landscape quality could be improved with respect to the core area of tourism, the business activity of the two company groups would increase equally. If, however, the quality improves in a wider area, both the number of clients and revenues would increase more for nature-based tourism companies than for general service companies. This clearly shows the different private benefits stemming from improving the provision of public goods in forest systems. With regard to company managers' views on financing a PES aimed at improving public goods provided by surrounding forest systems, compared with general service companies, nature-based tourism companies had both more interest in collecting payments from tourists and making a private agreement with forest owners for improving landscape quality. The results hint at the need for developing new governance mechanisms within the PES-paradigm, tailored and targeted to the system context (e.g., targeting landscape improvements to enhance nature-based tourism) and comprising non-pecuniary incentives (due to low interest in entrepreneurs' self-financed PES).

Iversen et al. (2019, this issue) assess people's willingness to pay (WTP) for a national afforestation program for carbon sequestration on recently abandoned semi-natural pastureland in Norway, and the trade-offs between this objective and the provision of other public goods (mainly landscape aesthetics and biodiversity). The assessment is complemented with the estimation of program costs and other impacts (using secondary data) to derive the social net return on different land use scenarios. The results show that any of the program scenarios considered are highly beneficial compared with the status quo of natural reforestation. Taking into account benefits stemming from the provision of the three public goods considered, the best scenario relates to recovering half of the abandoned pastures (with the remaining half left to natural reforestation), closely followed by the scenario of half recovery of abandoned pastures and a quarter devoted to climate forest planting (and the remaining part left to natural reforestation). The results clearly evidence trade-offs between public goods, as the benefits from planting forest to sequestering carbon do not outweigh the 'costs' in terms of lower levels of biodiversity. In addition, worthy of mention are the results from a sensitivity analysis showing that, for the rural population, the ranking of scenarios according to the net present value differs compared with that obtained for the whole Norwegian population, visibly preferring alternatives which only comprise the recovery of abandoned pastures. This spatial heterogeneity in preferences may be explained by the different use values associated with landscape aesthetics and biodiversity of rural and urban residents. In this sense, the higher WTP values among rural households may be motivated by several spatial patterns, especially spatial discounting (i.e., the WTP is lower the higher the distance from the ecosystem) and the lower likelihood that substitutes are present (Granado-Díaz et al., 2020). One of the main policy implication hints at the need for considering values related to other public goods (such as biodiversity) when designing agri-climate policies.

The paper by Czyżewski et al. (2020, this issue) aims at developing a conceptual framework for the economic rent valuation (ERV). The article also presents an illustrative application of ERV based on the case

of the West Pomeranian region of Poland. The rationale for the paper is the fact that agri-ecological infrastructure in rural areas delivers public goods people directly value, such as food, fibre and energy, but the market fails when it comes to public goods, making their valuation difficult. For this purpose, indirect valuation methods are used, though these encounter many methodological issues. In this paper, the authors develop a framework to estimate the economic rent resulting from the random endogenous influences of public goods on production factors in rural areas. The ERV method attempts to reduce the biases of the market-based and contingent valuation methods that result from model misspecification and unrevealed preferences, and advocates for adoption of the variance component model. The paper reveals the potential advantages of ERV and its complementarity with other methods.

2.3. Matching demand and supply

To provide information of the broader picture of public goods provision by agricultural and forestry systems, addressing both sides, supply and demand, is clearly recommended. By doing so, analysts can better support policy-making, for example by identifying hotspots where policy action yields the highest net social gains. Two papers included in this issue, Zavalloni et al. (2019a) and Alcon et al. (2020), are in the same vein as recent contributions incorporating supply- and demand-side assessments of public goods provision by these systems (Gómez-Limón et al., 2019; Tienhaara et al., 2020). Ideally, both sides should be addressed in order to provide more meaningful insights from the policy-making perspective, whilst this may not always be possible due to assessments of this type are very high resources-demanding.

Zavalloni et al. (2019a, this issue) assess the land use, public good levels and welfare deriving from agricultural production and from the provision of three selected goods, namely soil conservation, rural vitality, and carbon sequestration. The method they use is a land allocation model calibrated for the hill and mountain area of the province of Bologna (Italy), in which the public goods society values are the results of a DCE carried out in the Emilia-Romagna region. In the reference scenario land use allocation is driven by the maximization of agricultural income; the results of this scenario are compared with a scenario where land use decisions maximize societal welfare and with a scenario that simulates Measure 13 of the Rural Development Programme (payment for areas facing natural or other specific constraints). The main result is that the societal optimum is reached through a substantial change in land allocation (e.g., a strong reduction in land abandonment and an increase in forest areas) and in the welfare composition (from private agricultural income to public good benefits) with respect to the private optimum. Moreover, generic income support reduces land abandonment but also total welfare, as it has negative effects through the reduction of carbon sequestration and increase in soil erosion. More targeted policies, that more explicitly connect support to public good provision, have better welfare effects.

Alcon et al. (2020, this issue) assess measures dealing with diffuse water pollution, that is a major problem in many agroecosystems, especially in irrigated areas linked to ecosystems of high ecological value. In particular, the paper focuses on agricultural measures aimed at mitigating diffuse pollution by combining relative effectiveness across measures with the perceived and real costs attached to them, for the case study of Murcia region (south-eastern Spain) with the objective of preserving the Mar Menor lagoon, a unique natural site. The real costs of the measures are obtained using market information while the perceived costs are obtained using a representative sample of the farmers at a regional scale. Results show that banning crops in areas within 100m-distance from the coast is the most cost-effective measure, followed by the adoption of a nitrate reduction system in desalinated effluent. The high divergences between real and perceived cost-effectiveness indicate that the adoption of good agricultural practices would require specific actions to reduce this subjective gap, mainly through information able to increase acceptability of the measures

proposed.

2.4. Governance and policy

The previous sections have shown that the provision or the non-provision of public goods is an essential characteristic of agricultural production. It also became clear that the supply of public goods often does not match demand. Policy and governance measures are therefore needed to match supply and demand. The following articles explain how policy shapes the provision of public goods and what measures policy and governance can take to contribute to an improved and coordinated provision of public goods. The first three papers by [Targetti et al. \(2019\)](#); [Ratinger et al. \(2020\)](#) and [Blackstock et al. \(2020\)](#) analyse the importance and possibilities of governance solutions and therefore show the need to involve stakeholders and society in general in order to develop successful solutions for the provision of public goods. The next papers deal directly with agri-environmental programmes and examine the perception of such programmes by society and farmers ([Vainio et al., 2019](#)) or the possibilities of composite indicators to assess the impact of agri-environmental payments ([Bartolini et al., 2020](#)). [Arnott et al. \(2019\)](#) research the impact of a real and very serious policy change, Brexit, on British agriculture and on the provision of public goods.

[Targetti et al. \(2019, this issue\)](#) assess the interactions between rural society, public goods and policies under different, locally relevant economic and social scenarios. The study is carried out in the Marchfeld, an intensive agriculture case-study area in Eastern Austria, which features a number of environmental problems. The authors apply a participatory approach based on the Fuzzy Cognitive Mapping technique, in assessing different policy mechanisms, including improved monetary incentives and the potential for an enhanced design of agricultural landscape governance. The work is based on a two-year-long process including focus groups, mind mapping and scenario co-development, as well as individual interviews with local stakeholders. The results show that integrating private or public, collective or performance-orientated monetary incentives with other non-monetary mechanisms like farmers' partnerships or enhanced awareness building are evaluated as central to an effective agri-environmental governance system. Moreover, the results highlight that different future scenarios have major effects on the effectiveness of mechanisms: in a purely market-driven context, tools based on collaborations among farmers are likely to be ineffective and monetary incentives are less efficient. On the other hand, positive social pressures and the influence of non-monetary governance initiatives expected in a sustainability-driven scenario are able to catalyse an efficient adoption of environmentally friendly practices, also at lower monetary rates.

[Ratinger et al. \(2020, this issue\)](#) present four cases of initiatives for organising the provision of public goods from agriculture and forestry in the Czech Republic and show their common and contrasting features in light of their relevance to local needs and possible integration in the future CAP framework. A particular focus is on the community-based character of these initiatives for the provision of public goods. Several non-governmental initiatives have emerged in recent years in the country. These initiatives are usually started by activists (elites) and take forms such as foundations or trust funds, but often present themselves as collective actions of communal interests. The research shows that elite-driven non-governmental organisations often emerge because of a lack of interest by the public bodies and because local communities do not have the capacity to set up a collective action for the provision of environmentally and socially "beneficial outcomes" (ESBO). The investigated cases, however, show that the new emerging initiatives soon came into conflict with non-involved actors. To improve the governance mechanism, an extension towards a community-based collective action is proposed, but this faces several identified hurdles: a) the difficulty in finding a common interest among actors; b) the difficulty in "sharing power"; c) uncertainty concerning property rights induced by the activities of the NGOs; and d) unfavourable socioeconomic and

institutional conditions.

[Blackstock et al. \(2020, this issue\)](#) explore how policy instruments influence the mix of public goods provided by Scottish agricultural and forested areas, drawing on desk-based and empirical research. The results are structured around four themes: (1) the existence of 'hybrid instruments'; (2) the importance of interdependencies; (3) when hybridity and interdependencies of instruments are designed or emergent; and (4) 'new' governance approaches for public goods. The work suggests that Scottish environmental policy instruments are not only designed to be 'coherent' but can be hybrids of more than one type of instrument; or require interdependency with another instrument to deliver their objectives. While, in general, policy design ensures that public policy instruments are coordinated and not contradictory, the research points to more purposeful interactions taking place 'on the ground' and suggests engagement with the different actors involved in developing and implementing policy instruments. The focus on interdependencies and hybridity taps into wider debates about environmental governance across multiple natural assets. Thus, the shift from individual instruments analysed in isolation to understanding their roles in a wider governance and institutional landscape can contribute to understanding, and potentially overcoming, the existing policy implementation deficit between the aims of EU agricultural and forestry policies and what has been achieved to date.

[Vainio et al. \(2019, this issue\)](#) address the problem of the perceived legitimacy of the current action-oriented and the proposed result-oriented AECS. Perceptions of this topic are poorly known, and this study helps fill this gap by analysing such perceptions in the context of Finnish citizens and farmers. Hypotheses on legitimacy, ecosystem service perceptions and environmental values were developed and empirically tested with nationwide surveys of Finnish citizens and farmers using *t*-tests and multiple linear regression. The results demonstrate that Finnish citizens perceive the proposed result-oriented AECS as more legitimate, whereas Finnish farmers attribute greater legitimacy to the current action-oriented AECS. Among both groups, a preference for action oriented AECS, and reluctance to change them, is associated with the perception that Finnish agriculture has been successful in producing ecosystem services. Also, among both groups, environmental preferences are associated with the legitimization of both AECS. The conclusion is that for a change in AECS to be legitimated, that change should be perceived as necessary, justified, and based on the values considered important by farmers and citizens.

[Arnott et al. \(2019, this issue\)](#) analyse the consequences of Brexit for British farms and subsequent implications for intensification, extensification and land sparing. In their study, they use combined agricultural survey and rural payments data to evaluate the extent of reliance upon Pillar 1 payments, based on a large sample of farm holdings in Wales. With this approach, they are able to eliminate some of the variation found in the Farm Business Survey through the delivery of a more comprehensive picture on the numbers and types of farm holding potentially facing economic hardship and the quantities of land and livestock associated with those holdings. They estimate that 34 % of the sampled farms face serious financial difficulties, showing that 44 % of agricultural land are vulnerable to land use change or abandonment. Based on their results, they consider the potential social and ecological impacts that the removal of direct payments may have on land use in Wales. They also discuss the use of a more balanced approach to land management that could support governmental visions to keep farmers on the land, improve productivity and deliver high quality 'Public Goods'.

[Bartolini et al. \(2020, this issue\)](#) contribute to the ongoing debate on the post-2020 CAP by providing additional reflection and proposing an alternative method to measure indicator-based agri-environmental payments. The aim of the paper consists of estimating a composite indicator to track changes at the farm level. The effects of differential payments on management intensity are calculated by applying a generalised propensity score approach to a case study comprising all

AECSS implemented in the Veneto region (north-eastern Italy). The results show how AECSS have a significant effect on the composite indicator of extensification, but the provision of environmental good differs among the varying levels of payments. Moreover, the effects are unevenly distributed across different payment levels, highlighting puzzling evidence linked to the effect of AECSS payments. Besides this, the authors stressed the complexities in the detection of policy failures based on ex-post data, which result from difficulties in disentangling the effect of each individual cause of failure. They emphasise the need for a different evaluation process for AECSS, which could perhaps combine advanced modelling of the causality of schemes and results with reflexive exercises by engaging the relevant actors and stakeholders.

3. Discussion, policy implications and the way ahead

This discussion summarises lessons learned and insights from each of the topics above and for their interplay; it tries to derive implications for further research.

Supply side studies investigate farmers' costs and WTA for the provision of public goods. Such studies are not so numerous in the literature and mostly hardly comparable, because of the diversity of landscape conditions and farm management features. On the other hand, this heterogeneity is actually the main point of these studies, as it can account for the diversification of costs for the provision of public goods across areas. This holds as well for heterogeneity within the same area, as this enables understanding of what categories of farmers/farms/land are most suitable for participation in public goods provision. It is also worth noting that, while the supply-side studies included in this issue are all focused on monetary valuation, with the above-mentioned usefulness for policy-making with regards to quantifying the land managers' provision of public goods in monetary terms, they may also be limited in explaining the numerous interdependencies interplaying in the joint provision of public and private goods by agricultural and forestry systems. In this regard, integrated assessments involving non-monetary valuation (such as e.g. Schaller et al., 2018) clearly complement such specific assessments by providing a broader picture of this provision.

Demand side studies have been one of the most common typologies of studies related to environmental issues. Studies concerning WTP for environmental goods are now very numerous and continue to grow, while methods are refined (Hanley and Czajkowski, 2019; Johnston et al., 2017). In this special issue, we have collected an heterogeneous group of papers, not only contributing to this literature but also pointing to three additional issues. The first is the need for spatial-explicit analyses, using either revealed or stated preference methods. The second is the search for alternative valuation methods for rent estimation. The third is the role of intermediary companies, e.g., in the forest sector, in interpreting and attributing value to public goods. Both these approaches encourage a reflection on the need to go beyond mere consumer/citizen preferences, but rather move demand into the interplay of factors linking consumers/citizens to the market.

Looking at the literature, there is a remarkably small number of papers addressing both demand and supply of public goods in empirical form. This is despite the fact that the core of mainstream economic analysis indeed uses this approach as a conceptual basis. This is understandable given the difficulty in having good empirical and consistent information on both demand and supply sides for the same area, also considering the interconnection between the different types of public goods. Filling this gap is however a key area of interest and research as it enables direct discussion of the topic of the optimal level of provision of public goods, an issue often neglected or left to the political process of (rather uninformed) identification of policy targets. In this regard, to ameliorate the resources required for a significant assessment of benefits, the use of benefit transfer methods represents a promising option (D'Alberto et al., 2020).

However, "simple" economic identification of optimal provision of public goods, or even the identification of an optimal policy, is not

enough to make it happen. Governance is one of the emerging issues that has probably been neglected by research in the past and is now taking paramount importance. It is not by chance that this has been the topic with the highest number of papers in this special issue. The key point here is that the values emerging in the previous sections (supply and demand) are not given, but rather socially built through processes involving appropriate governance structures and mechanisms leading to action, including trust and acceptance. This also brings to attention the local context and the dynamic of interactions in order to allow transitions, as well as, in some cases, the embedding in community-based solutions. In this sense, hybrids of existing mechanisms, such as collaborative AECSS (Zavalloni et al., 2019b) or community-based environmental certification to grasp commodification potential in food markets (Salazar-Ordóñez et al., 2020) represent hopeful governance options to be developed.

Information and policy support are in the background of most of the papers in this special issue and will surely be the core of future work, in light of the emerging opportunities from digitalisation and big data. Information support systems are increasingly demanded for research projects related to public goods provision by agricultural and forestry systems, as a way to better disseminate and give access to key research results (Zasada et al., 2017). The studies collected in this special issue highlight, however, the need to keep in mind the role of these instruments for decision-making in order to guide the development of new information tools. In particular, when policy is concerned, intervention targeting and payment mechanisms (e.g., based on results) are of paramount importance as a goal for the use of new technologies.

4. Concluding remarks

The issues of the provision of public goods by agriculture and forestry have been dealt with by economic literature for decades. Despite this, it still attracts high (and growing) interest by practitioners and researchers, due to the high "demand" linked to the new policy agenda and higher consumer awareness. Scientific approaches have attempted to develop in parallel to the changing agenda, both in terms of methods and topics addressed. The papers collected in this special issue and the comparative discussion of their findings show that this branch of research is still rather open and needing more effort both on the methodological side and on empirical grounds.

The lessons learned from the papers collected in this special issue hint at two broad directions for research. On the one hand, there is a need to investigate further the micro-mechanisms of decision-making, value creations and coordination among actors, including the micro-level issues in policy design. On the other hand, there is a need to address the topic of public goods taking a holistic view of how agriculture and forestry systems work. The results also suggest that these different approaches need to be better integrated to be useful for answering real-world issues. Hence, finally, this special issue indicates a general message about the need to promote cross-fertilisations and synergies among different methodological perspectives, able to complement one another in meeting these ambitious goals.

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