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New Frontiers of Forest Economics: Forest economics beyond the perfectly competitive commodity markets☆

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ABSTRACT

The paper provides an overview of the papers included in this special issue, and presents thoughts about New Frontiers of Forest Economics. The paper argues that science does not mean analysis alone; it should be complemented by synthesis and forest economics is a promising field to rediscover synthesis as a methodology of science. The paper sets the goal of boundless profession of forest economics and suggests three key areas of research: (i) economic models that interweave other-regarding and non-cooperative self-interest preferences; (ii) rigorous analysis and synthesis of externalities and development of new economic approaches to address the diversity of interrelated property rights of complex ecosystems; and (iii) treating markets and political institutions as entangled institutions.

1. Introduction

In 2011, a working group on the New Frontiers of Forest Economics (neFFE) was formed by Peter Deegen, Martin Hostettler, Shashi Kant, and Sen Wang. The group organized the first International Conference on the New Frontiers of Forest Economics, June 26–30, 2012, at ETH, Zurich, Switzerland. The group's second International Conference on the New Frontiers of Forest Economics: Forest Economics beyond the Perfectly Competitive Commodity Markets was organized at Peking University, Beijing, China, from August 18 to 23, 2015. The conference was hosted by Prof. Jintao Xu at the National School of Development, Peking University, China. The conference was supported by Environmental Economic Program in China (EEPC), National School of Development, Peking University, and co-sponsored by the Rights and Resources Initiative (RRI) and the Environment for Development (EfD) Initiative.

The goal of the conference was to continue the work on forest economics for the 21st century that started at the first neFFE conference at ETH, Zurich, Switzerland. Two key objectives of the conference were: (i) to bring together leading thinkers in forest economics from academia, government, and organizations related to the forest sector to explore thought-provoking perspectives on forest economics beyond the boundaries of perfectly competitive commodity markets, and (ii) to provide a unique forum to present and discuss cutting-edge thinking papers that will enrich and provide future directions to the discipline of forest economics.

Similar to the first conference, the number of participants was restricted to 40, and only 13 papers (2 invited and 11 chosen through a rigorous selection process) were presented. All chosen papers in full length were submitted before the conference, and each paper had two discussants. The presentation by the author of each paper was followed by the presentation of two discussants' reports and open discussion with other participants. Hence, there was a thorough and lively discussion of each paper. After the conference, the authors were given the reports of the two discussants and editors' suggestions/observations on their papers, and they were asked to revise their papers in view of these observations and the observations of the participants during the discussion. We received 11 revised papers that are included in this

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volume. In addition, after the conference the authors of three papers that were presented as posters were asked to submit their full manuscripts. Each of these three manuscripts was reviewed by two referees and one guest editor and the authors revised their papers as per suggestions of two referees and the guest editor.

The papers included in this volume are the revised papers. Similar to the special issue of Forest Policy and Economics that included the papers presented at the first neFFE conference, we are including the reports of two discussants of each paper. The discussant reports were prepared for the first draft of every paper, and therefore the discussant reports provide some idea about the evolution of papers. The combination of the final paper and two discussants' reports may be more enriched reading rather than the reading of the final paper only. The anonymous reviewer's reports are not included to maintain their anonymity.

The papers included in this volume provide multiple perspectives about the New Frontiers of Forest Economics. In addition, many discussants and other participants contributed their thoughts towards the New Frontiers of Forest Economics. Hence, the remainder of this paper is divided into three sections. First, a brief overview of the papers included in the volume is provided. Second, a synthesis of collective perspectives of the conference about new frontiers is presented. Conclusions and acknowledgements are presented in the final section.

2. Overview of the papers included in this volume

The volume starts with Khan (2016-in this issue). In this paper, the author makes a bold attempt to address the tensions between two communities – economists and foresters. The paper attempts to develop an understanding of the basis of tensions and lines of communication to dispel tensions. The author uses economic-anthropological inquiry and mathematically- focused inquiry to achieve his objectives. The author raises some key questions. Are there autonomous principles of forest science? How complementary or substitutable are the principles of forest science for the principles of economic science? Is it all a question of common-sense, or are there different perspectives, different communities, each with its own irreconcilable cultural and political stance, each straining for toleration and accommodation of its other? The author attempts to answer these questions through the readings of Samuelson (1976) and Mitra and Wan (1985, 1986); and he views one in light of the other and use Muir-Pinchot rivalry as the hinge between these two texts. The author concludes that the disagreement is around conceiving a forest as an instrument to be exploited for a society's needs or as something beyond a purposive calculus, optimization, and economics itself. The author suggests many frontiers of forest economics including economics of sustainability and extinction, dovetailing the economics of forestry with environmental economics and the economics and the politics of climate change, Austrian-Wicksellian capital theory, and stochastic capital theory.

In the second paper, Sohngen and Tian (2016-in this issue) present an economic analysis of global climate change impacts on forests and markets. They start with a demonstration of foresters' adaptation to important supply and demand driven shocks that affected timber prices and forest investments in the last century. Typical examples are the changing rotation ages, the increasing intensification of forest management and the movement of species across regions to find better growing conditions. Many of the adaptations that foresters have made will be of the same type as adaptations that foresters will be asked to make by the society in the future in order to adapt to climate change. To consider the implications of climate change, the authors present the results of an integrated assessment analysis that link a dynamic global vegetation model with a global forestry model. The projections show that climate change decreases global timber prices by 15% relative to the baseline, increases the area suitable for forests globally and increases the global growing stock volume per hectare. The authors conclude - while climate change will alter the future, it looks as if the trajectory of forest management techniques to slowly increase global forest stock will continue.

The next three papers are focused on *behavioral economics and its applications to forestry*. In the third paper, Valatin et al. (2016-in this issue) observe that there is enough evidence from behavioral economics to suggest that cognitive factors affect preferences, values and choices of individuals, and policy 'nudges' can influence individuals' decisions in ways that help achieve societal goals. The insights from behavioral economics can be critical for some key elements of forest economics such as the estimation of non-market values of ecosystem services using stated preference techniques. The influence of cognitive factors on values poses a fundamental challenge to economists to develop a valuation framework that allows/incorporates the social endogeneity of preferences in protocols/objectives such as maximization, satisficing, and cost-effectiveness in ensuring safe minimum standards, or in pursuing a rights-based approach. After this introduction, the authors discuss the role of nudges in shifting choices in socially desirable directions and provide evidence from literature. The authors disaggregate behavioral elements of woodland creation using the Stages of Change model and suggest a number of relevant intervention points at which nudges could be applied to encourage woodland creation to help meet climate change mitigation and adaptation goals. The authors suggest that differences in attitudes, circumstances, motivations, and behavior must be incorporated to design nudges for different types of land managers, and pilot studies should be conducted to identify cost-effective nudges. The authors present a strong case for behavioral economics including testing out nudges being an important frontier of forest economics and policy.

In the fourth paper, Kumar and Kant (2016-in this issue) explore the role of revealed social preferences in the outcomes of Joint Forest Management (JFM). The authors present a game theoretic model of JFM and discuss the role of self-interested, altruism, commitment, and reciprocity in JFM outcomes. The authors organized a public good game in five villages of central India to identify social preferences of villagers in each village and measured the state of JFM using 4 criteria and 3 indicators for each criterion. The village-level average allocations to public good game and the JFM outcomes are highly correlated. Villager's preferences are reciprocal in two villages which had high success in JFM while villager's preferences are commitment in three other villages which had moderate to low success in JFM. The authors do not find any significant variation in social preferences across demographic, economic, and social characteristics of villagers. The authors argue that social factors, used by other authors (Kant, 2000; Lise, 2000) to explain JFM outcomes, affect the social norms of individuals and social preferences are the manifestation of evolved social norms in any given social group. Hence, the authors support the case of behavioral economics being an important frontier of forest economics.

The fifth paper is by Kant et al. (2016-in this issue), and this paper extends the boundaries of non-market valuation methods used in forest economics by using the life-satisfaction approach (LSA) to value social, cultural, and land use (SCLU) activities of First Nations people of Canada. The authors argue that the LSA overcomes problems associated with conventional stated-preference methods, such as problems of hypothetical nature of questions, unfamiliarity of the task under valuation, and strategic behavior of respondents, and revealed preference methods, such as the absence of market equilibrium; the degree of market capitalization; and the effects of risk perception distortions. In addition, the LSA does not rely on the assumptions of rationality and perfect information. The authors use a two-layer multi-domain model that includes Financial, Health, Housing, and SCLU domains. The data for model estimation were collected from a First Nation in Ontario, and participatory methods were used for data collection to avoid category fallacy. The authors use three methods – Z factor, 2SLS, and 3 SLS - to address the problem of endogeneity. The SCLU domain contributed more than twice the financial domain to general satisfaction (GS). SCLU activities, such as trapping days, gathering days, traditional diets, quality of time spent on gathering and trapping, and satisfaction with land laws made significant contributions to general satisfaction. The results empirically confirm the view of the First Nations about the importance of SCLU

activities in their welfare and the need to focus First Nations welfare policies on SCLU activities.

Market and political institutions are the focus of the next five papers. In the sixth paper, Deegen (2016-in this issue) examines how markets and political institutions influence the simultaneous existence of private and public timber production. The author models the effects of the separation of forest ownership and forest management, and of private and public ownership using the Faustmann's framework. The author argues that the main difference between public and private timber enterprises is related to the exit clause - public timber production is characterized by a strong exit clause while any stakeholder can exit almost without any constraint in the case of private timber enterprises. In the case of public production, the strong exit clause increases the liability as a technique for hedging the risks of timber production. The degree of separation of the public fiscal decision making into a production and a liability decision increases the impact of liability. The reason for this is that where there is a higher degree of public decision making an unconstrained majority rule applies, which also leads to a transfer of liability to a minority. In addition, the limited time perspective involved in public choices does not outperform the advantage of lower discount rates associated with public timber production. The strong exit clause in public timber enterprises also provides an opportunity for the forest manager to increase the forest rotation length. The paper concludes with some applications of the model to a representative democracy. Hence, Deegen uses the popular Faustmann's formulation to address a completely different issue – the simultaneous existence of public and private timber enterprises – from the issues that are commonly addressed by this formulation.

In the seventh paper, Coordes (2016-in this issue) argues that forest economic theory is based on bilateral exchanges within market institutions while forest management is coordinated by market and political institutions. For example, forest harvests and regeneration are individual actions, but individuals do not interact in isolation. Every individual's actions are restricted by the actions of other members of relevant social groups, including the institutions that have evolved as the results of past interactions. Hence, the physical structural diversity of forests is due to institutional diversity within which forest users interact. The author uses Faustmann's formulation to define the forest owner's objective – to maximize land value – and the non-cooperative game formulation to model the interactions between landowners. The analysis of the game theoretic model reveals that predictions of objectively observable harvest and regeneration ages can vary considerably depending on the property rights assignment and the ensuing institutional setting for exchanges. Optimal harvest ages, as implied by the Faustmann or Hartman models, are subject to fully internalized interdependence settings, and different forest structures emerge as the rights to forests deviate from private rights. Since politically coordinated forest management is not the same as forest managed under privately held rights, external effects cannot be coordinated implicitly or internalized via exchanges of individual property rights. Hence, a single silvicultural solution based on dominant forest economics theory grounded in Faustmann's formulation is not economically efficient under diverse property right arrangements and institutional settings. The paper answers a very important question related to the applicability of Faustmann's rotation age to public forests. The paper also provides empirically testable hypotheses on the evolution of forests within political institutional settings.

In the eighth paper, Zhang (2016-in this issue) examines the role of property rules and marketability of environmental services in designing the schemes for payment of environmental services (PES). The author analyses the joint production process of timber and environmental services and its implication for PES. The joint-production process of timber and an environmental service make it difficult to identify the point that separates the free and privately-driven portion of the supply curve of the environmental service from the portion that needs payment from the users. Hence, the buyers of environmental services have to make a choice between: (i) incurring high transaction costs on the study of opportunity costs of landowners and the environmental benefits their lands could provide; and (ii) paying some landowners money without being able to induce socially desirable land use changes. The author infers that market transactions work better for a single environmental service with well-defined production function, well defined and enforced property rights, and low transaction costs. Government-sponsored PES programs work better especially for multiple environmental services with large but less measurable benefits, production functions being complex or unknown, and for cases when transaction costs are high. For true global public goods such as climate change, the transaction costs are so high that there needs to be a global political commitment before any meaningful markets for these services could emerge. In brief, all PES mechanisms depend on well-defined property rights as well as well functioning governments.

Hyde (2016-in this issue), in the ninth paper, reviews the literature on local forest tenure, case studies in forestry related to tenure, and the broader history of experience with collectives and cooperatives to identify the characteristic cases of successful collective or community forest management. The author identifies four different situations for his review and analysis – cases of broad national and even global resource values, cases of regional and local resource assets, local collectives, and local forestry collectives. On the basis of his analysis, the author infers that successful collective action occurs - where participants share a value for the resource in question, the marginal cost of participant's addition to the group of decision makers is declining and incentives for free riding are limited. The author suggests that: (i) smaller groups of managers may cooperate in labor and capital intensive activities like fire control or harvesting, or in specialized activities beyond their personal expertise such as processing and marketing of products; and (ii) generally agriculture or forest land, except low-valued open access land beyond the perimeter of agricultural crops and managed forests, are not part of successful and sustainable community-wide collective enterprises.

In the tenth paper, Li and Yin (2016-in this issue) argue that China's latest forest tenure reforms have further devolved the use rights of collectively owned forestland and relaxed government control over private forestry operations. However, many features of reforms including restrictions on timber harvest, taking back of devolved forestland without fair compensation, lack of flexibility in local execution, and a rush to form co-operatives limit operational and economic efficiency of reforms. The authors discuss practical solutions to these challenges. The authors argue that it is essential to better understand institutional economics in regard to property rights, collective action, transaction costs, and governance, and to better understand the primary features of forest ecosystems and forestry as well as the rural society of China. The authors hope that this paper will contribute to the continued discussion and more effective implementation of the forest devolution and institutional transition in China.

The next four papers are focused on advancing modeling techniques used in the traditional paradigm of forest economics. In the eleventh paper, Ochuodho and Alavalapati (2016-in this issue) argue that traditional gross domestic product (GDP) estimates fail to explicitly and fully account for natural capital in the system of national accounts (SNA). The authors use United Nation's System of Environmental-Economic Accounting (SEEA) to integrate natural capital into the system of national accounts, and demonstrate how a natural capital-integrated system of national accounts in input-output table can be used as an effective tool for natural resource management and policy analysis in a computable general equilibrium (CGE) modeling framework. The authors provide evidence that without natural capital accounting and integration into the system of national accounts, GDP estimates may give misleading signals as a measure of a region's economic performance, where economic growth could be at the expense of natural capital depletion.

In the twelfth paper, Susaeta et al. (2016-in this issue) present the evaluation of technical, allocative, and total profit efficiencies of loblolly

pine plantations in the southern USA using data envelopment analysis (DEA). The authors use data of 28 plots to assess stand-level efficiency in timber production, carbon sequestration, and species richness. The authors found 96% of forest plots technically efficient and 75% plots allocative or total profit efficient in providing timber, carbon sequestration and species richness. The authors also examine efficiency of these plots under climate change scenarios representing moderate and high greenhouse gas emissions pathways and found allocative or total profit efficiency remains similar to the initial conditions, and total profit efficiency increases.

In the thirteenth paper, Piao et al. (2016-in this issue) evaluate the return and risk characteristics of three types of real estate investment trusts (REITs) (timber, specialized, and common REITs) in the United States using the intertemporal capital asset pricing model (CAPM) and the multivariate generalized autoregressive conditional heteroscedasticity (GARCH) model. Results from the intertemporal CAPM demonstrate that REITs behave like procyclical small and value stocks. Results from multivariate GARCH model show that the conditional volatilities of REITs rise more after good news and REITs as a whole respond positively to past shocks. Despite being a part of specialized REITs, timber REITs have large market capitalizations and no excess returns, and are insensitive to recessionary shocks. Timber REITs have the smallest unconditional variance and are most vulnerable to idiosyncratic shocks.

Yao et al. (2016-in this issue), the last paper, is focused on the validation and enhancement of a spatial economic tool called the Forest Investment Framework (FIF) developed to enable the assessment of key ecosystem services provided by planted forests in New Zealand. The FIF includes timber viability component as well as components on indicative values of carbon sequestration and avoided sedimentation of waterways. The authors validate FIF's timber viability component using data from seven case-study forests in New Zealand. The authors also suggest and discuss water quality, water yield, and recreation to include as new components in the FIF.

3. The east meets the west: analysis and synthesis

The conference started with the guest presentation by Mr. Feng Jiaping, the Chief Engineer of the State Forestry Administration (SFA) of China. The presentation was focused on the progress and reforms of China's forest sector, and is not included as a separate paper in this volume. Feng emphasized that the last five generations of the Chinese leadership, in the past 50 years, have put continuously increasing efforts on protecting forest resources and the critical role of forestry in sustainable development, ecosystem conservation, development of West China, coping with climate change, and in guaranteeing ecological security. In support of these efforts, Mr. Feng discussed a number of laws passed by China and the increase in forest investment from 8.75 billion yuan in 1998 to 432.55 billion yuan in 2014.

Feng also discussed the progress in six areas of forestry. First, China used a three-pronged approach to increase and protect forest area - afforestation and reforestation, protection of natural forests, and the implementation of a logging quota system. Second, wetland resources have been protected, resulting in the total wetland area of 53.6 million ha (5.58% of the total land area). Third, desertification has been brought under control and deserted areas are planted with economic tree species. Fourth, biodiversity and wildlife species have been protected through the establishment of natural reserves, national parks, and other protected areas. Fifth, the forestry sector has maintained an annual growth rate of over 20% in the last decade leading to the total output value of forestry increasing from 409 billion yuan in 2001 to 5.4 trillion yuan in 2014. Sixth, the collective forest tenure reforms have given individualized contract rights to nearly 100 million households benefiting 534 million rural people. The state-owned forest farms and the state-owned forest areas are currently going through reforms to establish ecological refuges to provide ecosystem services.

In short, Feng emphasized the critical role of forests in the subsistence security of the mankind, the security of fresh water resources, the security of homeland, the security for all species, the security of climate, and the sustainable development of both the environment and the mankind, and provided an overview of the efforts of China towards protection of forests, wetlands, biodiversity and wildlife, and other ecosystem services while also increasing the economic returns from forests as well as contributions of forests towards sustainable development.

In essence, Feng's presentation was focused on a synthetic view of forestry[1] while all papers presented were focused on a selected single aspect of forestry. In other words, Feng was focused on the whole while the papers presented were focused on parts. Similar to the dominant paradigm of modern science, forest economics is dominated by analytical thinking that is applied to study the whole system by first dividing the whole into independent non-interacting components and studying each component independently. The whole system is then understood from the study of these independent components. Even though, quantum physics has moved physics beyond the Descartes and Newton's Cartesian view of the universe, forest economics, similar to main stream economics, is still dominated by the Cartesian paradigm. Capra (2010) summarized development in physics as following:

> "In the new paradigm, the relationship between the part and the whole is more symmetrical. We believe that while the properties of the parts certainly contribute to our understanding of the whole, at the same time the properties of the parts can only be fully understood through the dynamics of the whole. The whole is primary….This change of the relationship between the part and the whole occurred in science first in physics, when quantum theory was developed. In those years, physicists found to their great amazement that they can no longer use the notion of a part—such as an atom, or a particle—in the classical sense. Parts could no longer be well defined. They would show different properties, depending upon the experimental context." (Capra, 2010, p.329)

Quantum physicists have realized that nature is not a mechanical universe – an assembly of building blocks – but it is a network of relations. The quantum view of nature is similar to the Eastern worldview of the unity and mutual interrelations of all things and events, in which all things are interdependent and inseparable (Capra, 2010).

The universe, a dynamic whole whose interconnected and interdependent parts are patterns of a cosmic process, can be better understood by synthesis, and not by analytical research; synthesis means the assembly of empirical views to the unity of knowledge (Kant, 1781). Thus with his presentation Feng brought to our mind that science does not mean analysis alone but also synthesis.

In particular forestry, where humans and biosphere are intimately connected, could be a promising field to rediscover synthesis as a fruitful and important methodology of science.

4. Conclusions

Kant et al. (2013), in the special issue of Forest Policy and Economics based on the First International Conference on New Frontiers of Forest Economics held in Zurich, 2012, provide a detailed discussion on the new frontier of forest economics. In summary, Kant et al. (2013) suggested three new frontiers. First, forest economists have to move quickly and openly towards multidisciplinary and transdisciplinary approaches to find socially economic efficient solutions to forestry

[1] Feng's presentation can also be termed as a political rhetoric and not focused. However, such characterization will be a good example of using "either-or" principle which is the foundation of the Cartesian view. With the lens of the "both-and" principle which is the foundation of integration science, Feng's presentation can be a political rhetoric as well as a synthetic view of forestry as well addressing the concerns of multiple stakeholders.

issues. Second, various streams of economics such as behavioral economics, complexity theory, constitutional economics, new institutional economics, welfare economics, organizational economics, and political economics, should be incorporated and integrated into forest economics. Finally, new models and methods using conventional market-based tools of forest economics to answer many unanswered questions will be the third frontier of forest economics. As these three frontiers are already quite broad and inclusive, we do not include additional frontiers.

The fourteen papers included in this volume provide some directions for future research in forest economics, but the objective of this volume is not to suggest the closed boundaries around forest economics. Our suggestion is that the New Frontiers of Forest Economics should be boundless contrary to the dominant paradigm of forest economics. Given the goal of boundless profession, here are some suggestions.

4.1. Moral sentiments and the wealth of nations

Together with the success of behavioral economics during the recent decades, economists have rediscovered the Theory of Moral Sentiments by Adam Smith (1759). Smith starts the book by stating: "How SELFISH soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it except the pleasure of seeing it. …. That we often derive sorrow from the sorrow of others, is a matter of fact too obvious to require any instances to prove it; …" (Smith, 1759: 4). This citation is surprising for many economists because they evaluate Adam Smith as a leading advocate for selfishness. But Adam Smith seriously recognized the change of relationships of individuals from close to far relations. Other-regarding sympathy and non-cooperative self-interest are not contradictory behaviors as Vernon Smith (1998) in his paper "The two faces of Adam Smith" pointed out. Especially in rural areas in which forestry often occurs, personal and impersonal relationships are closely interwoven. The time is ripe for developing economic models which reproduce the rich and diverse interweaving of other-regarding sympathy and non-cooperative self-interest. Forestry in the broadest sense as the management of highly complex ecosystems could present a very appropriate "laboratory" for this kind of research. The papers by Valatin et al. (2016-in this issue); Kumar and Kant (2016-in this issue) and Kant et al. (2016-in this issue) of this special issue could be seen as examples for this kind of research.

4.2. The economic ecosystem approach

The awareness that forests are not collectives of trees but complex ecosystems came more and more to the center of ecological research on forests. An economic consequence of this complexity is the high diversity of property rights. Normally watershed rights, property rights of endangered animals and plants, recreational rights, rights to collect fuel wood, rights to collect medicine plants and much more are distributed to many different property right holders which affect each other. In the common language of economists these relationships are called externalities. These externalities need to be taken more seriously in forest economics. In consequence new economic approaches are called for to analyze the diversity of interrelated property rights of complex ecosystems. The papers by Khan (2016-in this issue) and by Coordes (2016-in this issue) of this issue could be starting points. In addition we recommend the paper by Rosser (2013) of the first special issue of the New Frontiers of Forest Economics as helpful reading for exploring a fruitful line of inquiry.

4.3. From the separated to the entangled analysis of forestry

Whenever forest economists study forestry they distinguish among two groups of institutional arrangements: markets and politics as two separate spheres of society. Forestry in the market sphere is commonly studied with the help of the Faustmann model. Forestry in the politics is mostly studied with the help of models of public finance (cp. cost-benefit analysis, willingness to pay, public good theory etc.) or of public choice theory. However market and political institutions are not separate spheres of society; instead, these institutions are entangled as Wagner (2010) has explained at some length (see also Patrick and Wagner, 2015). "… political agencies no longer stand outside and above the market economy, but rather operate on the same plane of action as all other enterprises in society..." (Wagner, 2010: 163-164); and conversely private corporations do not maximize profit alone, they also seek political outcomes. In particular forestry is a typical example of such entangled relationship where it is not easy to determine which part of the profit is caused by political outcomes and which political outcomes are based on profit. The papers by Zhang (2016-in this issue); Hyde (2016-in this issue); Li and Yin (2016-in this issue) throw some light on this approach.

Finally, as suggested by Kant et al. (2013), no economic framework should become the gospel of forest economics, and everybody is welcome to contribute new and potentially conflicting theories on a diversity of social phenomena in forestry.

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