



Post forest reversal discussion: Restructuring public subsidy system for private forests under the differences of topographic conditions in Norway

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ABSTRACT

Global attention has focused on how to utilize wood resources with less impact on ecological services generated by forests, and governments are restructuring the subsidy system to achieve effective resource governance. We examined (1) the changes in wood utilization against growing wood stock among high-income countries; (2) regional differences in the Norwegian wood stock and its utilization and (3) the allocation system of public subsidies for forestry under the request of balance between wood production and conservation of forests in Norway. The utilization rate of wood differed significantly between the eastern and central-western regions of the country ($P < 0.01$), but there was no significant difference in the growing wood stock per ha ($127.7 \pm 10.9 \text{ m}^3 \text{ ha}^{-1}$ in the eastern region and $119.2 \pm 21.1 \text{ m}^3 \text{ ha}^{-1}$ in the central-western region). The difference in utilization status was significantly correlated with the share of harvestable forest areas located in steeper slopes ($r = -0.935$, $P < 0.001$) and the forest road density ($r = 0.735$, $P < 0.01$). The government strategically implemented both financial support and regulations in each region on the basis of regional differences in wood resource conditions. As is the most of the western countries, Norway faced the competition between conservation and production of forests, and terminated public subsidy for forest in 2003. However, because a change in utilization of Norwegian wood stock ($-2.2\% \text{ yr}^{-1}$) was one of the lowest values among the high-income group between 1990 and 2005, the subsidy was recovered and targeted to galvanize wood production with guidelines of mitigating environmental degradation. The proper allocation of both incentives and disincentives for forest management is pivotal to achieve the sustainable utilization of wood resources in developed countries, which might alleviate the transfer of environmental burden to developing nations through trade.

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Introduction

Under the forest transition (FT) theory, an U-shaped trajectory of forest area change is observed in the course of societal and economic development of a nation (Nagata et al., 1994; Mather and Needle, 2000; Meyfroidt and Lambin, 2008; Rudel, 2009; Rudel et al., 2009; Barbier et al., 2010). The FT theory has been extended to a global scale, pointing out various patterns of forest area recovery and impacts on the course of forest area change through trade (Meyfroidt and Lambin, 2011). The theory highlights the issue of demand leakage; forest-cover reversal of a country could be accompanied by the leakage of forest loss in other countries (Meyfroidt and Lambin, 2009). Although some tropical countries experience a decline in forest cover area because of conversion of forest for food, energy and wood production for economic development (Sohngen and Sedjo, 2000; Foley et al., 2005; Gibbs et al., 2010), some

high-middle income countries have recovered a portion of forest areas once exploited for other land uses (Kauppi et al., 2006; Pfaff and Walker, 2010). It is thus important to promote domestic wood production to mitigate the negative impacts of wood production on a global scale, but it remained unknown if the wood utilization against the domestic stock would be flipped into an increase once a country recovered from deforestation and degradation of forests.

Sustainable forest management (SFM) is one of the most economical means of mitigation and adaptation to climate change (DeFries et al., 2010), but there is increasing discussion of which administrative level can govern forest resources most effectively and efficiently. Decentralization, community resource management and privatization are extensively applied to devolve the responsibilities to the lowest possible level of administration (Agrawal et al., 2008; Phelps et al., 2010). However, the success of the resource management policy depends on socioeconomic conditions, resource conditions, administrative capacity including existence of professional human resources, and redistribution of financial resources (Warmer, 2001; Kakizawa, 2004). Therefore,

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an optimal form of governing forest resources can be changed depending on the spatial and temporal context and an analysis on the policy formation is at play.

International and European trends in forest policy are aimed at the promotion of domestic wood utilization and regulation of unsustainable forestry practices (Schmithüsen and Hirsch, 2010), but little has been considered how a government can supplement the differences of productivity due to topographic conditions (i.e. steepness). 19th century scholar Karl Marx described the concepts of disadvantage, and the steep slopes generally decline productivity and profitability (Kurushima, 1984), calling for a support to compensate for the differences to manage forests in steep terrain. Incentives and disincentives are considered financially and legally (Fortney and Arano, 2010) with a scope of stimulating wood production whilst mitigating the pressure on ecological services (Enters et al., 2004). Nevertheless, in practice, it has been a challenging task for some countries with slope variations how to form a policy with a combination of support and regulations. It is partly because the differences of steepness necessitate a prioritization of funds to offset the decline in productivity and the increase in costs by adopting costly harvesting system (cable yarding) (Fiedler et al., 1999), and much tailor made system being appropriate for the differences of forest locations to avoid environmental problems such as erosions (Enters et al., 2004). For this reason, it is vital to assess how a country does form a combination of support for forest management and regulation of undesirable practices such as evasion of replanting duties to achieve the aim of increasing the national wood production.

Norway embraces 24% of productive forest areas (SSB, 2011a), but the forest resources are underutilized because of the weak forestry support system (Follo, 2011). The growing stock of the country increased from 350 million m³ in 1950 to 800 million m³ in 2000 (UNECE, 2007) owing to underutilization and afforestation after World War II, and there is a necessity to stimulate production for the purpose of satisfying the domestic energy demand (Eid et al., 2001, 2010; Bolkesjø et al., 2006; Sato, 2010; Bergseng and Solberg, 2007) and contribute to mitigate climate change through tree replanting. Although forest administration in Norway was decentralized from the central government to the municipality level in 1994 (Landbruks og matdepartement, 1999), a part of the budget was redirected to the county level in 2007 (Landbruks og matdepartement, 2007a). Knowledge of how, why and to what extent the changes in the governmental decentralization process were implemented in Norway has not been thoroughly documented, although it could provide insights into the ongoing global trend toward decentralization and devolution of power to the lowest level of administration possible. In addition, formulation and delivery of a policy against regional differences in wood resources would be important for countries with forests in complex topographic conditions because the slopes would alter the productivity and may cause environmental problems without a combination of regulations and financial supports (Fiedler et al., 1999).

The objective of this study was to clarify the regional difference in forest resource conditions and the impacts of the restructuring public subsidy for forests in Norway. More specifically, we aim to: (1) clarify the national utilization of wood against the growing wood stock of the world for positioning the Norwegian wood utilization status; (2) explore key indexes for describing the wood resource conditions; the growing stock, status of wood utilization against the annual growth and its association with elevational gradient in each county; and (3) examine a transition of the public subsidy system for private forests, namely the impacts of the budget reallocation from municipalities to the county level in 2007 and discuss its implications.

Methods

Study area

Norway ranked the second-wealthiest country worldwide in terms of GDP per capita (US\$ 84,839 per capita in 2010) (World Bank, 2011) and has a land area of 385,186 km² that accommodates a population of 4.9 million (SSB, 2011b). The climate of the country is characterized by temperate and high precipitation along the coastal zone and colder weather in the interior (the eastern side of the country) (SSB, 2011c; CIA, 2011). In contrast with the increased production of crude oil and natural gas since the 1970s, the contribution of the wood and pulp sector to the national economy has declined; the wood and pulp industry's share of national GDP was 4.1% in the 1950s but declined to 1.5% of national GDP in 2000 (Stødal et al., 2004). The contribution of the sector to employment was 5.1% in 1962 and 1.6% in 2001 with regional differences (Stødal, 2004).

Norway has about 8.0 million ha of productive forests (i.e., forest areas with productivity greater than 1 m³ ha⁻¹ yr⁻¹). Private ownership accounts for about 80% of the total forest area. The number of forest owners is 113,000, of which 20% are female (Schmithüsen and Hirsch, 2010). The composition of the share of the income source of the forest owners is about 80% of revenues from wood sales, and 10% of revenues from hunting and fishing (SSB, 2011d). The main forest species is Norway spruce (*Picea abies*), which comprises about 34.8% of the total forest area and 74.0% of the annual harvest, followed by Scots pine (*Pinus sylvestris*) with 36.6% of the forest area and 23.0% of harvested areas, and broadleaf species which constitute 28.3% of the forest area and 3.0% of the annual harvest (Landbruks og matdepartement, 2011).

The overall terrestrial protected area increased from 7.0% in 1990 to 14.6% in 2010 (United Nations, 2011). In 2010, a total of 9.1 million ha and 2741 zones of terrestrial areas are stipulated as protected areas, of which national parks, nature reserves and landscape protected areas account for 48.6%, 32.9% and 17.8% of these areas, respectively (SSB, 2011e). However, the overlap of protection zone and protected forest areas is relatively marginal. Only 1.7% of the productive forest area in Norway lies within protected areas, which is less than the proportions of 10.7% in Finland and 3.4% in Sweden (Yrjölä, 2002). Nevertheless, greater consideration for ecological services when harvesting timber from productive forests is emphasized in the Forestry Act (Skogbrukslova) (Lovdata, 2011a) and the national forest certification (Living Forests, 2011).

Fig. 1 summarizes the institutional structure of forestry administration in Norway. A section responsible for forestry exists in each of the 19 counties (fylkes kommune) and the 340 municipalities (kommune). The number of municipalities has decreased from 730 in the 1950s because of the administrative restructuring in the course of decentralization (OECD, 2007). The economic incentive program for private forest owners consists of two components: (1) a forest trust fund scheme (established in 1932) and (2) a public subsidy system (established in 1863). The trust fund scheme collects a portion of the timber sales from forest owners in return for a tax reduction and is disbursed by the government based on the request of forest owners for investment in forest management activities (i.e. forest planting, silviculture including thinning) (Lovdata, 2011b). The interest in the trust fund account is utilized for the administration of forestry support systems at each level of the government (SLF: Statens Landbruksforvaltning, counties and municipalities) and supporting entities (e.g., research institutes and forest owners cooperatives) (Lovdata, 2011b). The public forestry grant mainly provides supports for forest planting, tending and thinning (only for first time thinning), forestry road construction and cable logging activities. There is an additional allocation from the government, aiming at enhancing the forest management

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