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Intensifying Forest Management in China: What does it mean, why, and how?

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ABSTRACT

Driven by increased space demand for urbanization and conservation as well as demand for food and bioenergy, competition for forestland in China has intensified. Meanwhile, the forestland in China has been poorly managed, leading to low stand quality, growth rate, and ecosystem functionality. Thus, an overarching question has been how to manage the country's forestland more efficiently. The objective of this paper is to address this question by assessing China's forestry development strategy, policy, and practice against the potential of its forests and the goal of its society. Our analysis suggests that a crucial pathway is to implement a classified management strategy, whereby a small portion of suitable forestland is dedicated to intensive plantations for producing timber and fiber, while a selective but large part of the other commercial forests will be more effectively managed to provide ecosystem services as well as to produce timber. Increases in growth and yield from these forests will result in positive feedbacks such that a larger amount of remaining forestland can be devoted to other non-timber uses to achieve sustainability nationally. In addition, a substantial portion of forestland has been and will be further set aside as nature reserves, wildlife habitats, and forest parks, etc. To implement this strategy successfully, China must make transform its forestry organizational and governance systems.

1. Introduction

Driven by economic and population expansion, increased space demand for urbanization and conservation, as well as demand for food, bioenergy, and timber, competition for forestland in China has intensified and is expected to further intensify in the coming years (SFA, 2015a,b). Meanwhile, forestland in China has been poorly managed, leading to low stand quality, growth rate, stock volume, and ecosystem functionality (SFA, 2015a,b). Thus, the Chinese government has expressed a strong desire to substantially increase timber and fiber production from its intensively managed plantations and much improved management of other commercial forests as part of its overall forestry development strategy (SFA, 2016). Additionally, China has also included forest-based mitigation as part of its commitments to attaining the targets of the Paris Agreement in fighting climate change—to boost the stock volume by 4.5 billion m^3 from 2006 to 2030 (NDRC, 2015).

As such, an overarching question has been how to allocate and manage China forestland more effectively in order to significantly improve the vitality and productivity of its forest resources to meet the ever-increasing demands for a whole host of ecosystem services. The objective of this paper is to address this question by critically assessing China's forestry development strategy, policy, and practice against the potentials of its forests and the goals of its society.

Drawing upon the international literature, we argue that a crucial pathway for China to improve its forestland use is to implement a classified management strategy, whereby a small portion of suitable land is devoted to intensively managed plantations for timber and fiber production, while a large, selective part of the other existing forestland will be more effectually managed to provide other essential ecosystem services as well as to produce timber and fiber. Moreover, increases in growth and yield from these segments of the forest ecosystems will result in positive feedbacks such that a larger amount of the remaining forestland can be dedicated to non-commercial uses to balance the competing demands for multiple services and achieve long-term sustainability on a national scale. At the same time, a substantial proportion of forestland has been and will be further set aside permanently as nature reserves, wildlife habitats, forest parks, etc. Of course, we recognize and will further articulate that a key premise for executing this strategy successfully is that China can fundamentally transform its forestry organizational and governance systems, which is the aim of this

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Special Issue, so as to greatly improve the management of its forest resources.

As a matter of fact, the Chinese government decided to adopt such a classified management strategy more than two decades ago (Yong, 1992; Yin, 1998). Unfortunately, it has been badly executed, as reflected, among other things, in the poor quality and low productivity of its plantation forests, the lack of substantive efforts of managing existing forests, and the virtual absence of a forest-products manufacturing industry that is well linked with timber and fiber production in or near the major forest regions. Consequently, the country has failed in accomplishing its strategic goal of producing 150 million m^3 of timber annually from commercial plantations thus far, and it has faced some tough challenges in its forest sector. This study will help elucidate how China can tackle these challenges and thus move onto a more constructive path of development.

Our paper is organized as follows. In the next section, a review of the multiple strands of the relevant literature will highlight the research developments regarding intensified land use in general and forestland use in particular in the broader context of sustainable development. In Section 3, we will synthesize the micro-level economic analyses of intensively managed pine plantations in the literature, which we hope will further illustrate the financial and silvicultural meaning, as well as the importance of, plantation forestry. In Section 4, we will examine China's current situation and identify what its main challenges are. In Section 5, we will lay out the crucial policy measures and reforms for China to overcome these challenges to accomplish its goals over the next 15–20 years. Finally, some concluding remarks will follow in Section 6.

2. Macro-level research advances

There have been studies of sustainable intensification of land us at the macro level in the literature. Most notably, Meyfroidt and Lambin (2010) observed that "A more optimal adjustment of land uses to the land capacity and concurrent land-use intensification is one of the basic mechanisms of forest recovery at a national scale. A more intensive land use concentrated on a small area may also reconcile raw material production with environmental conservation at the global level." Lambin and Meyfroidt (2011) further noted that "Two contrasted—but not mutually exclusive—approaches have been proposed to manage future land use: One attempts to reconcile production with ecosystem conservation locally through nature-friendly farming, whereas the other one separates them further through regional land use specialization…, which may increase the global efficiency of land use and thus can spare land for nature." (p. 3469). In their view, thus, land use transition can be realized through multiple interacting mechanisms including farming and forestry intensification, land use zoning, and natural forest protection.

Recent discussion of sustainable intensification of agriculture has gained momentum (Godfrey et al., 2011). For instance, De Vivo et al. (2016) remarked that:

> "*With the Earth's population predicted to rise to nine billion by 2050, we must increase the yields of global agriculture without environmental degradation or cultivating more land. Producing 70 percent more food for an additional 2.3 billion people by 2050, while at the same time combating poverty and hunger, using scarce natural resources more efficiently, and adapting to climate change are the main challenges world agriculture will face in the coming decades. Given these challenges, current approaches are or may become unsustainable. We must find new methods that address all elements of the agricultural system… The sustainable intensification of crop production approach focuses on the need to feed a growing population while coping with an increasingly degraded environment and uncertainties resulting from climate change. This concept provides opportunities for optimizing crop production per unit area, taking into account the range of sustainability aspects including potential and/or real social, political, economic and environmental impacts*."

Similar research has been undertaken by forest policy analysts as well. Ever since the late 1970s, scholars at the Resources for the Future (RFF) have been exploring ways of meeting the challenges related to land allocation and provision of ecosystem services more efficiently. Applying economic efficiency criteria to the management of Douglas-fir forests in the Pacific Northwest, Hyde (1980) projected that harvests from all lands could be increased by 74% annually at the currently expected prices. He further posited that a smaller timberland base implies more remaining land to meet the competing demands of dispersed recreational and environmental interests and, thereby, reduction of the intense industry-environment conflict. In his Forward to Hyde's book, Marion Clawson, the Director of RFF at the time, stated that "the United States has the capacity to produce substantially more of all outputs than it currently does, but realizing that potential will be neither easy nor simple… General considerations arising out of this situation led Resources for the Future to recruit William F. Hyde to its staff… This book is the capstone and the culmination of his research at the Resources for the Future."

Then, another RFF fellow, Roger Sedjo, published his work on the comparative economics of plantation forestry. In that book, he examined the potential financial returns to plantation forests in a number of promising regions around the globe (1983). Later, Sedjo (1999) revisited the question of the potential of plantation forestry, which confirms what he found earlier—plantations from nontraditional regions have been growing rapidly in size and economic importance, and, thus, have been playing an increasing role as a source of the world industrial wood. Furthermore, experience suggests that plantations are playing an environmentally beneficial role in reducing pressure on greater areas of natural forests and generating positive ecological effects as they replace degraded marginal agricultural lands.

According to the Global Forest Resource Assessment (FAO, 2015), natural forests accounted for 93% of the world's total forest area in 2015; planted forest area increased from 167.5 to 277.9 million hectares since 1990, amounting to 7%. Meanwhile, Payn et al. (2015) reported that in 2012, 46.3% of industrial roundwood came from planted forests globally, and Buongiorno and Zhu (2014) estimated that planted forests reduced harvesting from natural forests globally by 26%. Therefore, Payn et al. (2015) asserted that "Intensification of production in existing forests will lessen the need for greater forest areas and offset any land use conflicts related to food security."

Furthermore, as of 2011, about 30% of the world's forests were designated as production forests, and close to 28% of the forest area was managed for multiple-use to provide a range of products and services simultaneously; meanwhile, the conservation of biodiversity represents the primary management objective for 13% of the world's forests, and the area of forests designated for protection of soil and water has also increased to 31% of the forest area (FAO, 2015). Clearly, classified forest management, or zoning, in conjunction with the establishment of plantation forests and protected areas, has been a megatrend of forestry internationally.

Notably, while the early works conducted by RFF and other scholars did not spell out such concepts as land-use zoning or specialization, their core ideas clearly showed their thinking along this direction. Most of these studies have examined the issue of land allocation from the perspective of economic efficiency, behind which lies the evolving market dynamics driven by increased demands and constrained supplies. On the other hand, these efficiency-oriented explorations have not necessarily been well captured in the more recent literature of sustainable intensification of land use.

3. Micro-level research developments

Around the turn of the century, one of the authors of this paper (Yin), working with his collaborators, carried out two novel