*PRIMAFF Review* No.71(2016.5),pp6-7

# Assessing the Impact of Wood Energy Utilization on Forest Management Practices and Local Economy

## — A Case Study in Nishiwaga Iwate —

Daisuke KUNII, Takashi HAYASHI, Daisuke SAWAUCHI

## 1. Introduction

Forest management practices like thinning are important to maintain the multifunctionality of forests and produce high quality timber on planted coniferous forests, which occupy more than 30% of the forests in Japan. However, owing to low demand for domestic timber and decreasing use of thinned wood, appropriate forest management practices have not been implemented in most of the planted forests in Japan. Demand for thinned wood, especially, affects the practice of thinning, thus, demand creation is very important. Recently, woody biomass like thinned wood has been drawing attention as a carbon neutral energy source and using thinned wood for energy is expected to promote forest management practices.

Resource availability, economic merit to the energy users, and positive economic impact on the region are important points to consider for sustainable use of wood energy. Furthermore, assessing the feasibility of forest management practices is also important for promoting wood biomass utilization and suitable forest management practices that advocate using thinned wood for energy. However, few studies so far have analyzed wood energy use from these four aspects.

This study aims to develop a framework for multi-dimensional assessment of wood biomass utilization for energy, and apply it to a case of wood chip use at a municipal hospital in Nishiwaga, Japan. In this town, the municipal hospital switched its heating energy source from heavy oil to wood chips processed from the wood thinned in the municipal forest. In our framework, we assess the activity from four aspects as follows;

(1) Supply and demand balance of wood chip
(2) Cost reduction effect for wood energy users
(3) Economic impact on local economy
(4) Impact on forest management practice

## 2. Methods

At first, we estimated supply and demand balance of wood chip and thinning area for each year from 2012 to 2030 using geographic information systems (GIS) and liner programing (LP) on forest registration data, elevation data, road network data, data for demand of wood chips at the hospital, and so on. Next, we assessed the cost reduction effect on the hospital by comparing the hospital's annual cost of using wood chips to that of using heavy oil for heating. The cost of heavy oil was estimated as the equivalent amount of calories generated from wood chips used in the hospital. Then we estimated local economic impact of wood energy use by Input-Output (IO) analysis. Finally, we estimate the forest area that needed thinning to meet the wood chip demand of the hospital, and we consider the impact on the forest management practice in the town.

In this study, we make some assumptions based on actual forest management practice in the town. We assumed that thinning was carried out until the supply reached the hospital's demand; therefore, the maximum amount of supply was limited to the demand. We focused on town-owned planted coniferous forest (*Cryptomeria japonica*). Trees comprising 30% of forest volume were thinned at the forest age of 25, 35, and 45 years. Only 27% of thinned wood was extracted from the forest; 40% of the extracted thinned woods was used as fuel wood chips in the hospital; and 60% of it was used as construction material. For economic assessment, we excluded the initial investment of facility installations and used the values as of 2012 for consumption tax and heavy oil price.

## 3. Results

### 3.1 Supply and demand balance of wood chip

The annual consumption of wood chips at the hospital was estimated at 1442 $m^3$. On the other hand, the estimated amount of wood chips obtained from the thinning in the municipal forest varied from 479 $m^3$ to 1442 $m^3$ per year, reflecting the forest area and volume that needs to be thinned each year. The findings imply that the wood chip supply from the municipal forest alone will not meet the wood chip demand.

### 3.2 Cost reduction effect on wood energy users

The annual cost of wood chip for the hospital was estimated at 5.3 million JPY. Meanwhile, the heating cost, when they used heavy oil instead of wood chip, was calculated to be 11.9 million JPY at the 2012 price of heavy oil. Thus, by using wood chip, the hospital would reduce its heating costs by 6.61 million JPY.

Original; Japanese
Translated and published in Sept. 2018

## 3.3 Economic impact on local economy

For estimating the economic impact on local economy, we compared, for both the cases of using wood chips and heavy oil for heating, the retained expenditure out of the hospital's expenditure for heating and the induced impact on the local economy (Table 1). Since all of the wood chips were produced within the town, 93.6% of expenditure made on them was retained in the town as the residents' income. On the other hand, since fossil fuels are imported, only 6.1% of the expenditure for heavy oil was retained in the town. This means that retained expenditure for wood chips was larger than that for heavy oil, even though total expenditure on fossil fuels was larger than that for wood chips. Then we estimated the induced economic impacts based on a 35-sector southern Iwate IO table for 2009, an updated version of the 2005 table by the authors. Induced economic impacts to the tune of 6.57 and 0.97 million JPY were brought about by the use of wood chips and fossil fuels, respectively (Table 1). Therefore, it was clear that the impact on local economy due to using wood chips was about seven times higher than that involving fossil fuels.

Table.1 Impacts on the local economy

| | Wood chips | Fossil fuel |
|---|---|---|
| Increased sales in the town (M JPY/year) | 5.3 | 11.9 |
| Retaining rate (%) | 93.6 | 6.1 |
| Retained expenditure within the town (M JPY/year) | 4.96 | 0.73 |
| Induced impact on the local economy* (M JPY/year) | 6.57 | 0.97 |

* Induced economic impacts were estimated by IO analysis. IO Table for sourthern Iwate prefecture in 2009 that was revised from IO Table in 2005 was applied.

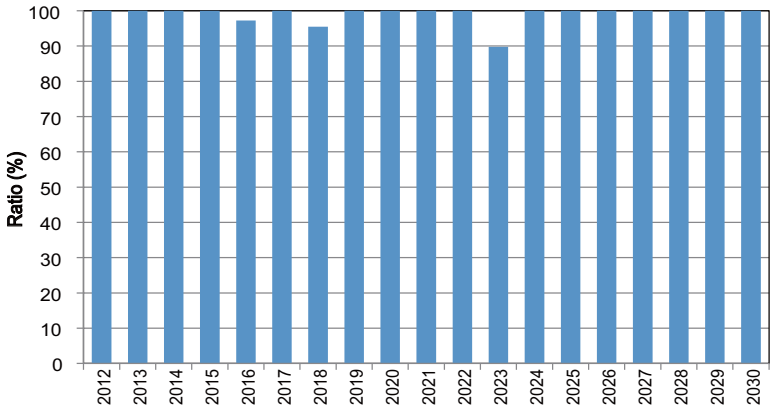


Figure 1. Ratio of thinned forest area to the forest area need to be thinned.

## 3.4 Impact on forest management practice

Finally, we considered contributions of wood chips utilization at the hospital to improve the forest management practice in the town. Thinning could be performed in 17 to 88 hectares of the municipal forest to supply wood chips to the hospital, and the amount of the wood chips thereby obtained was estimated from 479 $m^3$ to 1442 $m^3$ per year. This means that thinning could be implemented in most of the forest where is needed to implement thinning in each year (Figure 1).

## 4. Conclusion

We applied, to the case of Nishiwaga town, a framework to assess wood energy utilization from the aforementioned four aspects. We found that, in the case of Nishiwaga, wood energy consumption reduced the heating cost of the hospital and generated a larger economic impact on the local economy than did fossil fuel consumption, and using thinning wood for energy contributed to forest management practice. However, the supply of wood chips from only the municipal forest could not satisfy the demand of the hospital continuously. Therefore, the hospital would have to look for an alternative way to gather wood chips to meet its demand for wood chips.

Assessing the four aspects in this study, we can identify the effects of using wood energy in the local area. Using the framework of our study, local government officers, and those holding responsible positions could anticipate the merits and challenges of using wood energy, and they could consider measures to face the challenges. Our framework could also be applied to other biomass utilization activities.

Acknowledgement

Part of this study was published in Hayashi et al. (2017).

Reference

Hayashi, T., Sawauchi, D. and Kunii, D. (2017) Forest Maintenance Practices and Wood Energy Alternatives to Increase Uses of Forest Resources in a Local Initiative in Nishiwaga, Iwate, Japan. *Sustainability* 9, 1949-1961.

Original; Japanese
Translated and published in Sept. 2018