

# A systematic literature review on the cessation of human intervention to semi-natural forests

Akiko OONO<sup>1</sup>, Chiho KAMIYAMA<sup>2</sup> and Osamu SAITO<sup>3</sup>

<sup>1</sup>Non-member of JSCE, Student, United Nations University Institute for the Advanced Study of Sustainability  
(5-53-70 Jingumae, Shibuya-ku, Tokyo 150-8925, Japan)

E-mail: oono@student.unu.edu

<sup>2</sup>Non-member, Research Associate, United Nations University Institute for the Advanced Study of Sustainability

<sup>3</sup>Member of JSCE, Academic Director, United Nations University Institute for the Advanced Study of Sustainability

Underuse of production forests has been acknowledged as a key challenge both in addressing environmental degradation and sustainable forest resource management in Japan. The objective of this study is to explore the scientific knowledge landscape on when, why, how, and by whose decision, underuse took place, beyond Japan's context. A literature search was performed on two databases, namely Web of Science and SCOPUS, and a total of 204 publications describing the cessation of forestry management, were reviewed through a systematic literature selection. We identified that forestry management was ceased mostly in the mid-20th century for the reasons of socioeconomic changes, and its consequences were brought about by natural ecosystem process such as canopy closure, stand growth and litter accumulation. The main type of decision-maker for the cessation of forestry management was Non-Industrial Private Forest Owners who were subjected to prolonged unprofitable forestry caused by the introduction of fossil fuels, chemical fertilizers, and other substitutes for forest products, and work force shortage due to rural depopulation. The research gaps identified was the insufficient research on the evaluation of underuse, to what extent underuse is regarded as "under"-use both from ecological aspect and the aspect of sustainable use of forest resources. Quantifying the extent of underuse in the aspect of both sustainable yield and ecological soundness would be beneficial for us to further discuss to what extent we should use and manage forest ecosystem goods and services in a sustainable way.

**Key Words :** *underuse, cessation of forestry management, satoyama, abandonment*

## 1. INTRODUCTION

Underuse refers to the state of abandonment of secondary environment (e.g. farmland and forest) and its facilities due to depopulation particularly aging and desertion in rural areas, and of dependence on crops and fuels from outside of the society, to the extent that changes industrial structures and affects natural environment and biodiversity<sup>1</sup>. Underuse takes place only in human-modified environment which used to have regular human intervention<sup>2), 3)</sup>. It has been acknowledged that underuse is a key challenge both in addressing environmental degradation and sustainable forest resource management in Japan. According to the National Biodiversity Strategy of Japan 2010-2020<sup>4)</sup> and Japan Biodiversity Outlook 2<sup>5)</sup>, reduced human activity in secondary environment is regarded as the second crisis of biodiversity, and the Japan Satoyama Satoumi Assessment<sup>6)</sup> also reported

that it is one of the direct drivers of environmental degradation leading to biodiversity loss.

In contrast to the negative significance of underuse, intentional abandoning of former human-modified environment is employed as a conservation technique mainly in Europe, and such techniques are called in various ways, for instance, nonintervention<sup>7), 8), 9), 10), 11)</sup>, hands-off management<sup>11), 12)</sup>, rewilding<sup>13)</sup>, or setting-aside<sup>14), 15)</sup>. In contrast, there are concerns regarding the altered state of ecosystems due to the cessation of forestry management, which are regarded as, for example, forest management neglect, undermanagement, derelict woodland. Thus, it remains unclear how far the idea of underuse in Japan's context is applicable to the international context.

The objective of this study is to explore the scientific knowledge landscape on when, why, how, and by whose decision, underuse took place, beyond Japan's context, to identify research gaps in addressing sus-

tainable use of benefits that forests provide.

## 2. METHODS

This paper is based on a systematic literature review, a methodology which differs from conventional reviews in that it aims at synthesising research in a systematic, transparent, and reproducible manner<sup>16)</sup>. The rationale behind systematic literature review is characterized as being transparent, focused, equal, and accessible, providing clarity, allowing for unification of research and practitioner communities, and overall leading to synthesis<sup>17)</sup>.

### (1) Search process

A literature search was performed in 1 May 2018 through two databases, i.e., Web of Science (WoS) and SCOPUS. Main search terms for the review were established based on the preliminary literature review on the decline in forestry management. The main query phrases were categorized into 4 types: A) underused forest ecosystem; B) underused forest resource; C) abandoned forest management; and D) under-/over-use of natural resource, and the synonyms of each term were listed to compile other possible expressions in similar meaning as shown in **Table 1**. For type A, for example, each keyword in group 1 is combined with each keyword in group 2 within the distance up to three words, and a total of 567 phrases were, then, combined with the Boolean operator 'OR' to create a search string. This produced 1,013 hits in total. The timeframe of the search was not predefined.

### (2) Exclusion criteria

Though systematic literature review can also include other types of publications, to guarantee quality and to reduce the sample to a manageable amount, we eliminated the following publications that are: patent, data set, data study, legislation, note, letter, trade publication, and conference review. Likewise, language was limited to English. After duplicates were cleaned, a total of 558 papers remained.

The 558 papers identified in the literature search were screened to determine if they met two relevance criteria as decline of human intervention to former human-modified forests, or reduced use of forest resources due to decline of human intervention to forest. A total of 204 papers fulfilled these criteria.

## 3. RESULTS AND DISCUSSION

**Figure 1** shows the number of selected papers by year of publication, as well as the accumulated number of papers in the selected literature set, both for Japan and other countries. The number of publications on non-Japanese sites has constantly appeared from the late 70s and started to increase from the late 90s up until present. While constant appearance of the publications on Japanese sites began a lot later from the first decade of 21st century, thereafter the number has been gradually increasing although fluctuating.

**Table 1** Keywords operationalized for search

A	1. Forest ecosystems forest OR woodland OR woods OR plantation OR coppice OR satoyama OR planted landscape OR semi-natural forest OR semi-natural woodland
	2. Declined intervention (nouns and adjectives) underuse OR underutilization OR undermanagement OR dereliction OR hands-off OR non-intervention OR underused OR underutilized OR undermanaged OR derelict
B	3. Forest resources forest resource OR forest ecosystem service OR woodland resource OR woodland ecosystem service OR wood OR natural resource OR ecosystem service
	4. Declined use (nouns and adjectives) underuse OR underutilization OR undermanagement OR undersupply OR hands-off OR nonintervention OR underused OR underutilized OR undermanaged OR undersupplied
C	5. Forestry management forest management OR forest practice OR stand management OR forestry OR forestry management OR forestry practice OR forestry activity OR woodland management OR plantation management OR coppice management OR coppicing OR satoyama management OR planted landscape management OR silviculture OR silvicultural management OR silvicultural practice OR silvicultural activity
	6. Discontinued states (nouns and adjectives) dereliction OR abandonment OR abandoning OR cessation OR insufficiency OR decline OR derelict OR abandoned OR ceased OR insufficient OR declined OR declining OR hands-off
D	7. Natural resources natural resource OR ecosystem service
	8. Under-/over-use (nouns and adjectives) (underuse AND overuse) OR (underuse AND over-exploitation) OR (underuse AND over-) OR (underutilization AND overutilization) OR (underutilization AND overexploitation) OR (underutilization AND over-) OR (undersupply AND oversupply) OR (undersupply AND overexploitation) OR (undersupply AND over-) OR (underused AND overused) OR (underused AND overexploited) OR (underused AND over-) OR (underutilized AND overutilized) OR (underutilized AND overexploited) OR (underutilized AND over-) OR (undersupplied AND oversupplied) OR (undersupplied AND overexploited) OR (undersupplied AND over-)

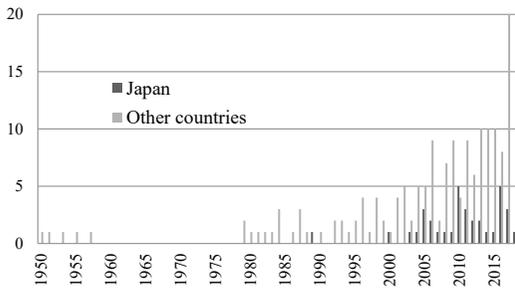


Fig.1 Year of publication

### (1) When did forestry cessation happen?

The information on the reported time of ceased forestry management or abandonment of forest was collected from the relevant literature set, if available. Duplicated reference sources on the time of ceased forestry management were thoroughly removed, and a total of 146 data were plotted in **Figure 2**. Cessation of forestry management had sharp increase in the 40s outside of Japan and hit the peak in the 50s. Two thirds of the papers on non-Japanese sites are concentrated in the period from 40s to 60s, but thereafter it constantly decreased until unreported after 2000. As for Japan, forestry cessation started in the 50s and hit the peak in the 60s. Number of reports in the 60s consists of two thirds of the total. Forestry cessation sharply dropped in the 70s and was moderately reported until 80s before unreported from the 90s in Japan. For both Japan and other countries, cessation of forestry management or abandonment was concentrated in the mid-20th century, though there is a ten-year time interval between the peaks.

Although the number of publications describing the cessation of forestry management has been increasing in recent years (**Figure 1**), the information on the timing of ceased human intervention to forests remain concentrated in the mid-20th century soon after the World War II. For that reason, it implies that the cessation of forestry management could commonly

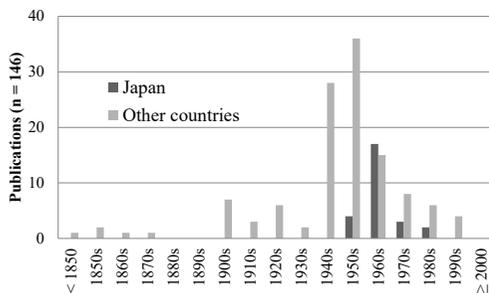


Fig.2 Time of forestry cessation

began in those countries involved in the overexploitation of forest resources for wartime necessity.

### (2) Why did forestry cessation happen?

The reasons for the ceased management were compiled with multiple attributes from 125 papers out of 204 documents. Results of Japan and other countries were plotted as shown in **Figure 3**. Causes of forestry cessation are sorted in four main groups: Economic, Social, Technological and Environmental. In the group of Economic causes, substitute products mostly mean the introduction of fossil fuels and chemical fertilizer that substituted firewood, charcoal and manure. Unprofitable forestry is a combined expression for the following Rise in production cost and Depreciation of forest products that unables to make ends meet. Import means the translocation of production that leads to the following Demand decline of domestic forest products and subsequent Market crisis. In the group of Social causes, the absence of those who are actually engaged in forestry is illustrated as Depopulation, Workforce shortage and Remote owners. Decline of aid-network a loss of mutual support among neighbours when conducting forestry practices. As a technological cause, Mechanized forestry is unable to access to steep slopes and therefore it could be a cause of forestry cessation. Finally, Reserve designation in the group of Environmental causes, is a protection strategy that restrict human intervention.

It was found out that the cessation of forestry management was mostly due to economic reasons both in Japan and other countries. Social reasons are also common both in Japan and other countries though the numbers were smaller than that of economic reasons, except for depopulation in non-Japan countries, suggesting that forest products were replaced by

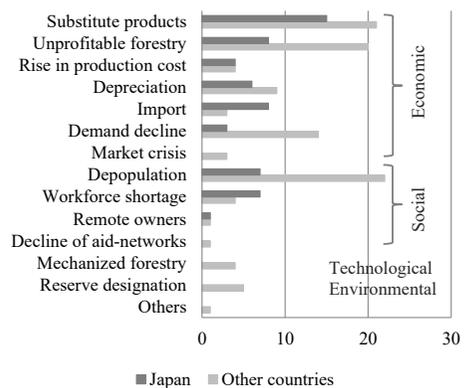


Fig.3 Causes of ceased forestry management

substitutes and were no longer closely related to people's lifestyle regardless of country after the mid-20th century. Regarding the groups of Technological and Environmental causes, these were only reported in non-Japan countries in the set of documents.

Postwar recovery and development were enabled by the massive economic growth which concomitant with socioeconomic changes around the world. As was often the case with forestry industry, socioeconomic changes like energy revolution, timber import, reserve designation, and large-scale agriculture with imported chemical fertilizers deprived the needs for forest products and resources that gave forestland owners no other choice but abandoning forestry management. Subsequently, outmigration of rural population accelerated the decline of forestry industry. Again, therefore, socioeconomic changes are reasons for the cessation of forestry management are commonly experienced both in Japan and other countries.

### **(3) How did forestry cessation cause the changes?**

The consequences of forestry cessation varies. The majority of papers is on the adverse effects of ceased forestry management that caused the decline of species diversity, suppressed tree growth and stability, and disasters. There are, however, some papers concluded with the positive effects of reduced human disturbance on specific invertebrate, vertebrate species or disturbance-intolerant plant species, as well as on high potential of biomass resources. It is important to note that such papers on positive effects of ceased forestry management were focusing on one aspect of forest, either on a specific group of species or potential biomass stocks, so it is inconsiderable to simply say that underuse has positive effect on environment or resource production, and vice versa.

The changes in abandoned human-modified forest were brought about through two main groups of causes: natural succession, and the state of altered forest ecosystems. Among the changes in natural succession, vast majority of driver was canopy closure followed by fuel accumulation and overgrown/densification of stands. Significant reduction in light availability in forest floor has been repeatedly reported in a number of studies to have changed species composition. Such natural succession then alters the composition and structure of forest ecosystems leading to landscape homogenization, species replacement, decline in the stability of

shade-intolerant tree species, and pest/pathogen outbreak, due to higher competition for light, nutrient and water.

Drivers of changes such as canopy closure, stand densification, and litter accumulation are developed by natural successional process which automatically progress as time advances, and needless to say that this is a universal phenomenon around the world. The problem is, unlike natural forests, human-modified forests do not always return to the original successional state by themselves after the cessation of human management, and therefore natural succession could alter biodiversity and landscape structure often in a negative way. Thus, there seem to be no apparent difference between the process of environmental changes in Japan and other countries.

### **(4) Who decided on the forestry cessation?**

Given the fact that the most of the causes of forestry cessation listed in **Figure 3** were attributed to Economic and social reasons which tend to incur a loss more to small-scale private forest owners than public owners, and also reserve designation is the only cause of forestry cessation, of which decision-makers are governmental agencies, it is suggested that the majority of actors contributing to making decisions on forestry cessation could be Non-Industrial Private Forest Owners (NIPFOs). NIPFOs and governmental agencies are therefore two types of decision-makers identified to have been responsible for forestry cessation.

The former is highly subjected to economic circumstances like prolonged unprofitable forestry resulting in the decline in prices/demand of domestic timber and non-timber forest products. With such difficulty in making ends meet, many small-scale private forest owners abandoned their forest property. Rather they were just caught up in the tide of rapid socioeconomic changes listed in **Figure 3** that made forestry and the use of forest products no longer active. This type of actors is the majority contributing to environmental changes both in Japan and other countries.

The latter designated forest reserves for conservation purposes, and/or encouraged forest owners to set-aside their property where they were paid to leave the land without crop production. Among the set of documents used in this study, there was no report unlike outside of Japan, which addresses the policy intervention for intentional forest abandonment in Japan.

Although policy decisions on the extent of envi-

ronmental protection vary in country to country, the influence of decline in forestry industry on small-scale forest owners is more or less a universal phenomenon regardless of country after the mid-20th century. Therefore, the majority of actors on the discontinuance of forestry management is, again, common around the world.

#### 4. CONCLUSION

We identified that forestry management was ceased mostly in the mid-20th century after the World War II both in Japan and other countries. This trend coincided with socioeconomic changes rather than intentional nonintervention management. Difficult economic circumstances were the main reasons, particularly in the alternative sources of energy and availability of cheap substitute materials that replaced the use of forest products, followed by social reasons such as depopulation, and workforce shortage.

The ecological changes which took place in abandoned human-modified forest, such as decline in species diversity, suppression of tree growth, and increase in wildfire risk, were brought about by natural ecosystem process such as canopy closure, stand densification, litter accumulation, and landscape homogenization.

The main type of decision-maker for the cessation of forestry management was NIPFOs who often manage small-scale forest property and are subjected to prolonged unprofitable forestry caused by unavoidable socioeconomic changes.

Even though there are some difference between Japan and other countries in causes of forestry cessation and types of decision-makers, historical timing of cessation and the process of change were quite similar with each other, and thus we conclude that the issue of underuse could take place any human-modified forest ecosystems in the world.

There is a clear difference between the Japanese concepts of underuse and the terms for planned cessation of forestry management used in other countries. On one hand, underuse represents the consequence of declined forest resulted from negative effects, but on the other hand, the terms for planned cessation of forestry management such as nonintervention, hands-off management, rewilding and setting-aside, represent merely a means to an end that decision-makers are wishing to attain.

The research gap identified was the insufficient research on the evaluation of underuse, to what extent

underuse is regarded as “under”-use both from ecological aspect and the aspect of sustainable use of forest resources. Currently, to our knowledge, there is little way to draw a line between adequately used forest and underused forest.

In fact, the term underuse is used in various meanings. It sometimes means a potential resource which is not currently utilized as, for example, the mobilization of wood from potential underused forests<sup>18)</sup>, an opposite term of overuse<sup>2), 19)</sup>, a conceptual problem of satoyama indicating a level of utilization below a sustainable manner of ecosystem use<sup>3), 20), 21), 22)</sup>. Also, it is used to mean that the decline in ratio of current yield compared to the past or traditional level<sup>22), 23)</sup>, or similarly, inflow of goods and services from outside<sup>2), 21)</sup>. Thus, quantifying the extent of underuse in the aspect of both sustainable yield and ecological soundness would be beneficial for us to further discuss to what extent we should use and manage forest ecosystem goods and services in a sustainable way.

This study poses the need for further research on the international significance of underuse in order to find out more the international relevance of underuse of human-modified forests.

**ACKNOWLEDGMENT:** This research was supported by the Environment Research and Technology Development Fund (S-15 Predicting and Assessing Natural Capital and Ecosystem Services (PANCES)) of the Ministry of the Environment, Japan.

#### REFERENCES

- 1) Takeuchi, K., Ichikawa, K., and Elmqvist, T., : Satoyama landscape as social-ecological system: historical changes and future perspective. *Current Opinion in Environmental Sustainability*, Vol. 19, pp. 30-39, 2016.
- 2) Takeuchi, K., : Rebuilding the relationship between people and nature: the Satoyama Initiative. *J. Ecol Res*, Vol. 25, No. 5, pp. 891-897, 2010.
- 3) Morimoto, Y., : What is Satoyama? Points for discussion on its future direction. *J. Landscape Ecol Eng.*, Vol. 7, No. 2, pp. 163-171, 2011.
- 4) Ministry of the Environment, The Government of Japan, : National Biodiversity Strategy of Japan 2012-2020, p29, 2012.  
[http://www.biodic.go.jp/biodiversity/about/initiatives/files/2012-2020/01\\_honbun.pdf](http://www.biodic.go.jp/biodiversity/about/initiatives/files/2012-2020/01_honbun.pdf)
- 5) Ministry of the Environment, The Government of Japan, : Japan Biodiversity Outlook 2, 2016.  
[http://www.env.go.jp/nature/biodic/jbo2/pamph01\\_full.pdf](http://www.env.go.jp/nature/biodic/jbo2/pamph01_full.pdf)
- 6) Japan Satoyama Satoumi Assessment, : Satoyama-Satoumi Ecosystems and Human Well-being: Socio-ecological Production Landscapes of Japan – Summary for Decision Makers. *United Nations University, Tokyo, Japan*, 2010.

- 7) Petersen, P. M. : Importance of site conditions and time since abandonment for coppice vegetation on Langeland, Denmark. *Nord. J. Bot.*, Vol. 22, No. 4, pp. 463-482, 2001.
- 8) Altman, J., Hedl, R., Szabo, P., Mazurek, P., Riedl, V., Mullerova, J., Kopecky, M. and Dolezal, J. : Tree-Rings Mirror Management Legacy: Dramatic Response of Standard Oaks to Past Coppicing in Central Europe, *PLoS One.*, Vol. 8, No. 2, e55770. doi: 10.1371/journal.pone.0055770, 2013.
- 9) Müllercrová, J., Péter Szabó, P. and Hédl, R. : The rise and fall of traditional forest management in southern Moravia: A history of the past 700 years, *J. Forest Ecology and Management*, Vol. 331, pp. 104-115, 2014
- 10) Lawrence, A., and Dandy, N. : Private landowners' approaches to planting and managing forests in the UK: What's the evidence?, *J. Land Use Policy*, Vol. 36, pp. 351-360, 2014.
- 11) Ficko, A., and Boncina, A. : Forest owner representation of forest management and perception of resource efficiency: a structural equation modeling study. *Ecology and Society*, Vol. 20, No. 1, article 36, 2015.
- 12) Erickson, D. L., Ryan, R. L. and De Young, R. : Woodlots in the rural landscape: landowner motivations and management attitudes in a Michigan (USA) case study, *Landscape and Urban Planning*, Vol. 58, pp. 101-112, 2001.
- 13) Brown, C. : Rewilding – A New Paradigm for Nature Conservation in Scotland?, *Scottish Geographical Journal*, Vol. 127, No. 4, pp. 288-314, 2012.
- 14) Stoate, C., Baldi, A., Beja, P., Boatman, N., Herzon, I., van Doorn, A., de Snoog, G. R., Rakosyi, L., and Ramwelle, C. : Ecological impacts of early 21st century agricultural change in Europe – a review. *J. Environ Manag.* Vol. 91, pp. 22–46, 2009.
- 15) Lambin, E., and Meyfroidt, P. : Global land use change, economic globalization, and the looming land scarcity. *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 108, pp. 3465–3472, 2011.
- 16) Thorpe, R., Holt, R., McPherson, A. and Pittaway, L. : Using knowledge within small and medium-sized firms: a systematic review of the evidence, *Int. J. Manag. Rev.*, Vol. 7, pp. 257-281, 2005.
- 17) Tranfield, D., Denyer, D. and Smart, P. : Towards a methodology for developing evidence-informed management knowledge by means of systematic review, *Br. J. Manag.*, Vol. 14, pp. 207-222, 2003.
- 18) De Boever, L., Acker, J. V., and Ghent, U. : Fast growing tree species within the European Forestry -Wood-Chain: Volume versus Quality and Use, *European Wood Processing Strategy: Future Resources Matching Products and Innovations*. pp. 119-126, 2008.
- 19) Schroter, M., Barton, D. N., Remmea, R. P., and Hein, L. : Accounting for capacity and flow of ecosystem services: A conceptual model and a case study for Telemark, Norway. *Ecological Indicators*, Vol. 36, pp. 539-551, 2014.
- 20) Watanabe, Y., Murakami, T., Mochizuki, S., Kotoda, A., and Kamitani, T. : Tree species classification using aerial photograph and high-spatial resolution remotely sensed data in the SATOYAMA (secondary forest) of Japan, *32nd Asian Conference on Remote Sensing 2011, ACRS 2011*, article 3, 2011.
- 21) Yamaura, Y., Oka, H., Taki, H., Ozaki, K., and Tanaka, H. : Sustainable management of planted landscapes: lessons from Japan. *Biodiversity and Conservation*, Vol. 21, No. 12, pp. 3107-3129, 2012.
- 22) Ohsawa, T., Okano, T., Nakao, F., Kabaya, K., Kofuku, S., Kikuchi, K., and Nakashizuka, T. : Underuse/overuse and diversity of provisioning services and their change: the case of the Japanese national ecosystem service assessment (JBO2). *Sustainability Science*, p p. 1-13, 2018.
- 23) Nabuurs, G. J., Pussinen, A., van Brussels, J., and Schelhaas, M. J. : Future harvesting pressure on European forests, *Eur J Forest Res*, Vol. 126, pp. 391-400, 2007.

(Received August 24, 2018)