Local Expert Risk Mediation (LERM) for a Sustainable Forestry Development in Kochi Prefecture/Kami City, Japan

by

Dennis Gain

A dissertation submitted to the Graduate School of Engineering
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

at

Kochi University of Technology

March, 2017

Doctoral Committee:

Professor	Tsunemi Watanabe
Professor	Tatsuyoshi Saijo
Associate Professor	Yasuchi Mabuchi
Associate Professor	Yoshinori Nakagawa
Visiting Professor	Masahiko Kunishima

Abstract

This dissertation presents a mixed exploratory and explanatory inter-functional sustainability analysis of present forest management of industrial private forest in Kochi Prefecture/Kami City, Japan to (1) determine sustainability risks on the basis of the concept of sustainable forest management (SFM), and (2) to propose an alternative management framework named: Local Expert Risk Mediation (LERM) which is capable of tackling these sustainability risks through collaborative risk management processes. The sustainability of various aspects of Japanese forest management and their long-term effects has been subject of national and international criticism, for being ineffective and for creating environmental spillover effects. Some of these spillover effects have been observed in the study area. Various problems concerning the efficient utilization of resources, forestland accessibility, production efficiency and stakeholder integrity have been a matter of concern in the study area, as they affect the realization of the general character of SFM. Controlling these problems is complex, due to their inter-relationship with each other, as previous research suggests.

The methodology of this study followed a mixed inter-disciplinary research approach which involved quantitative and qualitative analysis of the five independent variables: situation (x_1), market (x_2), implementation (x_3), government (x_4), and cognition (x_5), that influence the SFM character. In the exploratory part of this research (Chapters 3 – 6) investigations have been performed to identify these issues of influence and to draw a large picture of current forest management in the study site. A grounded theory approach with theoretical coding was applied during the investigations. The collected qualitative and quantitative data was then analyzed through institutional analysis among the independent variables (x_1 – x_4) and inter-connections were identified. Then, causality of influence criteria was further analyzed. The key findings were four unsustainability risks: (1) environmental degradation, (2) discontinuity, (3) resource maldistribution, and (4) market inefficiency were identified through discussion based Cause-State-Effect-Risk and sSWOT analyses. The inter-connection and severity of these four unsustainability risks was discussed based on theories of macroeconomics and sustainable development. It was argued that the current forestry system in Kochi Prefecture shows probable signs for a planned economy with imperfect competition, imperfect distribution of income and economic and natural wealth, and which shows signs of economic and environmental

spillover effects. Additionally, it was found that management follows a segregative rather than a integrative approach.

A mitigation proposal is made. This plan is meant to be implemented by the above mentioned alternative integrative collaborative risk management framework LERM which is the internal component of the Development-Application-Integration-Adaptation (DACA) strategic management cycle which aims national strategy and policy development through bottom up – top down inter-communication.
To test the risk mitigation effectiveness of DACA – LERM forest management, short (20 years), mid (40 years), and long-term (60 years) risk probability and impact perception was measured in a key-stakeholder survey for two scenarios: once without and once with an DACA – LERM management scenario. Given results, risk factors for these scenarios were determined. It was found that although risk perception for DACA – LERM was significantly lower for mid and long-term durations, risk progression still increases over time. This finding suggests that the perception of risk is reduced with DACA – LERM management, however, a certain degree of uncertainty remains. This finding supports previous research where claim has been made that SFM approaches improve sustainable development, however, cannot fully eliminate management uncertainty due to the large amount of external influence. As part of this risk perception assessment, level of agreement for an integrative forest management approach, and agreement for considering five external factors to affect the certainty of successful internal implementation of LERM: Support and promote (1, 2), involve (3), legislate (4), sustain (5) was also measured. It was found that more than two thirds of participants agree or somewhat agree that these external factors should be incorporated in management decisions. The highest agreement was measured for a management adaptation to integrative management: 97%.

For realizing the dependent variable of the SFM Character, the final independent variable cognition (x_5) was measured in a separate stakeholder opinion survey. Participants were asked which of the four SFM functions forest management in Kochi should focus on. It was found that two thirds of the participants explicitly prefer function segregation. However, the majority implicitly agreed to integrative management. Given the integrative focus of LERM, leadership through expert risk mediation has the potential to facilitate the realization of SFM by decreasing the uncertainty of sustainability risks in Kochi Prefecture/Kami City.

Zusammenfassung

Diese Dissertation präsentiert eine gemischete interfunktionale Nachhaltigkeitsanalyse mit Forschungs- und Erklärungsansatz des gegenwärtigen Forstmanagements für in der Präfektur Kochi/Stadt Kami in Japan, um (1) basierend auf primären Forschungserkenntnissen und angelehnt an das international anerkannte Konzept der nachhaltigen Forstwirtschaft, Nachhaltigkeitsrisiken zu erkennen, und um (2) ein alternatives Managementkonzept mit dem Namen „Local Expert Risk Mediation (LERM)“ vorzustellen, mit dem Potenzial diese Nachhaltigkeitsrisiken durch kollaboratives Risikomanagement auf lokaler Ebene zu reduzieren. Die Nachhaltigkeit verschiedener Aspekte der japanischen Forstwirtschaft ist seit einigen Jahren Subjekt nationaler und internationaler Kritik, gestützt auf seine Ineffektivität und für das erzeugen von Spillover-effekten, welche auch bereits in der Präfektur Kochi erkennbar sind. Verschiedene Probleme, beispielsweise betreffend der effizienten Nutzung von Ressourcen, der Zugänglichkeit von Beständen, der Rundholzproduktion und der Stakeholderintegration sind zunehmend eine Sache der Besorgnis geworden, welche die Realisierung des allgemeinen Nachhaltigkeitscharakters stören. Die Kontrolle dieser Nachhaltigkeitsprobleme ist aufgrund der Abhängigkeit dieser Problemfaktoren untereinander komplex, wie bisherige Forschung bisher ausgiebig diskutiert.

Die Methodologie dieser Arbeit folgt einem gemischten interdisziplinarem Forschungsansatz der sowohl quantitative als auch qualitative Analysen der fünf unabhängigen Variablen: Situationsfaktor (x_1), Marktfaktor (x_2), Implementierungsfaktor (x_3), Führungsfaktor (x_4) und Wahrnehmungsfaktor (x_5) welche den Nachhaltigkeitscharakter direkt beeinflussen. Im Forschungseil dieser Arbeit werden mögliche Probleme innerhalb der unabhängigen Variablen (x_1 – x_4) wurden in den jeweiligen Unterstudien (Kapitel 3 bis 6) basierend auf der Grounded Theory identifiziert und ihre wechselseitigen Beziehungen mit Hilfe einer Instututionsanalyse ermittelt. Anschliessend wurde auf Basis einer Cause-State-Effect-Risk Analyse fünf Nachhaltigkeitsrisiken: Umweltzerstörung, Unstetigkeit, Verteilungsverlust, Inflexibilität und Marketineffizienz ermittelt und diskutiert. Die Zwischenbeziehungen dieser fünf Nachhaltigkeitsrisiken wurden auf der Basis von makroökonomischen Marktstruktur- und nachhaltigen Entwicklungsansätzen diskutiert. Es wurde argumentiert, dass das gegenwärtige Forstmanagement in der Präfektur Kochi Anzeichen

einer Planwirtschaft mit unvollständigem Wettbewerb, mangelhafter Verteilung von Resourcen, und welche Hinweise auf Umweltübertragungseffekten zeigt. Ausserdem wurden die Vor- und Nachteile eines segregativen und eines integrativen Funktionsansatz diskutiert. Im Erklärungsteil dieser Arbeit wurde ein alternativer Managementansatz und Abschwächungsplan für die Reduzierung der Nachhaltigkeitsrisiken vorgeschlagen. Die Implementierung dieser Plans ist Bestandteil des oben genannten kollaborativen Risikomanagementkonzepts LERM, welches die interne Komponente des Development-Application-Integration-Adaptation (DACA) Strategiemanagementzyklusses darstellt, welcher die Kommunikation von nationaler und lokaler Strategiebildung durch bottom-up Management anstrebt. Um die Effektivität von DACA-LERM Forstmanagement zu überprüfen, wurde die kurzfristige, mittelfristige und langfristige Risikowahrscheinlichkeits- und Risikowirkungsempfindung der fünf Nachhaltigkeitsrisiken anhand einer Stakeholderanalyse für zwei Szenarien erfasst, einmal mit derzeitigem, und einmal mit DACA-LERM Management. Basierend auf den Ergebnissen beider Szenarien, wurden die jeweiligen Risikofaktoren ermittelt und diskutiert. Es wurde erkannt, dass obwohl die Risikoempfindung für das DACA-LERM Scenario entscheidend geringer war, die Risikoentwicklung aber weiterhin mittel- und langfristig anstieg. Dieses Ergebnis zeigt, dass die Risikoempfindung sich zwar mit DACA-LERM reduzieren lässt, ein gewisser Grad an Ungewissheit aber bestehen bleibt. Das Ergebnis unterstützt die Forschungsbehauptung das nachhaltige Forstwirtschaftsmodelle zwar die Nachhaltigkeitsentwicklung fördern, nicht aber Ungewissheit gänzlich eliminieren können. Als Teil dieser Risikoanalyse wurde zudem die Zustimmung für integratives Management, sowie die Zustimmung für die Erwägung der fünf externen Influenzfaktoren in einer Umfrage ermittelt. Mehr als zwei drittel der Befragten befürworteten voll oder teils die Aufnahme der Influenzfaktoren in Entscheidungsprozessen. 97% Zustimmung konnte für integratives Management gemessen werden.

Für die Realisierung des Nachhaltigkeitscharakters wurde letztlich der Wahrnehmungsfaktor (x_5) in einer seperaten Stakeholderstudie gemessen. Obwohl ein Großteil der Befragten explizit die Segragation von Waldfunktionen befürwortete, wurde implizit Akzeptanz für Integrität gezeigt. Durch die Verringerung von Nachaltigkeitsrisiken hat LERM Management durchaus das Potenzial durch Expertenrisikovermittlung die lokale Realisierung der nachhaltigen Forstwirtschaft in der Präfektur Kochi zu erleichtern.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

This dissertation proposes the theoretical framework of the multi-stakeholder management concept of Local Expert Risk Mediation (LERM) as a public management theory to improve communication among institutional, private and administrational stakeholders. The aim of LERM is to support the objectives of the national government to realize Sustainable Forest Management, hereinafter referred to as SFM, in the sense of multifunctional forestry in the City of Kami, Kochi Prefecture, Japan.

SFM is a forest management concept, which is reported to have been introduced by the Saxon Hans Carl von Carlowitz in his work titled Silvicultura Oeconomica in 1713. Different to older approaches to a sustainable management of forests, von Carlowitz's work was a new basis for advanced management, which goes in accordance with the principles of sustainable development, meaning management that is environmentally suitable, socially beneficial and economically feasible for the generations of today and the future. The fundamental idea of SFM is to avoid logging more trees than are able to regrow, in order to maintain a lasting supply of wood now and in the future, while respecting biodiversity, surrounding ecosystems and the needs of society. The Food and Agriculture Organization of the United Nations defines SFM as follows:

> *"It is the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biological diversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national and global levels, and that does not cause damage on other ecosystems.* (FAO, 2000)*"*

SFM is an interdisciplinary approach that has become a global hot topic since the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. In the interaction of social-economic systems with ecosystems, aim of SFM is to preserve forest performance by applying the fundamental components of sustainability: Economy, Ecology and Society by preserving the main forest functions: Utility, Protection and Recreation, to maximize the productivity of all tangible and intangible forest resources such as wood, water, air, biodiversity and recreational and health benefits. (Figure 1). In particular, Economy targets the production and the supply of wood as a public good. Wood is a naturally produced carbon neutral material, which found its use in a variety of applications but mostly as a source for building material and renewable energy production. The SFM component Ecology aims the preservation of the forest ecosystem, its vitality and stability for ensuring climate preservation, biodiversity and protective aspects such as from wind, snow and landslides. The SFM component Society, targets the balancing of the interaction of human society and forests, e.g. by providing recreational and relaxation opportunities, or the conservation of cultural aspects. All three SFM components and the forest functions they address are equal in their importance and are interrelated. A manipulation of one component will have an effect on the other two components. For instance, a decrease of ecosystem balance affects the risk of overall economic productivity, and as a result, a decrease of social benefit may occur. Therefore, for benefit maximization a balancing of forest functions through sustainable management in this sense is crucial. (BMELV, 2011).

Promotion of Sustainable Forestry

Managing forests sustainably is worthwhile. Forest covers about one-third of the world's land area. Often denoted as the heart or lungs of the earth, forests play an especially crucial role in achieving multiple global environmental benefits, such as carbon sequestration through geoengineering, the conservation of biodiversity and the protection of surrounding ecosystems. Besides, sustainably managed forests have the potential to enhance the quality of wood as a raw

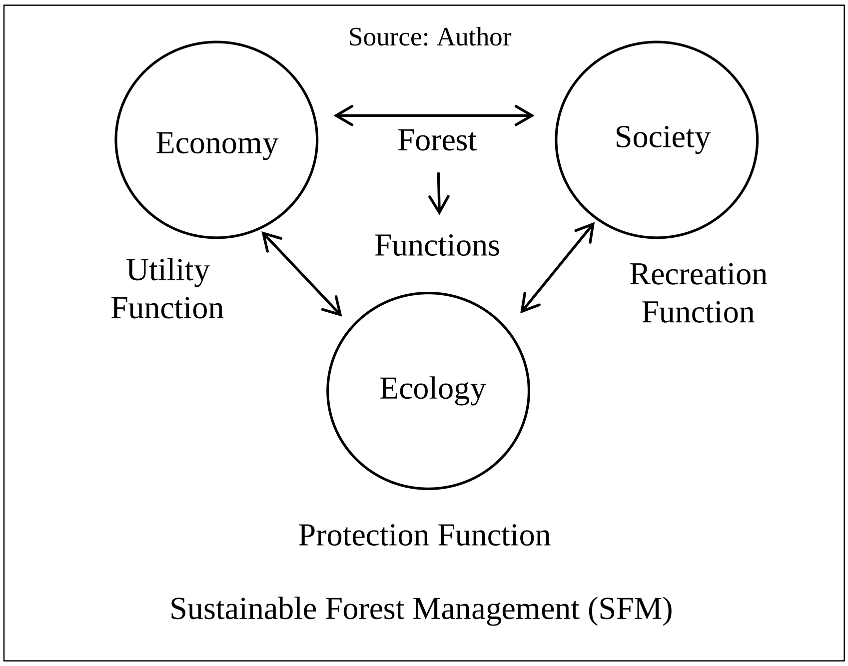


Figure 1: General Sustainable Forest Management (SFM) concept

material as well as the quality of non-wood products such as mushrooms or edible animals. Those who depend on forest resources for their livelihood benefit from sustainably managed forests, but also for society in general, forests deliver a variety of functions beneficial and crucial for our wellbeing. The forest ecosystem is expected to further play a key role in both, developed and developing countries to cope with the effects of climate change.

Society has needs and wants on forests. A forest is a place for recreation and recovery. A forest protects society from natural hazards such as storm, flood and snow. Forests provide a habitat for a large variety of flora and fauna. In addition, forest provides society with a renewable carbon-neutral energy source. Forests are present in most parts of the inhabited world and play an essential role in strengthening the regional benefit. The forest and its sustainable services, economic, ecological and social functions have a special meaning for the human being since the creation of humanity.

Various different interest on forest functions makes the creation of balance complex. Over time, demand changes on forest resources may result in insufficient management to maintain sustainability. Through frequent on site assessment, managers are required to find appropriate measures to ensure maintenance of sustainability. Such vital decisions regarding the condition of forest commonly result in stakeholder conflicts where effective consensus building becomes necessary. Forest managers face the challenge of balancing forest use against environmental goals. Balance of stake is the key for effective realization of SFM.

Models of sustainable forest management

Two commonly practiced models of forest management are even-aged (also known as rotation forestry) monocultures and uneven-aged mixed cultures (also known as continuous cover management or permanent forest). While in uneven-aged forests timber is removed selectively always leaving a certain number of trees, in even aged-forestry, forests are given life cycles, which normally end in clear-cuts. Both models are still considered capable of being sustainable if applied appropriately. However, even-aged forestry receives growing criticism for sustainability deficits. Although even-aged forest brings maximum return on investment, it is argued that there is a higher risk for harming the environment during the first years of reforestation when the forest floor is constantly exposed to sunlight affecting underground microorganisms. Moreover, even-aged coniferous forests dry out the forest floor in a stronger way than most broadleaf stands, which increases the risk for environmental degradation through erosion. Aboveground biodiversity is affected in especially dense monocultures. Considering these environmental risks of even-aged management, uneven-aged management consisting of coniferous and broadleaf species is increasingly considered the dominant sustainability approach as it brings substantial structural advantages such as increased forest stability, vitality and biodiversity, with a lower risk for erosion. However, uneven-aged management being a more complex approach requires more cost intensive management and a more complex infrastructure. This intensive management includes access to silviculture and biodiversity expertise, and proper forest access for the application of management. Regardless the model, unrestricted forest access, active forest owner participation, and an appropriate legal framework and support scheme to upkeep consensus towards long-term sustainability strategies are necessary.

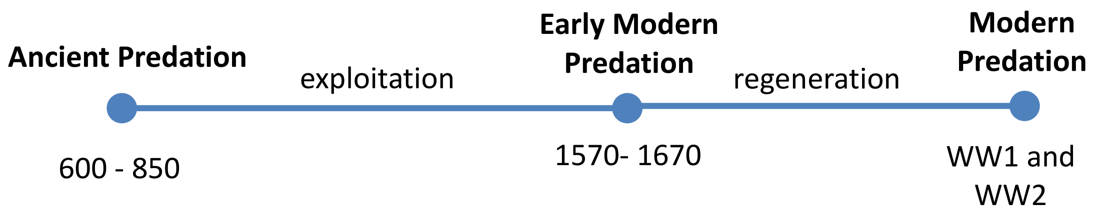
Maintenance of SFM

Although often referred to as long-term approach, SFM is in fact an ongoing management approach without timely limitations. Therefore, once sustainability can be considered accomplished, it is the challenge for managers to maintain this state by the successful application of countermeasures against internal and external influences such as climate change, pest, change of industry demands, selection of management techniques and application of technology.

1.1 Background

Brief History of Forest Management in Japan

As graphically summarized in Figure 2, forests in Japan have reportedly been subject of repeated exploitation and regeneration for more than 1,400 years. Areas logged by monumental builders concentrated in Edo in approximately 800 AD and moved further outward. By



Source: Totman, 1998

Figure 2: History of deforestation and reforestation in Japan

approximately 1550 AD, loggings spread to Chugoku, eastern Shikoku and southern Tohoku. By approximately 1700 AD, forest exploitation had reached Kyushu, Shikoku and southern Hokkaido. Followed by this time of forest exploitation came a regeneration period that lasted until the breakout of WWI when another period of extensive exploitation started again when wood became vital for military purposes. Forest management during this regeneration period targeted replanting, protective and productive functions, and was widely carried out by silviculture specialists, similar to the forest management found in Europe at the time. Intensive management could be found around Edo areas, high grade and intermediate management until southern Tohoku. While most of Tohoku remained untouched in this period of regeneration, certain areas in eastern Shikoku received low-grade management. Tosa, nowadays known as Kochi, was unaffected by any type of major management. The time during the two world wars was another period of serious forest exploitation and forest damage in Japan. While extensive logging for energy and warfare affected forest cover, allied air raids lead to considerable damage through forest fires. In Kochi, wide areas of mountains lost their forest cover, which were widely reforested during Japan's reforestation project after World War II (Totman, 1998).

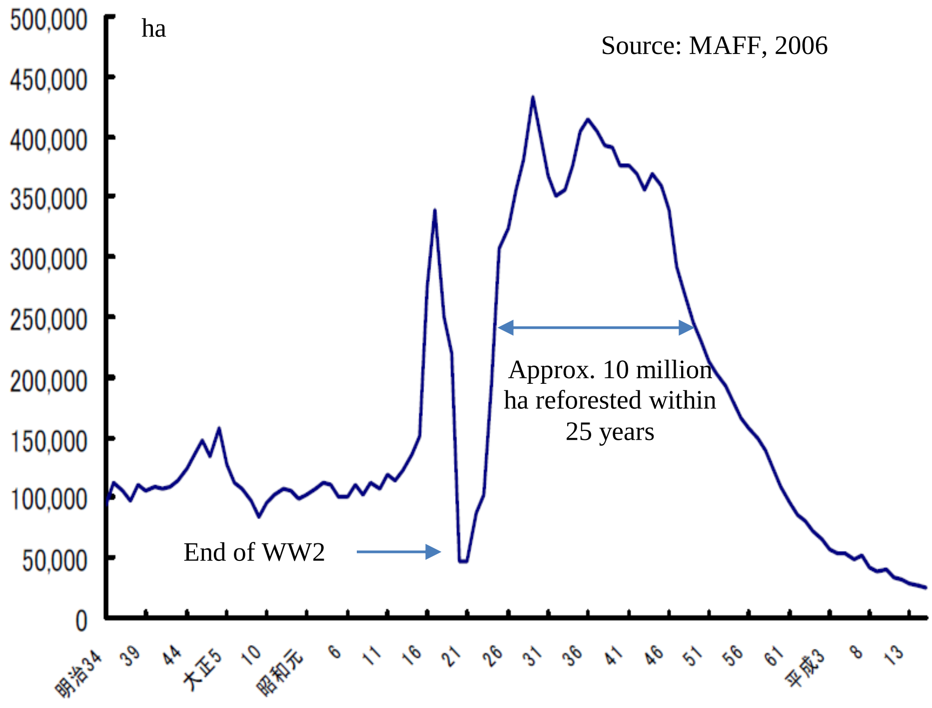


Figure 3: Reforestation per hectare in Japan from 1901 – 2001

Within approximately 25 years, beginning shortly after the end of World War II, nearly ten million hectares of forestland was reforested as industrial forest (Figure 3). This national large-scale reforestation project aimed the reestablishment of Japan’s forests and with it the stability of the environment.

Local implementation

Much attention has been paid to improve the implementation of SFM into local communities throughout Japan. Because of the current state of forests, the forestry industry and surrounding ecosystems, management has become refined to:
(1) understand the issues for local implementation, and improve the technological efficiency and international competitiveness of timber production from the planting stage, over stand care to harvest,
(2) improve communication and involvement of private forest owners to acquire unhindered stand access,
(3) assess growth characteristics of local industrial and natural forest areas in terms of long-term productivity,
(4) improve legal frameworks including governmental support schemes, and introduce certification schemes for a fair but effective realization of multifunctional forest.

Review of literature for these observations is presented in detail in Chapters 3-6.

1.2 Research location and problem statement

Research and dissertation were composed in Kami City, a medium sized city with a population of approx. 25,000 in the central part of Kochi Prefecture on Shikoku Island in southern Japan. Kami is subdivided into three districts, Tosayamada Town in the south-west, Kahoku Town in the central area, and Monobe Town in the northeast. Monobe Town accommodates large areas of national forest. There are two Forest Owners’ Associations (FOA) in Kami, Kami FOA and Monobe FOA. However, focus is given on Kami FOA due to them being the largest in terms of managing private industrial forest. Forest area in Kami is approx. 47,000 ha. Besides Kami FOA, key stakeholders with and without decision making authority are Kochi Pref. Information and Technology Center, Kochi and Kami Forestry Department, NGOs such as 21st Century Forest and Water Organization and forest owners. Although the main research location is Kami City, it is necessary to take into consideration that national decisions directly affect local management in Kami, mainly demography development strategies, national policy and financial support frameworks.

Table 1: Area of type of forest and ownership in Kami (2016)

Type of forest/ownership	National forest	Private forest
Industrial forest	71ha	31,590ha
Natural forest	14,398ha	

Source: Kochi Pref. Information and Technology Center (2016)

Ownership

Forest ownership throughout Japan is uniquely composed of large areas of small-scale private industrial forest, nearly 80% of plantations in Japan. These private plantations are highly fragmented in terms of area per owner. Of the approximately 2.5 million private forest owners, 1.5 million owners hold each less than 1 hectare of forestland (Ota, 2007). About 90% of private owners hold each less than 10 hectares. In 2012, the Japan Forest Act introduced a new management plan (Collective Forest Management Plan System) that is supposed to target the coordination and consolidation of small-scale forest owners to ensure effective local implementation of SFM.

However, only owners holding a forest area of larger than 100 hectares, therefore not the majority of private owners with less than one hectare qualify for this 5-year plan. Successful applicants receive special income and tax treatment, favorable conditions, government financing and promotion in other subsidy programs (MAFF, 2013). Although governmental support for forest owners in terms if SFM can be considered appropriate, this particular program further increases the problem of policy fragmentation as criticized by the Programme for the Endorsement of Forest Certification (PEFC) Chairman Street (2012) by providing special treatment and funding for only a specific group of forest owners.

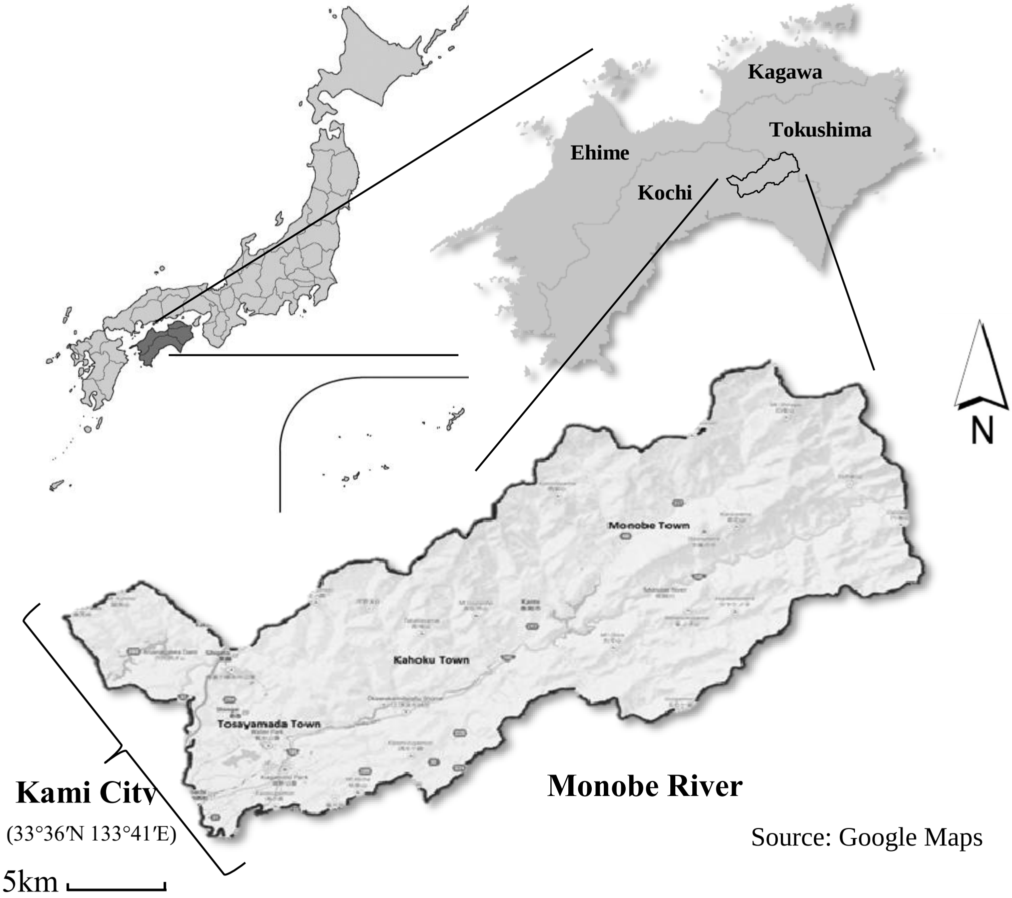
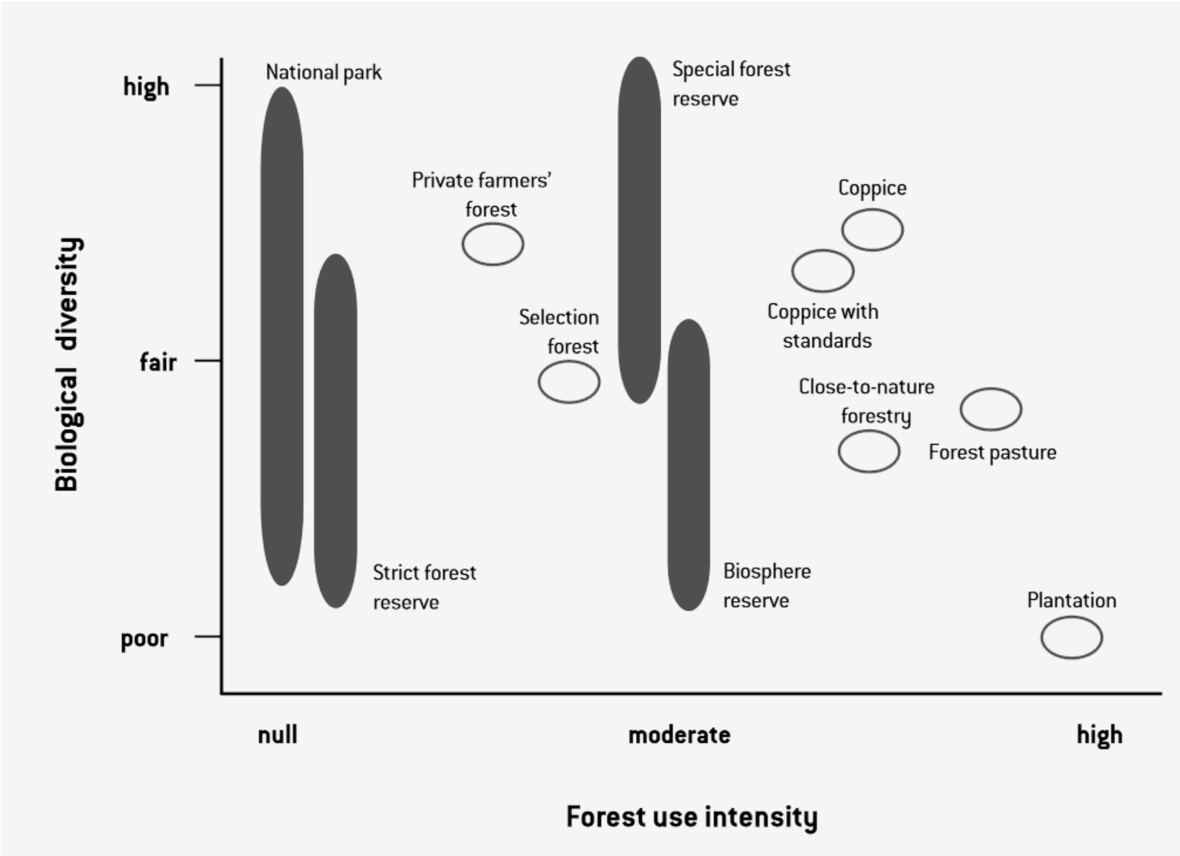


Figure 4: Location of Kami City

Forest use intensity and biological diversity in industrial forests

Figure 5 shows the degree of forest intensity and biological diversity of common models of forest management in industrial forest and forest for biodiversity conservation. Biological diversity incorporates the variety of ecosystems, species, genes, and their interconnections. Biological diversity is commonly measured as (1) the number of species in an ecosystem and (2) species evenness, meaning the abundance of these species in the ecosystem. Total species diversity (gamma diversity) depends on the number of species in a forest area (alpha diversity), as well as the degree of variation of alpha diversity across other forest areas (beta diversity). Forest use intensity has often a strong negative impact on alpha and beta diversity due to the forest structure in these forests being specifically designed create high financial returns lacking the three principles for preserving biodiversity in forest: (1) habitat connectivity (forest connectivity), (2) structural complexity and (3) ecosystem integrity (support for natural composition, disturbance and succession) (Bollmann & Braunisch, 2013). In Kami, almost the entire industrial forest are plantations not being actively managed by private farmers. Compared to plantations, private farmers' forest is considered to possess fairly higher biological diversity, but paired with a lower use intensity. This is due to private farmers' forest often having uneven aged multi-story structures where extraction and care management are conducted not in high-intensity waves as in plantations but in many small interventions spread over a rotation period. To enhance biodiversity in plantations, including those in Kami, an increase of habitat connectivity, structural complexity and ecosystem integrity is recommended.



Source: Bollmann & Braunisch, 2013

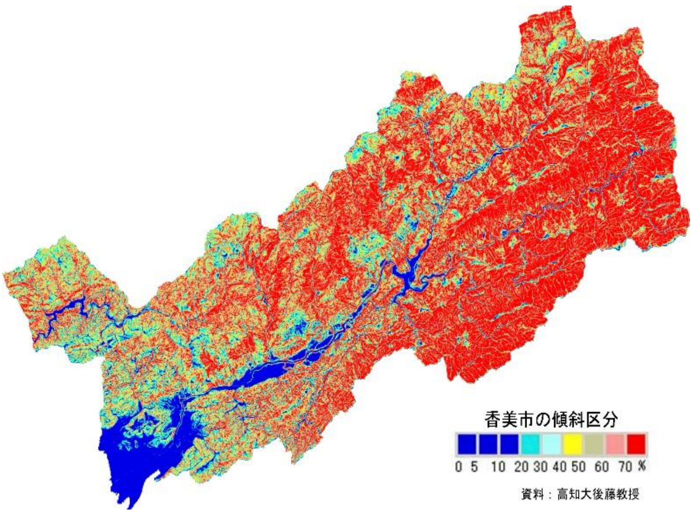
Figure 5: Relationship between forest use intensity and biological diversity of common models of forest management.

Highlighted symbols in Figure 5 indicate models specifically assigned for biodiversity conservation. Unhighlighted symbols indicate management models assigned to production.

Access to private industrial forest

Limited access to private forest, also induced by an increase of ageing private forest owners, is of significant concern in Kami. A considerable number of individuals has been difficult to be identified by local authorities. It has been reported that a majority of these owners are new owners who have inherited forestland from past generations. Many of them are assumed to have relocated to other areas in Japan. The tracking down of these new forest owners is difficult as the Japanese privacy law protects the locating of people including forest owners. However, without consent of the forest owner, management of their forest cannot be administered under the current legal framework. In many cases, this forest is left untouched increasing the risks for loss of biodiversity and other critical environmental damage through degradation. This circumstance of limited access to private forest further complicates management significantly, as frequently reported by local authorities in charge of forests in Kami City.

Source: Kochi University



slope	%
＜ 30% (16.7°)	8%
＜ 50% (25.6°)	18%
＜ 70% (35.0°)	31%
70% (35.0°)＜	43%
Total	100%

Source: Images taken by Author,
Illustration: Kochi University

Figure 6: Images of unthinned industrial forest in Kahoku Town and site topography

In comparison to Kami City, the identification of forest owners and their contact establishment is less complicated for local authorities in Germany. Private forestland needs to be registered and there is a legal commitment for forest owners to manage their forest sustainably (§11 BWaldG). In addition, it is usually required for forest owners to join a professional forestry society. Private forest is monitored by local public forestry agencies, which have the authority to identify and contact owners in events of threatening forest sustainability. Moreover, a forest owner in Germany is held responsible for the sustainability of the own forest and the damage of neighboring forest caused by inappropriate management actions. Should a forest owner not be capable of self-management, there are the two options: sell the forest or keep the forest and seek management assistance. Such assistance is commonly gained for instance by entrusting management to a third party or by joining a local forest union.

Accessibility to private forest is a common issue in Japan. It can be argued that Japan could face the challenge of incorporating private forest owners in management related decisions.

Spillover effects

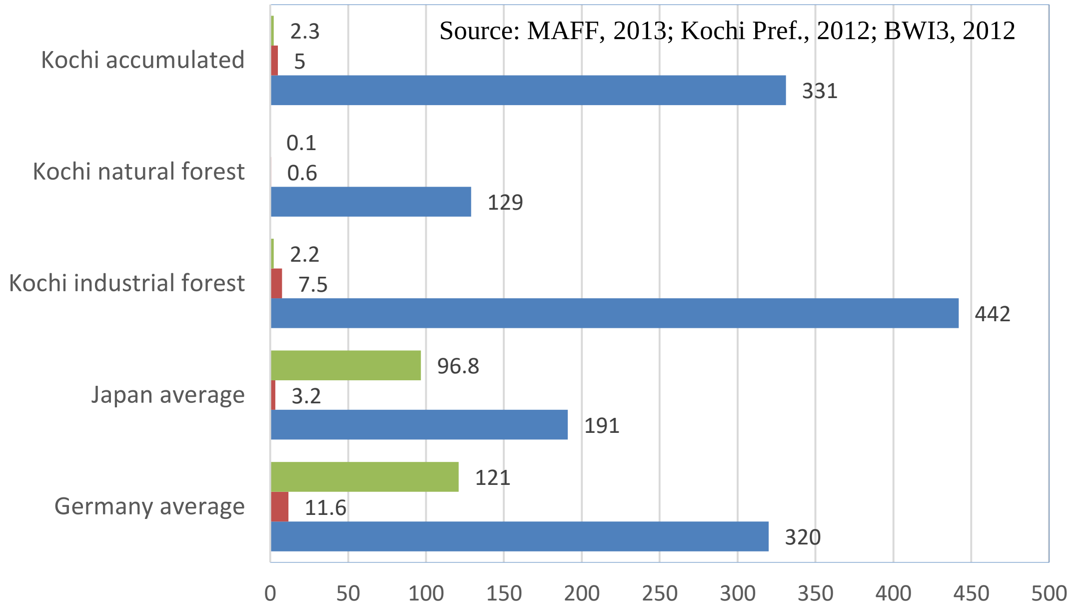
Man-made forest is in most cases less natural than a forest that was created by nature itself, and therefore in order to develop, requires an adaptation of its surrounding environment to prevent it from degrading. Similar to agriculture, where also large areas of land are planted by man for crop consumption purposes, such an adaptation requires for instance the fertilization of soil and measures to prevent pest contamination and resulting damage. Hinoki and sugi plantations in Kochi are such unnatural man-made constructs created for the sole purpose of the production and lastly the consumption of coniferous timber. A man-made forest can be seen as a foreign body within a surrounding balanced natural environment that is trying to regain control. In this process spillover effects, both of natural and non-natural origin may occur. The most commonly reported are soil erosion through drying the forest floor due to density or after clear-cuts, forest degradation due to density or pest infestation, or loss of biodiversity, forest stability and vitality in monocultures. A reduction of water quality in surrounding water bodies can occur with a worsening of the forest soil quality and its water filtering capability. Unnatural spillover effects may also occur. These are for instance a reduction of timber quality after pest infestation or unutilizability of timber for sawn wood after growth stagnation in stands of high density or low nutrition.

As nature dynamics usually work to assimilate man-made forest, it is of vital importance to ensure that both natural and non-natural spillover effects are avoided. Constant monitoring of industrial forest by trained silviculture specialists is needed to encounter the beginning of possible spillover effects early, and to be capable to administer appropriate countermeasures in a suitable timeframe.

Forest age structure

Although the Japan reforestation project can be considered an urgently necessary effort in regards to reestablishing the Japanese forestry industry and environmental stability, this large-scale project resulted into a strong stand age concentration within industrial forest. These reforested areas are recently becoming mature and marketable which has led to increased efforts to thin and clear-cut affected stands to avoid loss of stand value and environmental damage through degradation. These management efforts are financially supported by the national, regional and local governments. Compared to Germany, a global player in the forestry industry and leading nation in the promotion of sustainable forestry, Kochi's forests do at first sight not appear to be in a worrying economic and unsustainable condition.

Comparing annual tree growth, Kochi's industrial forest performs similarly to the German average (Figure 7). Stock per hectare values in Kochi, however, outperform the German average by more than 30 per cent. Although a higher stock per hectare value indicates superior availability of wood mass, in the case of Kami, this achievement comes at a price regarding sustainability. Wood mass per hectare is determined by the number of trees and the average diameter at breast height (DBH) of these trees. Therefore, two scenarios can achieve the same amount of wood mass, (1) high density but low average DBH, or (2) low density but high average DBH. As tree age affects DBH, matured stands will consist normally of more wood mass than younger stands under comparable site conditions. In the case of Kami, wood mass is in most cases indicated by relatively high tree density but low average DBH (Figure 7) and most importantly a significantly high concentration of maturing stands between 45 and 60 years. Rejuvenated and young stands make a meaningfully smaller forest area (Figure 8). A high tree density can bring significant sustainability risks such as loss of biodiversity through soil and underplanting degradation and inefficient radial tree growth.



	Germany average	Japan average	Kochi industrial forest	Kochi natural forest	Kochi accumulated
Annual total growth Mil. m^3	121	96.8	2.2	0.1	2.3
Annual growth m^3/ha	11.6	3.2	7.5	0.6	5
Total Wood Stock m^3/ha	320	191	442	129	331

Figure 7: Annual forest growth and stock comparison for Kochi, Japan and Germany

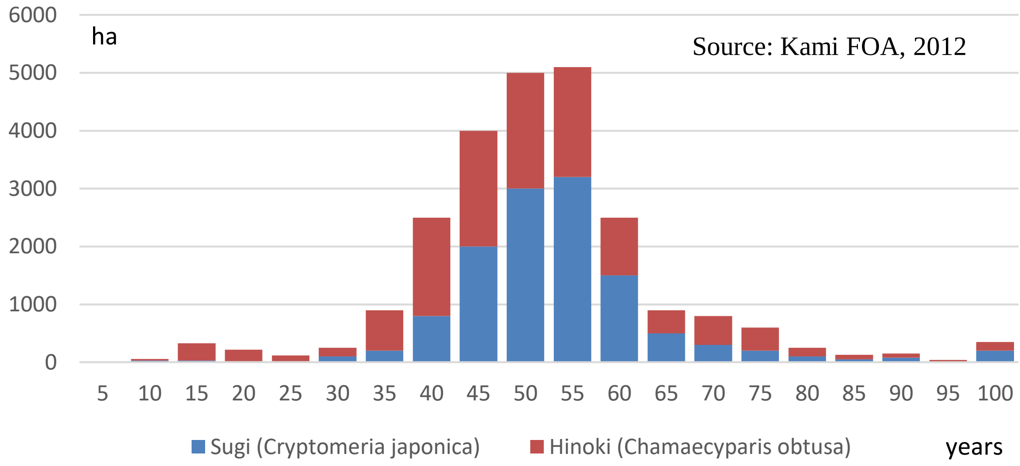


Figure 8: Age distribution of sugi and hinoki plantations in Kami City

Common problems of current forest condition in Kochi Prefecture/Kami City

Given the current state of knowledge on the forestry condition in Kami City, five common problems have been reported by stakeholders such as NGO and interest groups, practitioners at Kami FOA, and Kochi Prefecture forestry officials in the local literature, and forestry related meetings:

(1) Resource Problem. Over the past approximately fifty years the area of manageable industrial forest, e.g. thinning of stands with marketable timber, and therefore the access to marketable timber was limited as most sites were still in development stages after their reforestation after WWII. This limitation of manageable forest and access to marketable timber has resulted into a shrinking of the domestic forest industry. In addition, since newly established forest require soft-management to maintain structure and density, private forest owners of these regions were not required to take extensive actions in regards to management and partly lost connection and likely interest in their forests, as also claimed by public forest agencies in Kochi and Kami. Due to the majority of private industrial forest being single-layered and of a similar age structure, significantly more management is required in maturity periods compared to the periods where these forests are still developing. Although rotation periods of certain stands are being extended to improve the age distribution of single-layered industrial forest, there is a risk that history may repeat itself for another period of scarce domestic timber availability. Such a repetition can negatively affect the development of local forestry industries.

(2) Accessibility Problem. Two important accessibility problems from and to the forest owner are currently present. With the current undeveloped and uncompetitive domestic timber industry, forest owners have few options to be active producers of roundwood and contributors to a local timber industry development. A local market for broadleaf timber is almost non-existent, limiting valuable timber to coniferous species, the most dominant ones being sugi and hinoki. Accessibility from forest owners to local markets is not the only accessibility problem. A large number of private forest owners in Kochi are not actively involved in the management of their forest. Public officials struggle with establishing contact to negotiate management strategies and market opportunities. Policy frameworks that provide access to private forest is crucial to minimize risks for environmental damage through e.g. pest and degradation. Ineffective forest management causing forest and surrounding ecosystem degradation has been observed

in Kochi Prefecture (Matsushita et al., 2010). Soil erosion affects stand quality in cypress plantations in Shikoku (Yokohari et al., 1997).

(3) Efficiency Problem. Due to strong global competition and a strong decrease of roundwood prices of the main coniferous tree species, self-sufficiency has decreased throughout Japan to below 30%. To keep local industries running, management is currently highly dependent on subsidies. Complex topographic conditions in Kami further challenges the application of technology required for cost efficient care and harvest. It can be argued that the idea of any subsidy is commonly to support early development of new technologies and strategies, not to long-term finance a given unsuccessful system. Aoyagi and Managi (2004) observed that forestry subsidies in Japan had adverse effects on economic performance. More subsidized prefectures exhibited statistically lower levels of efficiency. A strategy change involving lower or no subsidies at all is likely to bring negative impact on management applicability. In Kochi, some of the expenses for the subsidies are collected through the Forest Environment Tax annually from the public (500 Yen per person). This tax is scheduled to be discontinued in the year 2016. Some public forest administration officers are worried about how to finance forest management further. Decisions have yet to be made whether to continue this tax or to

(4) Integrity Problem. Decisions made regarding forest structure management can affect environmental sustainability, especially when these decisions incorporate the new or reestablishment of low diversity monocultures, or clear-cutting harvest strategies. Opinions and suggestions by NGO and other environmental activists for improving economic and environmental sustainability have been unsatisfactorily acknowledged and integrated in decision-making processes.

(5) Awareness Problem. Although a matter of strong consideration in many other industrial nations, the concept of SFM is starting to become of relevance in Kochi. However, SFM is still unknown to most practitioners.

1.3 Theoretical framework

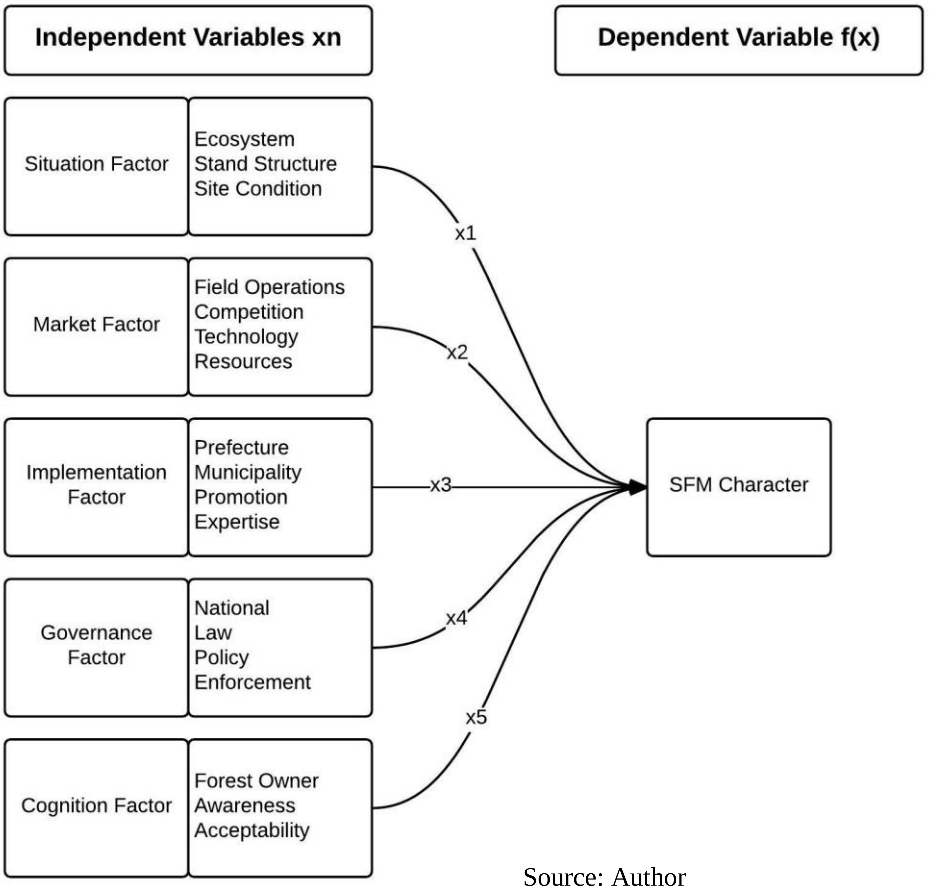
To tackle the problems of the current forestry condition and to realize sustainability as suggested by SFM working groups at local level, a restructuring of forest management practices and the legal framework is needed in Kami City. For successful local restructuring, three crucial preconditions are suggested by various researchers. Von Detten (2011) arguments the necessity of a long-term sustainability rather than a resilience approach, as resilience, without an enduring strategy, implies the risk of “anything goes” or “laissez faire” way of approaching forestry. In the literature, the term resilience has been used rather unspecifically. While descriptions can be found describing resilience as an important revitalization capability for the implementation of SFM, other researchers and stakeholders often see resilience to be solely related to forestry business rather than SFM as a whole. Especially in the context of combining environmental, social and economic resilience, the term resiliency is still used too unspecifically to provide guidance for practice and policymaking (Fuller and Quine, 2016).

There are dynamic external economic and environmental factors that affect the human-forest interrelationship such as social demand on forest resources and climatic and biotic changes. While nature is capable of balancing these external factors itself, man-made forest must undergo continuous supervision in order to become capable of adapting to these dynamics. Although resilience is an important aspect in forest management to improve a damaged forest condition, a limitation on resilience can lead to a neglecting of external dynamics and with it to more vulnerable forest and surrounding ecosystems. To make sure external dynamics are effectively balanced in man-made forest, a sustainability approach becomes vital. To apply resilience and sustainability effectively, unhindered access to forest is needed. Yamaba & Nakagoshi (2000) argue that especially for Japanese communities dealing with the problem of limited access to forestland, an alternative approach must incorporate a framework for wider analysis of local participation. Given this framework, Fujisawa (2004) further argues that to operate sustainable forest production, ownership and management need to be separated and the new system should aim the motivation of forest owners to invest in the forest stands subject to management. Ota (2010) concludes that Japanese forest policy is mainly responsible for the current sustainability issues due to its limitation of effectively acting as a framework for local implementation of SFM. In order to implement an alternative system successfully, Japan’s forest policy would require alteration accordingly. SFM being an interdisciplinary approach requires integrative processes, in particular: a unified multi-stakeholder consensus-building framework in the governmental, industrial and private sectors. The challenge: (1) all stakeholders must accept a management framework that equally promotes sustainability and supports stakeholder wants and needs. (2) The new SFM system should have the potential to operate self-contained, or in other words, function without major influence of one or more stakeholders and without dependency on financial support.

However, to come up with an alternative proposal for an integrative system that can combine social, economic and ecological sustainability to realize the SFM character, the current state of research applicable in Kami City requires further examination in five areas. (1) Forest condition: species distribution, age and annual growth directly influence site productivity. An evaluation of forests in Kochi in comparison to those in a nation that successfully practices SFM may reveal growth potentials and give insight to the current situation of the ecosystem. (2) The application of forest works produces costs, which need to be compensated by trade of marketable forest resources. Production cost must at least meet the selling price of wood for efficient operation and is determined by fixed and variable cost such as use of technology, local conditions, and human resources. What is the market condition for forest resources and how did production costs develop in international comparison? How are field operations applied? (3) How are national and regional forest legislature matched in Kochi/Kami towards the implementation of SFM? How does the framework address the criteria and indicators of SFM? How does the framework compare to those in countries that are known for successfully practicing SFM? (4) The national government passes laws and makes goals regarding forest management in Japan. What are the strategies in Kochi/Kami to implement these goals and how appropriate are they? (5) What kind of risks can be expected with the current management system and how could they progress over time? How would an alternative system contribute to reducing these risks, and improve social, environmental and economic sustainability? Moreover, a system change is always subject of social acceptability. Can it be accepted?

These five areas are referred to as:

(1) Forest ecosystem condition and productivity, → **Situation Factor**
(2) The timber industry and field operations, → **Market Factor**
(3) Prefectural and municipal government implementation strategy, → **Implementation Factor**
(4) National law and policy, → **Governance Factor**
(5) Acceptability of an alternative forestry system. → **Cognition Factor**



Source: Author

Figure 9: Independent and dependent variables in theoretical framework

1.4 Motivation and study purpose

Much research has been conducted in recent years to improve forest management, in particular the sustainability aspect in Japan's private industrial forest, however, with yet disputable local results. Nevertheless, examples of successful local implementation of SFM are found throughout the world. Global leaders can be considered the German speaking nations in Europe. The purpose of this study is to:

(1) Reveal and understand potential weaknesses of independent variables in regards to local realization of SFM in private industrial forest.

(2) Propose and discuss an alternative management system for Kami City that is comparable to those found in the German speaking nations in Europe, and which is based on local environmental, social and economic conditions in Kami.

(3) Clarify the risk perception and local acceptability of such an alternative management approach.

1.5 Research hypothesis and objectives

This study postulates:

Hypothesis:

H_1: Integrative leadership through expert risk mediation can facilitate the realization of SFM by decreasing sustainability risks in Kochi Prefecture/Kami City.

To test the hypothesis, the following objectives are performed:

Objectives:

1. Perform a comparative simulation of annual height and volume growth of Japanese forest with German forest growth performance indices PI – **Investigation I**.
2. Discuss general implementation issues of SFM in Japan and compare basic industry competitiveness between Japan and Austria – **Investigation II**.
3. Evaluate and discuss the appropriateness of the Kochi subsidy scheme for private forest in regards to achieving national sustainability goals. – **Investigation III**.
4. Analyze and compare to what degree Japanese, German and Austrian forest law addresses and enforces criteria and indicators of SFM – **Investigation IV**.
5. Perform institutional analysis of unsustainability risk causality in private industrial forest from an ecosystem perspective.
6. Based on findings of Investigations I – IV and institutional analysis, derive sustainability risks and chances for SFM in Kami based SFM criteria and indicators.
7. Based on sustainability risks, derive, verify and discuss an alternative forest management model based on sustainability risks identified in exploratory and explanatory research.
8. Identify the degree of local acceptance for an integrative forest management framework among key stakeholders in Kochi Prefecture – **Investigation V**.

Summary

Chapter 1 introduced the concept of SFM and its importance for the preservation of earth environment and the wellbeing of society. Two common approaches to forestry, even-aged monocultures and uneven-aged mixed cultures, as well as their advantages and disadvantages for environment, economy and society were introduced. The risks and criticism of even-aged monocultures were discussed and the maintaining aspect of SFM was emphasized. A brief historical background of Japanese forestry involving important periods of forest exploitation and regeneration was presented. The Japanese national reforestation project after WWII that encompassed the reestablishment of nearly 10 million hectares of industrial forestland in only 25 years was illustrated. Current topics of focus of local implementation of management with emphasis on sustainability were introduced. After an introduction of the study site and key stakeholders, the problem statement of forest management in regards to sustainability was presented. The impacts of limited integrity of small-scale private forest, the imbalanced forest age structure, and the even-aged monoculture forestry approach that excludes natural forest from any type of management, on environmental and economic spillover effects in Kami were discussed. Five commonly reported problems of the forestry condition in Kami City/Kochi Prefecture: Resource Problem, Accessibility Problem, Efficiency Problem, Integrity Problem and Awareness Problem were emphasized. After a demonstration of the research framework, motivation and purpose of study, the hypothesis and objectives of this research were stated. Chapter 2 will outline the methodology of this study.

References

Aoyagi, S. & Managi, S. (2004). The impact of subsidies on efficiency and production: Empirical test of forestry in Japan. Int. J. of Agricultural Resources, Governance and Ecology 3 (3/4), 216-230.

Bollmann, K. & Braunisch, V. (2013). To integrate or to segregate: balancing commodity production and biodiversity conservation in European forests. Integrative approaches as an opportunity for the conservation of forest biodiversity. European F. I., 18-31.

BMELV. (2013). *Illegaler Holzeinschlag.* Bonn.

FAO. (2000). *Asia-Pacific Forestry Commission: Development of National-Level Criteria and Indicators for the Sustainable Management of Dry Forests of Asia: Workshop Report.* Bangkok, Thailand: United Nations.

Fujisawa, H. (2004). The forest planning system in relation to the forest resource and forestry policies. Journal of Forest Research 9 (1), 1-5.

Fuller, L., Quine, C. P. (2016). Resilience and tree health: a basis for implementation in sustainable forest management. Forestry 89 (1): 7-19.

MAFF. (2013). *Annual report on forest and forestry in Japan for FY2012.* Tokyo: Forestry Agency, Policy Planning Devision.

Matsushita, B., Xu, M., Onda, Y., Otsuki, Y. & Toyota, M. (2010). Detecting forest degradation in Kochi, Japan: ground-based measurements versus satellite (Terra/ASTER) remote sensing. Hydrological Processes 24, 588-595.

Ota, I. (2007). A forest owners' cooperative in Japan: obtaining benefits of certification for small-scale forests. (F. a. Nations, Hrsg.) *Unasylva, 228*(58).

Ota, I. (2010). Forest law and policy developments in Japan. *Working Papers International Series Forest Policy and Forest Economics,* pp. 3-11.

Street, W. (2012, June 18). PEFC chairman at Forests: The heart of a green economy. *Rio+20 side event*. Rio de Janeiro.

Totman, C. (1998). The Green Archipelago. Universiy of California Press. Rio de Janeiro.

von Carlowitz, H.C. (1732) Silvicultura Oeconomica. Leipzig. Ben Johann Friedrich Brauns sel. Erben

von Detten, R. (2011). Sustainability as a guideline for strategic planning? The problem of long-term forest management in the face of uncertainty. European Journal of Forest Research 130, 451-465.

Yamaba, A. & Nakagoshi, N. (2000). Community-based management of rural pine forests in a suburban village of Hiroshima Prefecture, western Japan. Journal of Forest Research 5, 237-242.

Chapter 2: Research type, scope and methodology

2.1 Type and scope of research

The type of this research involves practical as well as theoretical research. Theoretical research includes the researching through secondary data used to (1) support methods and findings of practical research and (2) to place this research into the current state of knowledge on the topic. Practical research is conducted by primary research in the form local investigations by making use of discussion groups (focus group discussions - FGD), interviews (of stakeholders in regards to application of management concepts), observations (of current practical forest management processes and ecological conditions), and questionnaires (of current and alternative scenarios in human-forest ecosystem relationships).

Focus of this study is generally on the sustainability aspect of forest management (SFM as described in FAO, 2000 and by the SFM criteria and indicators of The Montreal Process, 2015) in private industrial forest in Kami City. Findings of this research will be useful for future policy making regarding the application of alternative, forest structure relating, forestry concepts that intend to (1) enhance the multifunctionality of forests, (2) improve the management of stakeholder interrelationship, and (3) mitigate sustainability risks. This research is important to, from the viewpoint of multifunctionality of forests, improve the processes of forest management and the resulting quality of industrial forest due to unsustainability effects as observed and reported by local authorities and researchers introduced in Problem Statement in Chapter 1. Cross-sectional management and ecological observational studies, observing external and internal factors that hinder the application of sustainable forest management in Kami City have been conducted in order to identify potential management issues and sustainability risks responsible for the problems stated. Modelling of an alternative policy and management framework that is capable of mitigating these management issues and the identified sustainability risks was performed. This model was tested and verified in a case study. Applicability of this model in Kami City, as well as in other potential areas in Japan, was discussed.

This research is important for national and local forest managers, as well as policy makers seeking to improve the quality of industrial forest, and to enable the multifunctionality aspect of industrial forest as describe by FAO and the Montreal Process in Kami City. The cases observed in this research may also be important for research conducted in areas outside of Kami

City and may serve as support material for managers and policy makers seeking improvement of forest sustainability there. This study gives forest managers and policy makers a (1) summary of the national and local implementation issues of SFM and their interrelationship. The next paragraph will provide a description of the type of research and will deliver an overview and explanation of the observation work conducted.

2.2 Methodology of research

This research follows a mixed-research approach, which involves quantitative and qualitative analysis of the independent variables ($x_{1...}x_5$) that are influencing the dependent variable of the SFM character in Kami City. Analysis of independent variables is necessary because of two

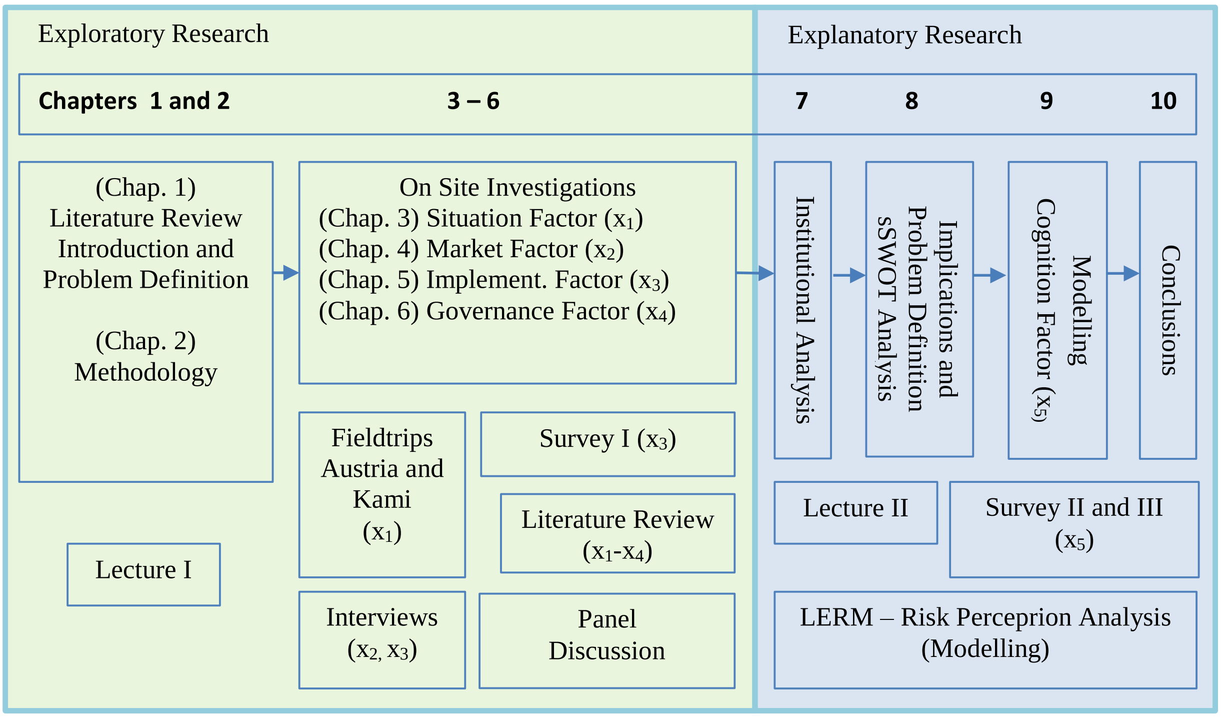


Figure 10: Framework of study

reasons. (1) Data is insufficiently available at the time this study is being conducted. For instance, the efficacy of law as an implementation tool for SFM is yet to be analyzed. Legislation directly influences the design of local SFM implementation measures and strategies. Several governmental strategies are being implemented in Kami City. The appropriateness of these strategies towards SFM and the reaching of national goals needs to be analyzed. Market structures also directly affect the type of forest management being conducted. Connections between market, management, governmental strategies, law and forest condition and productivity in Kami City are yet to be analyzed and discussed regarding risks and chances. The collection of such supportive data is crucial to become able to understand and describe the current status quo of either integrative or non-integrative (segregative) forest management in Kami City and to come up with a strategy for improvement. The second reason why analysis of independent variables is necessary is: (2) independent variables influence the dependent variable factorially. Ignoring one variable for the design of an alternative SFM management model could lead to inapplicability in the event this variable tends towards zero. Analyses for independent variables ($x_{1...}x_5$) involve strong focus on exploration (Chapters 3 – 6). This is necessary, also due to insufficient research available on the topic at the time this study is conducted. In this exploratory research section, additional studies are conducted to collect and support overall data findings. A survey is administered to evaluate the appropriateness of subsidies for private industrial forest in Kochi. This evaluation is conducted through a focus group discussion (FGD) involving experts from Japan, Austria and Germany. A field trip to Steiermark, Austria will be organized to compare management systems, legal frameworks, infrastructure and technology aspects. A panel discussion will be held in participation with leading forest practitioners in Kochi to debate current issues and chances of realizing SFM. Two lectures will be given at Kochi Prefecture Forestry School. The first titled "European Sustainable Forest Management" deals with the history of the concept of sustainable forestry and the requirements on local human and non-human resources for successful local implementation. Various examples for successful implementation strategies from the above-mentioned field trip in Steiermark, Austria will be presented. At the end of the lecture, a survey will be administered about acceptability for such strategies, followed by a discussion about implementation possibilities in Kochi. The second lecture at Kochi Pref. Forestry School notices this discussion and deals with transformation strategies of the current rotation forestry system in Kochi to alternative integrative approaches similar to those found in Germany and Austria. After the lecture, a survey will be administered to measure the risk perception for the current and an alternative integrative forest management system, followed by a twenty-minute discussion. Lastly, key stakeholders will be interviewed on several occasions to gain additional information on current SFM implementation issues and chances in Kochi/Kami.

Following are general methodological descriptions for each study on the analysis of the independent variables ($x_{1...}x_5$) in the exploratory research section of this study. More detailed descriptions of methodologies, including sampling and materials will be applied for each of these independent variables. These are presented in their respective chapters.

2.2.1 Exploratory research

Chapter 3 – Ecosystem analysis: Theoretical height growth and volume growth comparison (x_1)

In this study a forest height growth potential and volume growth comparison is conducted based on theoretical height growth data of common tree species in Kochi and Germany. Goal of this study is to estimate how industrial and natural forest may have developed if they had been managed under the same SFM concept as in Germany. Spatial distribution data is collected for the common tree species in the respective nations. Theoretical height growth data for these species is collected from international tree databases. The selected tree species are then categorized into three height growth groups (slow, moderate and fast growth); tree species and their area are itemized into each of these groups. Areas are treated as monocultures. Site condition data for Kochi forest is taken from the official Kochi forest growth assessment report for sugi and hinoki. Conditions for natural forest are estimated based on growth tables. Due to lack of spatial distribution data for natural forest, this area is treated once assuming all slow species and once all moderate species. Theoretical height growth per hectare is then estimated through linear calculation for each Kochi and Germany. Last, a volume growth estimation is performed simulating Kochi potential growth performance under management conditions and forest age structure in Germany.

Chapter 4 – International comparison of field operations (x_2)

In this study, a forestry market and forest certification analysis is conducted at the field operation level. Goal is to analyze the Japanese forestry industry as a whole, as well as the local forestry industry in Kochi Prefecture in contrast to the concept of SFM. This study includes extensive literature review on the history of forestry in Japan, current critics on forest management procedures and the current development of forest certification. Interviews with forest practitioners at Kami Forest Owners Association in Kochi Prefecture are held to gain insight of current local issues and chances. An inter-institutional field trip involving forestry practitioners from the private and governmental sector trip to private and national forestry bodies in Steiermark, Austria is organized to compare forest management practices with those in Kami City. Steiermark, Austria was selected for this field trip due to three reasons.

(1) Austria is a global player in the forestry industry that has a history of successful local integrative SFM implementation. (2) Topographical conditions are comparable to those in Kami City involving the use of similar management technologies. (3) Forest structures are comparable with a focus on similar coniferous tree species.

Chapter 5 – Analysis of Kochi subsidy scheme for private forest – a focus group evaluation (x_3)

The three general on-site management related National Biodiversity Strategy of Japan (NBSJ) objectives for private forest (1) Development of diverse forests, (2) Forest conservation and management, and (3) Control of wildlife damage are selected. Expected direct and/or indirect influence of each subsidy on these objectives are evaluated via an Expert Focus Group Evaluation (Survey I) in Japan (n=6), Germany (n=6) and Austria (n=6). In this expert evaluation, direct influence of a subsidy is demonstrated if site management is expected to contribute to one or more NBSJ objectives. Indirect influence is demonstrated if site management is expected to contribute to one or more NBSJ objectives implicitly, not directly aimed by subsidy statement. No influence is demonstrated if site management are not expected to contribute to one or more NBSJ objectives positively. All participants are individually clarified about the procedure and are required to become familiar with subsidy and NBSJ objective statements. In addition, participants have to have relevant professional forestry experience of a minimum of 5 years.

Chapter 6 – International forest law and policy SFM analysis (x_4)

Japan is internationally participative to support processes towards SFM. However, Japanese forestry is being criticized by various researchers for poor its forest management, which has is claimed to have led to widely-stretched degraded forest areas (Matsushita, X, Onda, O, Toyota, M, 2010). As claimed by Ota (2010), the Forest and Forestry Basic Law of 1964 aims to improve the implementation of sustainable forestry in the prefectures of Japan. In order to answer the research question how well the internationally accepted indicators and criteria for SFM are employed in the Japanese Forest and Forestry Basic Law of 1964, a law analysis for information about these criteria and indicators is conducted. To extend the content for interpretation, it is compared to the forest laws of Germany and Austria. The national forest law of Germany is chosen for this comparison because the German forestry industry is known for being advanced in technology, market and innovation. Moreover, the concept of SFM is claimed to have its origin in Germany (Grober, 1999). The forest law of Bavaria is selected as it is one of the states with the least natural resources in Germany, so unlike other federal states, forestry remained one of the most important economic sectors. The Austrian forest law is selected due to similar topographical and legislative conditions with Kochi Prefecture.

Each individual law is analyzed for information detail about the SFM criteria and indicators as described in the Montreal Process. The SFM criteria and indicators are categorized into three groups. (1) General Principles for Forests and Forestry, (2) International SFM Criteria and Indicators, (3) Unaddressed 1992 UN Earth Summit SFM Values.

(1) General Principles for Forests and Forestry represent typical forest and forestry values including definitions for forestland, forest ownership, forest management, as well as forest conservation measures and monitoring. Subgroup (2), International SFM Criteria and Indicators, derives the norms for sustainable forest management of the Montréal Process and Forest Europe, which are the working groups of the two countries that are part of this research study. These norms are based on the forest management standards released at the 1992 UN Earth Summit. Subgroup (3), Unaddressed 1992 UN Earth Summit SFM Values, lists ideals of the 1992 UN Earth Summit that were neither adopted by the Montréal Process nor Forest Europe, which are however, relevant factors with the potential to effectively contribute to sustainable forest management and are therefore, although considered of minor importance, worth addressing. Each forest law is lastly evaluated in respect to the key requirements model for forest law and forest policy of Lindsay et al., 2007.

2.2.2 Explanatory research

<u>Chapter 7 – Institutional Analysis</u>

Purpose of Chapter 7 is to identify interinstitutional issues hindering the implementation of SFM. It presents an institutional analysis of unsustainability risk causality in private industrial forest from an ecosystem perspective using common ecosystem service damage and analyzing qualitative data collected in Investigations I – IV. Kami Forest Owners' Association (FOA) in Kami City was selected as the main FOA, as it is considered one of the most influential FOA in Kochi Prefecture and even in whole Japan. This research offers basis for a less complicated analysis of ecosystem service hazards and provides causal clarity at different institution levels.

<u>Chapter 8 – Implications of Exploratory Research Findings</u>

Studies in the exploratory research section ($x_{1...}x_4$) and the institutional analysis in Chapter 7 are evaluated and discussed based on the theories of Macroeconomics and Sustainable Development. Sustainability risks for Kochi Prefecture/Kami City will be derived from this evaluation and discussed. A risk mitigation plan and the need for a change of the current forest management system in order to implement this plan successfully is discussed. In this discussion, mixed-forest strategies and the possible need for local expert leadership will also be discoursed.

A Strength – Weakness – Opportunities – Threats (SWOT) analysis is conducted in reference to the outcomes of exploratory research, current literature and is further supported with data from practitioner interviews who participated in the field trip to Austria[1].

Chapter 9 – Local Expert Risk Mediation (LERM) model

In Chapter 9, an alternative integrative forest management framework for Kochi Prefecture/Kami City with the name: Local Expert Risk Mediation (LERM) is proposed. This proposal will deal with the problem of implementability into local/regional and national strategic management structures. Five important sustainability-ensuring factors and their interplay between these local/regional and national strategic management structures are discussed. To validate the effectiveness of LERM, a survey is conducted with key-stakeholders to measure their risk perception of this system in regards to reducing the sustainability risks identified in Chapter 8. This risk perception is simulated for two scenarios and over three given timeframes. Additional questions regarding the agreement of the implementation of the five important sustainability-ensuring factors are asked, evaluated and discussed. Then, social and institutional acceptance of LERM among key-stakeholders is assessed by administering a survey to participants after a lecture on European sustainable forestry held by the author at Kochi Prefecture Forestry School. The explicit and implicit acceptability among key-stakeholders for an integrative forest management framework is discussed.

Chapter 10 – Conclusion

In the last chapter of this piece of research, conclusions are drawn regarding the hypothesis. The strengths and weaknesses of the proposed integrative forest management framework LERM are discussed and recommendations for future research are made.

[1] A video recording of this field trip including all interviews is available on request to the author or Kochi University of Technology. A written summary in Japanese is located in Appendix A: Field trip summary

2.3 Limitations

Although this research was prepared with care, awareness of methodological and researcher limitations should be addressed.

Methodological limitations

- Lack of forest site-condition data for both scenarios in Investigation I of this study (Chapter 3) required the design and application of an alternative methodology to simulate the theoretical growth potential of natural forest in Kochi Prefecture. Availability of site-condition data of tree species in natural forest would have provided a more accurate comparison.
- Although availability of relevant research studies on the topic were available for various countries, access to studies about the realization of SFM in Japanese local communities, were scarce at the time of data collection. Therefore, instead of a common explanatory research design, the application of an exploratory research design was necessary.
- For this this study, several results were acquired through self-reported data in the form of interviews, surveys and expert evaluations. Although it was tried to verify this data, it may still contain a certain degree of bias.

Data collection limitations

- This study partly depended on access to private forest owners who were some of the key stakeholders from which data had to be collected. Due to the Japanese privacy protection law, these forest owners cannot be identified easily. Data was therefore collected at events and other occasions at which private forest owners were present.
- The concept of SFM, although internationally acknowledged, is still a broad framework due to its interdisciplinary conception. There is still much debate on whether SFM can exclusively be realized for uneven-aged mixed forests, and not for even-aged monoculture forestry. As an international trend towards uneven-aged mixed forestry is visible, it is important to point out that this study was conducted supporting research for these forestry approaches. Given worldwide criticism, even-aged monoculture forestry is not considered an adequate SFM approach by many researchers.

- This research was conducted in a study site in Japan and required literature review, assessment of secondary data and collection of data from Japanese people and literature. The author of this study does not possess native Japanese language proficiency. The review of literature had to be focused on the most relevant and considered important works.

Summary

The purpose of Chapter 2 was to describe type, structure and methodology of this research. After a general overview of the research design, the exploratory and explanatory research sections were introduced. The methodological framework of sub-studies addressing independent variables in both of these sections was described. Sample selection, data collection and statistical procedures used to analyze the data gained to address independent variables are located in each respective chapter. An overview of methodological and data collection limitations concludes Chapter 2.

References

FAO. (2000). *Asia-Pacific Forestry Commission: Development of National-Level Criteria and Indicators for the Sustainable Management of Dry Forests of Asia: Workshop Report.* Bangkok, Thailand: United Nations.

Grober, U. (1999, November 25). *The Inventor of Sustainability*. Retrieved July 22, 2013, from Die Zeit Online: http://www.zeit.de/1999/48/Der_Erfinder_der_Nachhaltigkeit

Lindsay, J. M., Christy, L. C., Di Leva, C. E., & Takoukam, P. T. (2007). *Forest law and sustainable development - Addressing contemporary challenges through legal reform.* Washington DC: The International Bank for Reconstruction and Development / The World Bank.

Matsushita, B., Xu, M., Onda, Y., Otsuki, Y. & Toyota, M. (2010). Detecting forest degradation in Kochi, Japan: ground-based measurements versus satellite (Terra/ASTER) remote sensing. Hydrological Processes 24, 588-595.

Ota, I. (2010). Forest law and policy developments in Japan. *Working Papers International Series Forest Policy and Forest Economics*, pp. 3-11.

The Montreal Process (2015). Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests. Retrieved April 29, 2016 from: http://www.montrealprocess.org/documents/publications/techreports/MontrealProcess September2015.pdf

Chapter 3: Investigation I – Ecosystem Analysis: Comparative theoretical height and volume growth

Much of forest management research in recent years has focused on the applicability and successful integration of sustainable forest management (SFM) into public policy and regulations aiming the preservation of the Earth's forests (FAO, 2012; Sanjay and Audun, 2003). SFM is a forest management approach, which unlike conventional economy driven timber production approaches, targets environmental conservation, the sustainable production of wood and non-wood resources, and the preservation of therapeutic effects that forests have on the human wellbeing (Chen and Innes, 2013; Day and Pérez, 2013; Sato et al., 2006). Sustainably managed forests provide an optimum balance of environmental and non-environmental services and products, and preserve biodiversity while being more resistant against climate change (Smith, 2002; Kirschbaum, 2000). It is generally accepted that SFM has become an important key element towards sustainable development (Knauf, 2014; Stupack et al., 2011). As a means to implement SFM locally, the advantages of continuous cover forestry (CCF) have received much attention all around the globe (Mason, 2015; Macdonald et al., 2009; Rojo and Orois, 2005).

Forest volume growth data are used for assessing forest conditions (Fang et al., 2014) as they provide researchers, forest managers and policy makers with information about changes in forest inventory and carbon sinks (McMahon et al., 2009). The latter are essential pieces of information for policy makers to discuss future emission targets and climate preservation policy (Kirschbaum, 2000). Forest growth data can provide insight into tree development issues such as stand density, and act as an indicator for the assessment and adaptation of intervention strategies (Carle et al., 2003). At national-level, forestry ministries regularly release forest volume growth data. Measurement of forest volume growth at national-level is complex, as it requires excessive financial resources, is labor intensive, and organizationally challenging. In Germany, volume growth estimated through in situ spot check analysis through Germany's National Forest Inventory Agency. In Japan, it is estimated based on sample analysis. To improve data quality, data collection time, and cost efficiency, innovative techniques such as remote sensing have been developed and are being tested for practical application (Matsushita et al., 2010). However, despite improved access to technology, it remains difficult to evaluate the capacity of volume growth data at international-level, due to different site conditions and means of management. Therefore, with national data alone, it is difficult to evaluate growth conditions, and consequently, is difficult to estimate how much more growth could be achieved under improved conditions.

Nearly half of Japan's entire forest area was reforested within approximately twenty-five years after WW2. The optimality of this reforestation project and the resulting growth conditions have become a matter of serious debate (Gain and Watanabe, 2013; Sterngold, 1995). Japan's forest area is approximately 25.1 million ha, and is about two and a half times larger than Germany's 10.8 million ha. However, average annual forest growth in German forests is reportedly significantly higher than in Japan – Japan: 78.2×10^6 m^3 ($3.2 m^3$ ha^{-1}) p.a. of which: industrial forest: 62.6×10^6 m^3 ($6.08 m^3$ ha^{-1}) p.a., and natural forest: 15.6×10^6 m^3 ($1.05 m^3$ ha^{-1}), Germany: 121.6×10^6 p.a. ($11.3 m^3$ ha^{-1}). From the authors' experience, Japanese forest administration often explains slower growth of natural forest as a function of predominantly slow growth tree species. Such attempts to establish a link between slow volume growth and predominantly slowly growing tree species are unconvincing as forest area also acts as a direct determinant for total growth. To provide an alternative explanation for Japan's slow forest growth, various researchers have warned about the risks of forest degradation associated with stand density, mainly due to the absence of silviculture practices in the past (Matsushita et al., 2010; Kolb et al., 1994). The issue of high stem density in Japanese forests must be taken seriously, as a reason for slow growth associated with environmental risks in Japan (Woodmiles, 2015). This study was designed to support the work of these researchers and provide an attempt to demonstrate that the performance of Japan's tree species alone cannot be made responsible for slow forest growth.

The aims of this study are (1) to estimate a theoretical mean annual height growth capacity of Japanese species to determine how high these species are capable of growing per year. Implications of theoretical height growth of natural forest will be discussed. (2) To support the hypothesis that tree species in Japan should not be made fully responsible for relatively slow annual volume growth. To do this, a volume growth capacity comparison of Japanese and German forests was performed by simulating how Japanese forests may perform if planted in under German conditions. The basic assumption: height to volume regression develops consistently. Although this is a general approach, it is performed equally for both nations. Performed at a large scale, it should deliver valuable insights about differences in growth conditions. (3) To discuss possible implications of theoretical growth capacity for carbon stock dynamics, and (4) to draw a possible link to factors that may disturb forest growth in Japan with the rationale for a transition to extended continuous cover forest management.

3.1 Methodology

The authors collected spatial distribution data of all major coniferous and deciduous tree species of Japan and Germany from the relevant government ministries of each nation. Rare tree species and species that cover only an insignificant area were excluded to facilitate calculations. Next, to identify the theoretical growth performance of each tree species, annual height growth data from six international plant databases was collected, however, not every plant database listed all the tree species relevant for this study. Next, to classify the tree species, they were divided based on annual theoretical height growth performance into three categories, slow 5-30 cm p.a., moderate 30-60 cm p.a., and fast 60-90 cm p.a., following conventional plant database categories. In addition, since Japanese forestland is classified into industrial and natural forest areas, subcategories for these species were created. To specify data outcomes, mean growth values were used for each of the three growth categories, slow ($h_s = 17.5$ cm p.a.), moderate ($h_m = 45$ cm p.a.), and fast ($h_f = 75$ cm p.a.). Area distribution for all slow, moderate and fast tree species was calculated and assigned to each of the three growth categories. Then, area distribution values and annual height growth values for each theoretical growth category were used to estimate the theoretical height growth performance (p^i) per tree for Japanese forest (p^1) and German forests (p^2). Their equations are given by:

$$p^i = \frac{1}{\sum_{j=1}^{n_i} A^i(j)} \sum_{j=1}^{n_i} A^i(j) h^i(j) \tag{1}$$

where:

p^i: theoretical height growth performance per tree and per hectare for country i

i: index to represent country (i=1: Japan, i=2: Germany)

j: index to represent type of group species ($j = 1-5$ in Japan, $j = 1-7$ in Germany)

A^i_j: the area of type of group species j in country i

$h^i(j)$: theoretical height growth rate in type of group species j in country i

n_i: the number of types of group species in country i (n_1=7 in Japan, n_2=5 in Germany)

As further described in Results, it should be noted that Japanese natural forest consists of predominantly slow and moderate growth species in the same area. Their distribution is not surveyed in detail; thus, their data is unavailable. Therefore, p^1 is estimated for two cases assuming all species in natural forest are of slow growth (p_s^1) and of moderate growth (p_m^1). Equations are given by:

$$p_s^1 = \frac{1}{\sum_{j=1}^{5} A^1(j)} \{\sum_{j=1}^{4} A^1(j)h^1(j) + A^1(5)h_s^1(5)\} \tag{2}$$

$$p_m^1 = \frac{1}{\sum_{j=1}^{5} A^1(j)} \{\sum_{j=1}^{4} A^1(j)h^1(j) + A^1(5)h_m^1(5)\} \tag{3}$$

where:

p_s^1: theoretical height growth performance per tree and per hectare for Japan assuming natural forest consisting entirely of slow growth species

p_m^1 : theoretical height growth performance per tree and per hectare for Japan assuming natural forest consisting entirely of moderate growth species

$A^1(5)$: the area of type of group species 5, including natural forest

$h_s^1(5)$: theoretical height growth rate in natural forest assuming that it entirely consists of slow growth species

$h_m^1(5)$: theoretical height growth rate in natural forest assuming that it entirely consists of moderate growth species

To compare total theoretical height growth performance (P) for Japanese and German forest, the values for the forest areas (A) of Japan ($A^1 = 25.1\times10^6$ ha) and Germany ($A^2 = 10.8\times10^6$ ha) were multiplied with each theoretical height growth performance per tree and per hectare (p) as follows:

$$P^i = p^i A^i \tag{4}$$

$$P_s^1 = p_s^1 A^1 \tag{5}$$

$$P_m^1 = p_m^1 A^1 \tag{6}$$

where:

P^i: total theoretical height growth performance for country i

P_s^1: total theoretical height growth performance for Japan assuming natural forest consisting entirely of slow growth species

P_m^1: total theoretical height growth performance for Japan assuming natural forest consisting entirely of moderate growth species

Regarding Japanese forest, total theoretical height growth performance for industrial forest (P_I^1) and natural forest is also obtained. For the latter, two values are again estimated assuming natural forest consisting entirely of slow growth species (P_{Ns}^1) and moderate growth species (P_{Nm}^1), respectively. The equations are given by:

$$P_I^1 = \sum_{j=1}^{4} A^1(j) h^1(j) \tag{7}$$

$$P_{Ns}^1 = A^1(5) h_s^1(5) \tag{8}$$

$$P_{Nm}^1 = A^1(5) h_m^1(5) \tag{9}$$

where:

P_I^1: total theoretical height growth performance for industrial forest in Japan

P_{Ns}^1: total theoretical height growth performance for natural forest in Japan assuming that it entirely consists of slow growth species

P_{Nm}^1: total theoretical height growth performance for natural forest in Japan assuming that it entirely consists of moderate growth species

Performing this comparison answers the first question how much mean annual height growth can be expected under average growing conditions, which will reveal whether Japan or Germany possesses a higher theoretical annual height growth capacity.

Finally, in an effort to draw conclusions based on differences in growth conditions, and to test the hypothesis that inferior growth conditions, and not only Japanese tree species may be responsible for comparatively slow annual volume growth, a volume growth capacity simulation (W) of how the forests of Japan may perform under the growth conditions of Germany was performed. Official annual volume growth (V) of Japan $(V^1 = 78.2 \times 10^6 m^3 p.a)$ with $(V_I^1 = 62.6 \times 10^6 m^3 p.a)$, $(V_N^1 = 15.6 \times 10^6 m^3 p.a)$ and Germany ($V^2 = 121.6 \times 10^6 m^3 p.a$) was determined for domestic species and set off against spatial distribution of tree species of each growth category in the opposite nation. Equations are given as follows:

$$W_I = \frac{P^2}{P_I^1} V_I^1 \tag{10}$$

$$W_{Ns} = \frac{P^2}{P_{Ns}^1} V_N^1 \tag{11}$$

$$W_{Nm} = \frac{P^2}{P_{Nm}^1} V_N^1 \tag{12}$$

$$V_I^1(j) = \frac{V_I \times h^1(j) A^1(j)}{\sum_{j=1}^{4} h^1(j) A^1(j)} = \frac{V_I \times h^1(j) A^1(j)}{P_I^1} \tag{13}$$

$$W_I(j) = \frac{W_I \times h^1(j) A^1(j)}{\sum_{j=1}^{4} h^1(j) A^1(j)} = \frac{W_I \times h^1(j) A^1(j)}{P_I^1} \tag{14}$$

Where:

W_I: a volume growth capacity simulation of how industrial forest of Japan may perform under growth conditions of Germany

W_{Ns}: a volume growth capacity simulation of how natural forest of Japan with assumption of all slow growth species may perform under growth conditions of Germany

W_{Nm}: a volume growth capacity simulation of how natural forest of Japan with assumption of all moderate growth species may perform under growth conditions of Germany

$V_I^1(j)$: Estimated annual volume growth in the area j of industrial forest in Japan

$W_I(j)$: a volume growth capacity simulation of how the area j of industrial forest of Japan may perform under growth conditions of Germany

The basic assumption in this approach is that theoretical height growth develops in an equal manner as volume growth. Tree species of one growth category should perform in a similar way in one area, under comparable growth conditions, as in another, or show superior performance under improved conditions. It is necessary to note that this comparative simulation of volume growth capacity did not address tree growth affecting factors such as climate, soil condition, stand age etc. These variables were excluded due to two reasons. The corpus of this simulation was constructed to reveal differences in growth conditions between Japan and Germany, to identify the extent to which such growth conditions in one nation are superior to the other. Moreover, intention was to keep methods simple, easy to replicate, and to simplify data requirement.

3.2 Results

Major tree species in Japanese and German forests (Table 2 and Table 3) consist of similar varieties of coniferous and deciduous tree species. The majority of forests in both countries consist of 11–13 tree species. However, there are important differences in spatial distribution and theoretical height growth performance of these species. German forests consist almost equally of coniferous and deciduous species, while approximately 60 per cent of Japanese forestlands have deciduous species. The most common conifers *Cryptomeria japonica* and *Chamaecyparis obtusa* are located in industrial forest, and account for approximately 7.1 million hectares. In regards to theoretical height growth performance, Japanese cedar and Japanese cypress are classified as moderate and slowly growth tree species. Fast growth species *Larix kaempferi* accounts for 1 million hectares of industrial forest in Japan. On the contrary, forests in Germany have approximately 5 million hectares of fast growing species.

Table 2: Annual theoretical growth of major Japanese tree species

j	Species Name	Common Name	Mean Theoretical Height Growth p.a. $h^1(j)$ [cm]		Area $A^1(j)$ [10^3 ha]	Type of Forest Area
1.	*Chamaecyparis obtusa*	Japanese Cypress	slow	17.5	2,600	Industrial forest
2.	*Crypromeria japonica*	Japanese Cedar	moderate	45	4,500	
3.	*Larix kaempferi*	Japanese Larch	fast	75	1,000	
4.	*Pinus densiflora* *Pinus thunbergiana* *Picea jezoensis* *Abies sachalinensis*	Japanese Red Pine Japanese Black Pine Yezo Spruce Sakhalin Fir	moderate moderate moderate moderate	45	2,200	
5.	*Fagus crenata* *Thujopsis dolabrata* *Picea jezoensis* *Cinnamomum camph* *Kashii* *Castanopsis*	Japanese Beech Hiba Yezo Spruce Camphor (Various species) Chinquapin	slow moderate moderate slow slow – moderate slow – moderate	17.5 – 45	14,800	Natural Forest

Note: Theoretical height growth p.a. for natural forest area lies between slow and moderate

In terms of forest area, missing spatial distribution data of certain tree species in both nations draws attention. Data for four fast growth species – *Carpinus betulus, Fraxinus excelsior, Betula pendula, Abies alba* – in about 2.3 million hectares in German forests were not available at time of data collection, around 20 per cent of Germany's total forest area. Spatial distribution data for ten species in Japan in approximately 17 million hectares of forestland were also not available, approximately 70 per cent of Japan's forest area. Four moderate growth species (*Pinus densiflora, Pinus thunbergiana, Picea jezoensis* and *Abies sachalinensis*) accounted for 2.2 million hectares of industrial forest. The remaining 14.8 million hectares consist of six species of slow and moderate height growth in natural forest.

Table 3: Annual theoretical growth of major German tree species

j	Group species	Common Name	Mean Theoretical Height Growth $h^2(j)$ [cm/yr.]		Area $A^2(j)$ [10^3 ha]
1.	*Picea abies*	Norway Spruce	moderate	45	2,800
2.	*Pinus sylvestris*	Scots Pine	fast	75	2,400
3.	*Fagus sylvatica*	European Beech	moderate	45	1,700
4.	*Quercus robur*	French Oak	slow	17.5	1,100
5.	*Pseudotsuga menziesii*	Douglas Fir	moderate	45	200
6.	*Larix decidua*	European Larch	fast	75	300
7.	*Carpinus betulus* *Fraxinus excelsior* *Betula pendula* *Abies alba*	European Hornbeam European Ash Silver Birch Silver Fir	fast fast fast fast	75	2,300

Analysis for the 2.2 million ha of moderate growth species in Japan (Table 2) and 2.3 million hectares of fast growth species in Germany (Table 3) did not pose problems due to equal theoretical height growth classification. However, Japanese natural forest consists of predominantly slow and moderate growth species in the same area. Detailed spatial distribution data was not available for every species complicated calculation. Therefore, analysis was performed twice, once assuming all species being slow growth species, and once assuming all species being moderate.

Table 4: Theoretical height growth performance per tree (p^i) and total (P^i).

	Country (i)	Theoretical height growth (p^i) and its ratio to p^2			Total theoretical height growth (P^i) and its ratio to P^2		
1	**Japan (slow natural forest)**	p_s^1	**27.13 cm**	**48.37%**	P_s^1	$6.810\times10^{10}m^3$	**112.4%**
	Japan (moderate natural forest)	p_m^1	**43.35 cm**	**77.29%**	P_m^1	$1.088\times10^{11}m^3$	**179.8%**
2	**Germany**	p^2	**56.09 cm**	**100.0%**	P^2	$6.058\times10^{10}m^3$	**100.0%**

Results for (p) show performance for Japanese forest being lower than German forest. Results for Japan's natural forest area show a range of 48.37 per cent (all slow species) and 77.29 per cent (all moderate species) of German forests (Table 4). A comparison of total theoretical height growth (P) shows a higher growth capacity for Japan's forests for both scenarios, all slow growth species (+12.41%) and all moderate growth species (+79.75%). Despite competitive height growth performance of tree species in Japan, growth conditions appear different. To quantify these differences of growth conditions, a comparative volume growth capacity simulation was performed to establish how the forests of Japan may perform if cultivated under German growth conditions. Volume growth capacity simulation results of Japanese forests indicate that growth conditions in Germany are more favorable than those in Japan. Thus, as mentioned in Methods, a comparison was made on between the average annual forest volume growth and theoretical height growth. The following three cases were analyzed.

Table 5: Theoretical growth capacity and simulated volume growth Comparison

JAPAN industrial forest vs GERMAN forest						
		Japan [$10^6 m^3$/yr.]		Germany [$10^6 m^3$/yr.]	Ratio of Japan to Germany	Performance Rate
Total theoretical height growth performance (P)	P_I^1	42,200	P^2	60,580	0.697	N/A
Annual volume growth (V)	V_I^1	62.6	V^2	121.6	0.515	0.739
A volume growth capacity simulation (W_I)		84.7				
JAPAN natural forest (all slow growth species) vs GERMAN forest						
		Japan [$10^6 m^3$/yr.]		Germany [$10^6 m^3$/yr.]	Ratio of Japan to Germany	Performance Rate
Total theoretical height growth performance (P)	P_N^1	25,900	P^2	60,580	0.428	N/A
Annual volume growth (V)	V_N^1	15.6	V^2	121.6	0.128	0.300
A volume growth capacity simulation (W_I)		51.9				
JAPAN natural forest (all moderate growth species) vs GERMAN forest						
		Japan [$10^6 m^3$/yr.]		Germany [$10^6 m^3$/yr.]	Ratio of Japan to Germany	Performance Rate
Total theoretical height growth performance (P)	P_N^1	66,600	P^2	60,580	1.10	N/A
Annual volume growth (V)	V_N^1	15.6	V^2	121.6	0.128	0.117
A volume growth capacity simulation (W_I)		133.7				

As can be seen, simulated volume growth of Japan's industrial forest accounts for approximately 84.7 million m^3 p.a., a 22 million m^3 p.a. higher value than the current 62.6 million m^3 p.a. Simulation results for Japan's natural forest area show even larger values indicating stronger differences in growth conditions. Given performance rates of 0.3 in the case of all slow natural forest, and 0.117 for all moderate forest, simulation results show approximately 3.3 times and 8.5 times higher total values respectively.

Table 6: Total and per hectare growth for Japanese group species

j	Species Name	$V_I^1(j)$ [10^6 m^3/yr.]	$W_I(j)$ [10^6 m^3/yr.]	$V_I^1(j)/A_j$ [10^{-4} m/yr.]	$W_I(j)/A_j$ [10^{-4} m/yr.]
1.	*Chamaecyparis obtusa*	6.75	9.12	2.60	3.51
2.	*Cryprомeria japonica*	30.04	40.60	6.67	9.02
3.	*Larix kaempferi*	11.12	15.10	11.12	15.10
4.	*Pinus densiflora* *Pinus thunbergiana* *Picea jezoensis* *Abies sachalinensis*	14.68	19.87	6.68	9.02
j	Species Name	V_N^1 [10^6 m^3/yr.]	W_N [10^6 m^3/yr.]	V_N^1 / A_j [10^{-4} m/yr.]	W_N / A_j [10^{-4} m/yr.]
5.	*Fagus crenata* *Thujopsis dolabrata* *Picea jezoensis* *Cinnamomum camph* *Kashii* *Castanopsis*	15.60	133.70 (W_{Ns}) 51.90 (W_{Nm})	1.05	9.03 (W_{Ns} / A_j) 3.50 (W_{Nm} / A_j)
	Total	78.20	218.39 (W_{Ns}) 136.59 (W_{Nm})		

Table 6 shows decomposed volume growth values for all areas A_j^1 for all slow, moderate and fast group species in industrial forest j: 1-4 ($V_I^1(j)/A_j$ and $W_I(j)/A_j$), and natural forest j: 5 (V_N^1 / A_j and W_N / A_j). As can be seen, compared to industrial forest, significantly higher simulation increases are shown for Japan's natural forest area for both slow and fast scenarios.

3.3 Discussion

Comparison of results shows that forest growth conditions in Japan may be inferior to those in Germany, with natural forest showing significantly more slowed growth than industrial forest. Unfortunately, due to missing data, a more accurate growth capacity estimate for natural forest was not possible. However, due to the slow growth species *Fagus crenata* being one of the most common species in Japanese natural forest, results may tend towards the slow, rather than the moderate estimate (Nakashizuka, 1987). As for industrial forest, one explanation for slow growth could be large distributions of recently rejuvenated areas, or mature stands with slowed radial growth. However, with large areas of newly established forests, annual timber volume stock should be expected to increase, and not decline as official data predicts (MAFF, 2012). These results broadly reflect how differences in forest area influence total growth, even with predominantly slow growth species. Overall results therefore indicate that relying on species performance data alone provides limited information on forest development, and should not be a sole determinant for the evaluation and justification of growth. This approach may therefore provide useful information to stakeholders concerned with large forest areas considering changes in forest structure, such as from single-layered coniferous monocultures to multi-structured mixed forests (Smith, 2002).

When evaluating the significance and possible applicability of the comparative growth capacity results, it must be noted that such a comparison between two countries based on height growth is very difficult to accomplish due to different species and site conditions affecting forest growth. Forest growth is influenced by a variety of internal and external factors, such as the type of species used, stand dynamics, soil fertility, climate characteristics such as temperature and precipitation, and topography. Contrasting mean site indices for Japan's common species *Cryptomeria japonica* and *Chamaecyparis obtusa* planted in Kochi Prefecture in southern Japan – one of Japan's most forest rich prefectures – shows that with proper management, site conditions for these species seem to produce above mean annual growth (Nishimura, 1993).

However, compared to nations in Europe where decades of historical tree development data are available, availability of, especially natural forest data, is still limited in Japan. This disadvantage of limited data availability complicates prognosis of forest growth and stock capacity. Although common in forest data and statistics, the treatment of forests and tree species as calculated monocultures in simulations as the one performed in this study will always provide much room for debate. In addition, the handicap of clear site condition data and its impact on the accuracy of results may also be questioned. However, prediction of forest growth, as best possible, is of common interest for the derivation of management strategies.

3.3.1 Implications for carbon dynamics in natural forest

Forest growth influences carbon sink activity (Singh et al., 2011; Drexhage, 2001). Carbon sinks are considered important natural CO_2 depots for the mitigation of effects of global warming (He et al., 2013; Fung et al., 2005). Proper silviculture measures have the potential to enhance site biodiversity, tree growth redistribution, increase timber stock, and the amount of carbon stored in the forest (Garcia-Gonzalo et al., 2006; Graham et al., 1999). Between 1966 and 2009, carbon stock in teragrams of carbon (TgC) in Japanese forests have nearly doubled from 1100 TgC to approximately 2000 TgC, and is expected to further increase to close to 2200 TgC by the year 2020. However, it appears that of this increase of 900 TgC, 700 TgC have been achieved in industrial forest, which unlike natural forest is managed (MAFF, 2015; Sasaki and

Kim, 2009). Sink activity decreases as forests grow older, however, although radial growth continues, mature stands are often undervalued for building up sinks (Carey et al., 2001). In Japan, approximately 4.5 million ha of natural forests are older than 81 years with low sink activity (Karjalainen et al., 2002). However, more than 5 million ha of natural forest are yet to reach maturity and are therefore capable of building up carbon sinks faster if managed.

Although Japan has decided to quit participation in the second commitment period of the Kyoto Protocol, the Japanese government is continuing its efforts to lower the production of greenhouse gas emissions, and to increase carbon sinks by promoting active management for silviculture such as thinning and reforestation (MOF, 2015). About 60 per cent of Japan's entire forest area is left unmanaged almost entirely. According to simulation results, the application of proper management may have the potential to boost growth between approximately 51.9 million m^3 p.a. and 133.7 million m^3 p.a., depending on type of tree species and distribution. Such increase has strong potential for positive effects on the development of carbon dynamics, as has been suggested in past research (Sasaki and Kim, 2009).

3.3.2 Accessibility to small-scale private forest

Japan's industrial and natural forest is organized in mosaic patterns. The majority of private forest stands are small-scale areas of below 20 hectares and are established within natural forest. Apart from forest growth, the results of this study may support two common issues of Japanese forestry, low accessibility to private industrial forest and insufficient forest owner management. The forest owner population in Japan is ageing dramatically (Schindelbeck et al., 2008). Moreover, results of the 2010 Opinion Survey of the Japan Ministry of Agriculture, Forestry and Fisheries (MAFF) found that approximately 77 per cent of small-scale private forest owners want to keep but not manage their forest (MAFF, 2010). This intention of private forest owners to keep ownership but not manage their forests leads to underutilization, which was also observed by researchers in Yamaguchi prefecture (Noriko et al., 2006). Underutilization of domestic forest resources in Japan through lack of management such as late or no thinning may lead to environmental damage through degradation, slow growth and shrinking profitability of the forest industry (Ota, 2002). In fact, average harvesting costs under comparable conditions are approximately twice as high as in Germany and have gone beyond the market price for *Crypromeria japonica*, Japan's most common conifer. This profitability problem has led to private forest owners distancing themselves from forest management. As a result, a growing number of small-scale forest owners has literally "gone missing" due to relocation, death and/or untraceable inheritance within family. Forest owners' associations and other management bodies are challenged to keep track of these forest owners to discuss silviculture measures. Moreover, Japanese privacy law restricts local administration to identify and contact these forest owners, which further complicates access to private forest for proper management (Gain and Watanabe, 2013).

An aging forest owner population, adverse behavior towards management due to low profitability, and identification restrictions by national policy to establish contact, can be considered the driving factors for the worsening of access to private forest, which hinders the application of forest management in those areas. Simulation results for industrial forest may be a direct effect of these three growth-affecting factors. The findings of this study may therefore contribute to those of other researchers who have discovered that improved management conditions may enhance volume growth, but did not state how much growth in comparison to growth conditions in other nations could be expected (Yamashita et al., 2004). To improve access to small-scale private forest in Japan, MAFF has introduced financial incentive schemes to enhance local productivity and to revitalize stands (Fujisawa, 2004). However, these financial support schemes appear to be merely a tool to buy administrative rights from private forest owners, without integrating them in planning and management related questions (Lutz et al., 1994). Although improved forest accessibility in Japan may have the potential to enhance volume growth, accessibility should not stop at physical access to forestland. Management integration, consensus, effective policy development, and motivation are important long-term aspects relevant for improvement (Knauf, 2014). Without constant compliance with society, sustainable forest growth cannot be maintained (Hasegawa et al., 2013; Kruger et al., 2013; Sasaki and Kim, 2009).

3.3.3 Integration of industrial and natural forest

Comparison of theoretical height growth, simulated volume growth capacity, and carbon sink activity indicates that slow growth of Japanese natural forest may be attributed to the fact that natural forest does not receive management. This issue of insufficient management has been raised by researchers in the past and is often linked to degrading forest areas (Matsushita et al., 2010). Simulation results imply that annual growth of natural forest has the potential for increase if management was improved. Given this growth potential, this finding could act as support material to support the debate of a change from rotation forest management (RTF) to integrated continuous cover forestry (CCF). CCF can bring local economic and ecological advantages (Mason, 2015; Rojo and Orois, 2005).The integration of natural forest and industrial forest to a balanced mixed-forest area has been under consideration (FAO, 2010). The often-criticized poor forest road network has been continuously improved throughout Japan, enabling enhanced access into both, industrial and natural forest areas, a precondition for successful implementation of CCF (MAFF, 2010).

An integration of natural and industrial forest in Japan would significantly increase the manageable forest area increasing flexibility in regards to maintaining and controlling carbon sink activity. For Japan being a nation that promotes climate protection, the growth potential results of natural forest in this study, can be used to justify a policy shift towards CCF, as a strategy to increase carbon pools and sinks in Japan. Ageing forest, degradation in industrial and natural forest due to limited access and absence of technology to respond to issues in natural regeneration, have disturbed an efficient development of carbon pools (Watanabe, 2003). An efficient strategy to optimize subterraneous and above ground carbon pools in degraded forest is to regenerate and stabilize affected areas by converting them to mixed cultures (Wirth, 2004).

However, uncertainty in the optimization of management practices for CCF is likely the main reason for slow policy development (Burger and Kelting, 1999). Sustainable management of uneven-aged forests is complex as development of stand structure and cutting schedules is more challenging and costly than in even-aged forests (Adams et al., 1974). Already have prices for Japanese cedar, one of Japan’s most important wood resource, fallen below production costs per m^3 of timber (MOF, 2015). Moreover, despite the efforts, CCF will likely not bring significant improvements in timber quality that could bring positive economic effects (Macdonald et al, 2009). Nevertheless, thinking towards sustainability, addressing mentioned issues restricting adequate management, long-term strategies that combine productivity and natural conservation are needed. Long-term strategies stabilize forest growth and natural balance, which can be achieved by adapting management towards site adapted mixed forests (Spiecker, 2003). The government sector, forest owners’ associations, environmental and society development organizations should consider the build-up of a communication network targeting a common goal by determining proper implementation actions (Cordonier Segger, 2004). Power distribution among leadership and administration should be analyzed and reallocated if necessary (Stefano, 2001). Target-oriented governance and goal-oriented distribution of financial incentives are central towards this direction (Shigematsu and Sato, 2013).

3.4 Conclusion

In this study, an attempt was made to compare theoretical height growth and volume growth of Japan's forests under German growth conditions. This growth comparison was motivated first due to significantly different annual growth volumes in both nations. Second, to challenge the common claim that growth performance of major Japanese tree species is responsible for slow forest growth. In this attempt, an analysis of forest structures of these nations was performed, and a methodology based on tree growth data of plant databases was developed to determine mean theoretical growth. In addition, a comparative growth capacity simulation was performed to identify the degree of variation of growth conditions. Indication was found that present annual growth of Japanese forest might not be restricted to predominantly slow and moderate growth species. Under the assumption of all species in natural forest being slow growth species, theoretical height growth capacity could be on par with German tree species due to Japan's significantly larger forest area. In addition, volume growth capacity simulation results show that under German growth conditions, Japanese tree species could possess a larger annual volume growth capacity of approximately 22 million m^3 p.a. more for industrial forest and between 37 million m^3 p.a. and 118 million m^3 p.a. more for natural forest. The tree species *Pinus sylvestris* was classified as a fast growing species according to the plant databases used in this study. Growth of this species, however, can vary greatly between moderate and fast even under comparable site conditions.

Forests are considered an important ecological system concerning mitigating the effects of climate change. The results of this study may be relevant findings for policy makers targeting an increase of carbon sink activity. Results may also draw a link between slow forest growth and the often-raised issues of forest accessibility, technical absence in both industrial and especially natural forest, degradation, dense planting and evaluating low productivity of Japanese forestry. Local integration of natural and industrial forest towards CCF may be the right step towards the mitigation of these issues.

This is the first study to our knowledge to compare theoretical forest growth capacity at international-level. It may be helpful to draw attention to possible links between yet unnoticed issues in forest management and could serve as discussion tool to support evaluation. However, this study has been primarily concerned with theoretical values. Results cannot be taken as evidence that values of forests simulated in this study could perform exactly the way as estimated. Moreover, performing this study was very difficult due to the need of incorporating uncertain growth influencing factors for which data was not available. A more precise estimation of theoretical height growth capacity, as well as a volume growth comparison incorporating site conditions was therefore not possible. Forest growth is influenced by internal and external factors ranging from stand development and dynamics, soil fertility, temperature, precipitation, topography etc. Although mean height growth values were used, availability of site condition data for both, industrial and especially natural forest would have given more accurate results. Nonetheless, it was of essential importance to incorporate natural forest in this research to demonstrate the immense growth difference of both forest areas, and as the position of natural forest may rise in significance towards a future of unified and utilizable managed forest.

References

Adams, D.M. and Ek, A.R. (1974). Optimizing the Management of Uneven-aged Forest Stands. *Can. J. For. Res.* **4**, 274–287.

Bundesministerium für Ernährung und Landwirtschaft (BMEL). (2014). Der Wald in Deutschland. Ausgewählte Ergebnisse der dritten Waldinventur. Berlin, Germany

Burger, J.A. and Kelting, D.L. (1999). Using soil quality indicators to assess forest stand management. *For. Ecol. Manage.* 122, 155–166.

Carey, E.V., Sala, A., Keane, R. and Callaway, R.M. (2001). Are old forests underestimated as global carbon sinks? *Glob. Chang. Biol.* **7**, 339–344.

Carle, J., Del Lungo, A. and Varmola, M. (2003) The need for improved forest plantation data. Paper presented at the XII World Forestry Congress. Quebec City: Food and Agriculture

Organization of the United Nations. (2003). http://www.fao.org/forestry/25852-01c5f986a36f9ce71eccfa8eafc9f2c18.pdf (accessed on 28 October, 2015).

Chen, J. and Innes, J.L. (2013) The implications of new forest tenure reforms and forestry property markets for sustainable forest management and forest certification in China. *Journal of Environmental Management* 129, 206-2015.

Cordonier Segger M.C. (2004). Significant developments in sustainable development law and governance: A proposal. *Natural Resources Forum* 28, 61-74.

Day, K.J. and Pérez, D.M. (2013). Reducing uncertainty and risk through forest management planning in British Columbia, *Forest Ecology and Management* 300, 117-124.

Drexhage, M. (2001). Estimating root system biomass from breast-height diameters. *Forestry* 74, 491–497.

Fang, J., Kato, T., Guo, Z., Yang, Y., Hu, H., Shen, H., Zhao, X., Kishimoto, A., Tang, Y. and Houghton, R.A. (2014). Evidence for environmentally enhanced forest growth. *PNAS* 111(26), 9527-9532.

FAO. (2010). *Japan Forestry Outlook Study.* Bangkok, Thailand.

FAO. (2012). *State of the World's Forests 2012*. Rome, Italy.

Kochi Prefecture Administration. (2014). *Financial Support Scheme for Thinning in Kochi Prefecture 2015.*

Fung, I.Y., Doney, S.C., Lindsay, K. and John, J. (2005). Evolution of carbon sinks in a changing climate. *Proc. Natl. Acad. Sci. U. S. A.* 102, 11201–6.

Fujisawa, H. (2004). The forest planning system in relation to the forest resource and forestry policies. *Journal of Forest Research* 9, 1-5.

Gain, D. and Watanabe, T. (2013). Forest Management in Japan: Application Issues of Sustainable Forestry and the Potential of Improvement through Accredited Forest Certification. *Internet Journal for Society for Social Management Systems* 3, 3086.

Gain, D. and Watanabe, T. (2013). The contribution of forest regulations on the realization of sustainable forest management: A comparative law study of Japan and Germany. *Internet Journal for Society for Social Management Systems* 3, 3731.

Garcia-Gonzalo, J., Peltola, H., Briceño-elizondo, E. and Kellomäki, S. (2006). Changed thinning regimes may increase carbon stock under climate change: A case study from a Finnish boreal forest. *Clim. Change* 81, 431–454.

Graham, R., Harvey, A., Jain, T. and Tonn, J. (1999). Effects of Thinning and Similar Stand Treatments on Fire Behavior in Western Forests. *Bark Beetles, Fuels, Fire Bibliogr.*

Hasegawa, M., Pulhin, J.M. and Inoue, M. (2013). Facing the challenge of social forestry in Japan: The case of reviving harmonious coexistence between forest and people in Okayama Prefecture. *Small-scale Forestry* 12, 257-275.

He, Q, Chen, E., An, R. and Li, Y. (2013). Above-ground biomass and biomass components estimation using LiDAR Data in a coniferous forest. *Forests* 4(4), 984-1002.

Heurich, M. (2013). Fernerkundungsmethoden für forstliche Inventuren. *Technische Universität München* 2013.

Karjalainen, T., Pussinen, A., Liski, J., Nabuurs, G.J., Erhard, M., Eggers, T., Sonntag, M. and Mohren, G.M.J. (2002). An approach towards an estimate of the impact of forest management and climate change on the European forest sector carbon budget: Germany as a case study. *For. Ecol. Manage.* 162, 87–103.

Kirschbaum, M.U.F. (2000). Forest growth and species distribution in a changing climate. *Tree Physiology* 20, 309-322.

Knauf, M. (2014). Is the sustainability revolution devouring its own children? Understanding sustainability as a travelling concept and the role played by two German discourses on sustainability. *Forests* 5, 2647-2657.

Kolb, T.E., Wagner, M.R. and Covington, W.W. (1994). Concepts of forest health: Utilitarian and ecosystem perspectives. *J. For.* 92, 10–15.

Kruger, C., Boxall, P.C. and Luckert, M.K. (2013). Preferences of community public advisory group members for characteristics of Canadian forest tenures in pursuit of sustainable forest management objectives. *Forest Policy and Economics* 26, 121-130.

Kwantlen Polytechnic University. (2015). *Plant Database*.

Lutz, E., Pagiola, S. and Reiche, C. (1994). The costs and benefits of soil conservation: The farmers' viewpoint. *World Bank Res. Obs.* 9, 273–295.

Mason, W. (2015). Implementing Continuous Cover Forestry in Planted Forests: Experience with Sitka Spruce (Picea Sitchensis) in the British Isles. *Forests* 6, 879–902.

Matsushita, B., Xu, M., Onda, Y., Otsuki, Y. and Toyota, M. (2010). Detecting forest degradation in Kochi, Japan: Ground-based measurements versus satellite (Terra/ASTER) remote sensing. *Hydrological Processes* 24, 588-595.

Macdonald, E., Gardiner, B. and Mason, W. (2009). The effects of transformation of even-aged stands to continuous cover forestry on conifer log quality and wood properties in the UK. *Forestry* 83, 1–16.

McMahon, S.M., Parker, G.G. and Miller D.R. (2009). Evidence for a recent increase in forest growth. *PNAS* 107(8), 3611-3615.

Ministerial Conference on the Protection of Forests in Europe (MCPFE). (2003). *Improved Pan-European Indicators for Sustainable Forest Management*. (p. 6). Vienna, Austria.

Ministry of Foreign Affairs of Japan. (2015). *Japan's position regarding the Kyoto Protocol.*

Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF). (2015). *Monthly Statistics of Agriculture, Forestry and Fisheries.*

Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF). (2015). *What is Natural Forest?*

Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF). (2010). *Annual report on forest and forestry in Japan for FY2009.* Tokyo, Japan.

Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF). (2011). *Annual report on forest and forestry in Japan for FY2010.* Tokyo, Japan.

Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF). (2012). *Annual report on forest and forestry in Japan for FY2011.* Tokyo, Japan.

Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF). (2013). *Annual report on forest and forestry in Japan for FY2012.* Tokyo, Japan.

Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF). (2014). *Annual report on forest and forestry in Japan for FY2013.* Tokyo, Japan.

Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF). (2010). Opinion survey of forest management.

Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF). (2015). *Tree species by age class and area*.

Nakashizuka, T. (1987). Regeneration dynamics of beech forests in Japan. *Vegetatio* 69, 169–175.

Nishimura, T. (1993). Investigation of techniques for late thinning. In *Bulletin of the Kochi Prefectural Forest Experiment Station*; Kochi Prefectural Forest Experiment Station: Tosayamada. Kochi, Japan. pp. 1–14.

Noriko, S., Premysl, M. and Takafumi, F. (2006). Attitudes of small-scale forest owners to their properties in an ageing society: Findings of survey in Yamaguchi prefecture, Japan. *Small-scale For. Econ. Manag. Policy* 5, 97–110.

Ota, I. (2002). The shrinking profitability of small-scale forestry in Japan and some recent policy initiatives to reverse the trend. *Small-scale For. Econ. Manag. Policy* 1, 25–37.

Pirotti, F., Guarnieri, A. and Vettore, A. (2013). Ground filtering and vegetation mapping using multi-return terrestrial laser scanning. *ISPRS J. Photogramm. Remote Sens.* 76, 56–63.

Plants for a Future Database. (2015). *Plant Database.*

Rojo, J.M.T. and Orois, S.S. (2005). A decision support system for optimizing the conversion of rotation forest stands to continuous cover forest stands. *For. Ecol. Manage.* 207, 109–120.

Sasaki, N. and Kim, S. (2009). Biomass carbon sinks in Japanese forests: 1966-2012. *Forestry* 82(1), 105-115.

Sanjay, S. and Audun, R. (2003). On the path to sustainability: Integrating social dimensions into the research and practice of environmental management. *Business Strategy and the Environment* 12, 2005-2014.

Sato, N., Marcel, P. and Fukawa, T. (2006). Attitudes of small-scale forest owners to their properties in an ageing society: Findings of survey in Yamaguchi prefecture, Japan. *Small Scale Forestry* 5(1), 97-110.

Schindelbeck, R.R., van Es, H.M., Abawi, G.S., Wolfe, D.W., Whitlow, T.L., Gugino, B.K., Idowu, O.J. and Moebius-Clune, B.N. (2008). Comprehensive assessment of soil quality for landscape and urban management. *Landsc. Urban Plan.* 88, 73–80.

Shigematsu, A. and Sato, N. (2013). Post forest reversal discussion: Restructuring public subsidy system for private forests under the differences of topographic conditions in Norway. *Land Use Policy* 31, 249-258.

Singh, V., Tewari, A., Kushwaha, S.P.S. and Dadhwal, V.K. (2011). Formulating allometric equations for estimating biomass and carbon stock in small diameter trees. *For. Ecol. Manage.* 261, 1945–1949.

Smith, W.B. (2002). Forest inventory and analysis: a national inventory and monitoring program. *Environ. Pollut.* 116, S233–S242.

Spiecker, H. (2003). Silvicultural management in maintaining biodiversity and resistance of forests in Europe—temperate zone. *Journal of Environmental Management* 67, 55–65.

Statistisches Bundesamt Deutschland, Dstatis, Wald und Holz. (2015). *Facts and Figures*.

Stefano, J.D. (2001). Power analysis and sustainable forest management. *Forest Ecology and Management* 154, 141-153.

Sterngold, J. (1995). Japan’s Cedar Forests Are Man-Made Disaster - NYTimes.com.

Stupack, I., Lattimore, B., Titus, B.D. and Smith, T. (2011). Criteria and indicators for sustainable forest fuel production and harvesting: A review of current standards for sustainable forest management, *Biomass and Bioenergy* 35(8), 3287-3308.

Umweltbundesamt. (2014). *Submission under the United Nations Framework Convention on Climate Change and the Kyoto Protocol 2014.*

Conifers. (2015). *The Gymnosperm Database.*

Japan Ministry of the Environment. (2012). *The National Biodiversity Strategy of Japan 2012-2020.*

The National Gardening Association. (2015). *Plant Database.*

The Plant List. (2015). *Plant Database.*

Third National Forest Inventory. (2015). *Results Database.*

Thomsen, A.G. and Friberg, N. (2002). Growth and emergence of the stonefly Leuctra nigra in coniferous forest streams with contrasting pH. *Freshw. Biol.* 47, 1159–1172.

Woodmiles. (2015). *Unhealthy conditions of Japanese forests*.

United States Department of Agriculture. (2015). *Plants Database.*

Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz (BMELV). (2009). *Waldbericht der Bundesregierung*. Berlin, Germany.

Waldwissen. (2015). *Waldinventuren aus dem Flugzeug.*

Munich University of Applied Sciences. (2014). *Waldinventur per Laserscan.*

Watanabe, S. (2003). Evaluation and Problems of Natural Forest Management : Technical Issues Occurring in Japan in Which Natural Forest Management Failed to Become Established, Resulting in Forest Degradation(<Special Issue>The Importance of Ecological Science in Management o. *J. Japanese For. Soc.* 85, 273–281.

Wirth, C. (2004). *Dynamik der Kohlenstoffvorräte in den Wäldern Thüringens : Abschlussbericht zur 1. Phase des BMBF-Projektes “Modelluntersuchung zur Umsetzung des Kyoto-Protokolls”.* Gotha, Germany.

Yamashita, T., Kasuya, N., Nishimura, S. and Takeda, H. (2004). Comparison of two coniferous plantations in central Japan with respect to forest productivity, growth phenology and soil nitrogen dynamics. *Forest Ecology and Management* 200, 215-226.

Chapter 4: Investigation II – International comparison of timber market and field operations

Forestry is, as claimed by William Street, chairperson of the world's largest forest certifier PEFC, more complex than rocket science. As researchers worldwide are still criticizing the effectiveness of sustainable forest management in Japan, the motivation of this research study is to analyze, evaluate and discuss the main issues the Japanese government is struggling with in contrast to international forestry standards and efforts. Sustainable forest management is being promoted worldwide and understood as a crucial act to preserve nature and to respond to the negative effects of global warming. Historical background information confirmed that afforestation, reforestation and rejuvenation activities shortly after WWII are responsible for Japan's extremely uneven forest age structure. Insufficient forest care affected timber quality, which decreased the overall productivity of forestry and led to forest degradation. The majority of affected forestland is owned privately and includes natural forest and plantations. Small-scale forest ownership further complicates effective forest management. The Japanese government promotes sustainable forest management and thinning. However, the role of thinning as an instrument of forest care is not clearly addressed and thinning could have been performed with the main purpose to increase domestic carbon sinks for meeting the carbon emission obligations for the Kyoto Protocol. Japan sets very high future forestry goals and intends to double domestic forest production by 2020. However, without proper modernization of the wood processing infrastructure and an expansion of markets for thinned wood, reasonable success is questionable. The progress of implementing forest certification is slowing down because of little demand for certified wood and costs that further affect forestry productivity. However, it is strongly recommended to continue efforts towards proper forest certification as it has the potential to enhance forest owner management, improve forest supervision and national forest policy.

4.1 Introduction

Agriculture and silviculture are both parts of political economy. While the first targets the production of products of animal and vegetable origin on a specially cultivated area, the purpose of silviculture is the production of raw materials and the conservation of protected and recreational areas (Graham & Jain, 2004). Forests provide a variety of goods and services which people throughout the world have been making use of since the first modern human being (Mauro, 2011). Wood, however, is not a raw material with unlimited availability. Whilst it does regrow each day, compared to the production of crops, forests grow at a much slower speed. Depending on the tree species, a rather long time may be required for the tree to reach its ultimate size. Broadleaf trees usually require about 50-60 years while conifer may continue to grow for centuries if conditions allow (Peterken, 1993).

4.2 Methodology

This research study targets the assessment of forest management practices in Japan in terms of sustainability with contrast to Germany. It aims to identify and discuss historic and current issues, as well as prospective future risks and chances of management strategies that have the potential to improve or idle the quality of forest management on a local and national level. To achieve this, Japan's position and efforts within the international community on sustainable forestry will be analyzed and evaluated. Historical background information of Japanese forest management will be assessed and reflected on current and possible future issues. Emphasis will be given on the importance of forest care and the management of forest owners. Potential actions for improvement will be derived and thoroughly discussed.

4.3 Results and Discussion

4.3.1 International comparison of SFM criteria and indicators

Approximately 300 years ago, the vision of SFM was born with the work of Carl von Carlowitz in Germany, and has been constantly evolving since then. In Germany and its federal states, these principles are laid down in forest laws that obligate forest owners to treat their forests with care. This attitude towards the necessity of healthy forests enabled a widely supported forest management in Germany that is close to nature. However, the reality in many parts of the world is different. Forests are being abused and the global forest area is further decreasing through deforestation, which affects the world's climate. Germany imported approximately 120 million cubic meters of primary and secondary wood products in 2009 of which 2.4 to 5.2 million cubic meters came out of illegal sources (BMELV, 2013).

A clear and internationally accepted definition for sustainable forest management has yet to be finalized. However, over the past two decades, international conferences on the management of forests and forestry have developed shared ideas. As listed in Table 7, the Food and Agriculture Organization of the United Nations (FAO), the Ministerial Conference on the Protection of Forests in Europe (Forest Europe) and the Montreal Process subdivide the principles of SFM into elements. While the FAO characterizes them as “Thematic Elements”, Forest Europe and the Montreal Process refer to them as “Criteria and Indicators” for SFM. Observed closely, they can be considered nearly identical, equally addressing all the three fundamental components economy, ecology and society. Sustainable forest management is achieved only when all three components are balanced uniformly. This statement is widely supported. At the Rio+20 United Nations Conference on Sustainable Development on June 18, 2012, Street (2012) claimed that even if two components of SFM are fulfilled but one component is not, you’d still be at zero and not two thirds towards SFM.

Table 7: Criteria and indicators for SFM in international comparison

FAO	Forest Europe	Montreal Process
Extend of forest resources	Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles.	Maintenance of forest contribution to global carbon cycles
Biological diversity	Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems.	Conservation of biological diversity
Forest health and vitality	Maintenance of forest ecosystem’s health and vitality.	Maintenance of forest ecosystem health and vitality
Productive functions of forest resources	Maintenance and encouragement of productive functions of forests.	Maintenance of productive capacity of forest ecosystems
Protective functions of forest resources	Maintenance, conservation and appropriate enhancement of protective functions in forest management	Conservation and maintenance of soil and water resources
Socio-economic functions	Maintenance of other socio-economic functions and conditions.	Maintenance and enhancement of long-term multiple socio-economic benefits
Legal, policy and institutional framework	Qualitative indicators Forest policies, institutions and instruments	Legal, institutional and economic framework

Source: FAO (2015), Forest Europe (2015) and Montreal Process (2015)

As apparent in Table 7, Forest Europe separates indicators into quantitative and qualitative indicators. Legal, policy and institutional framework are termed as qualitative indicators (MCPFE, 2003).

4.3.2 Industrial and natural forest age structure and distribution of ownership

Japan is covered with forest about two-thirds of Japan's land area, approximately 25 million hectares. The main tree species are Hinoki (*Chamaecyparis obtusa*), Sugi (*Cryptomeria japonica*) and Larch (*Larix kaempferi*). Forest ownership is distributed to about 60% private, 30% national and 10% prefectural. Similar to the period of wood shortage in central Europe at the end of the late Middle Ages and during the early modern period, Japan experienced a similar shortage after World War II, mainly due to the enormous wood use by the military. Nearly 10 million hectares of land were replanted in only 25 years between 1950 and 1975 to rebuild Japanese forests. Perhaps the biggest drawback of this approach was the amount and pace of the replanting that resulted into an unbalanced forest age structure as evident in Figure 11. Care of the newly replanted forestland through periodic thinning was widely not performed. Inadequate management lead to a gradually increasing forest density which slowed down forest growth leading to forest degradation, as criticized by Matsushita et al. (2010).

Japan's forest age structure may be unfavorably balanced. The problem with this condition in terms of sustainability is the difficulty to ensure a long-term constant supply of timber. Should fossil fuels become scarce and renewable energy sources become more important, the import of wood to satisfy Japan's demands may become more difficult. The imbalanced age structure of private forest owners is of large concern among practitioners in Japan. A considerable number of people who recently became forest owners through inheritance from a past generation left their birthplace and are difficult to be identified which further complicates forest management. Japan will face the challenge to incorporate fragmented private forest, especially among the majority of small-scale forest owners holding less than 1 hectare of forestland, and to balance stakeholder interests to reach a management environment that can be considered sustainable.

Another commonly raised issue is the large proportion of small-scale private forest owners. Eighty per cent of the economically used forest plantations are privately owned. Forestland in Japan is highly fragmented in terms of area per owner. Of the approximately 2.5 million private forest owners, 1.5 million owners hold each less than one hectare of forestland (Ota, 2007). About 90% of all private owners hold less than ten hectares per person. In 2012, the Japan Forest Act introduced a new five-year management plan: the Collective Forest Management Plan, which targets the coordination and consolidation of small-scale forest owners to facilitate large-scale implementation of SFM in industrial forest.

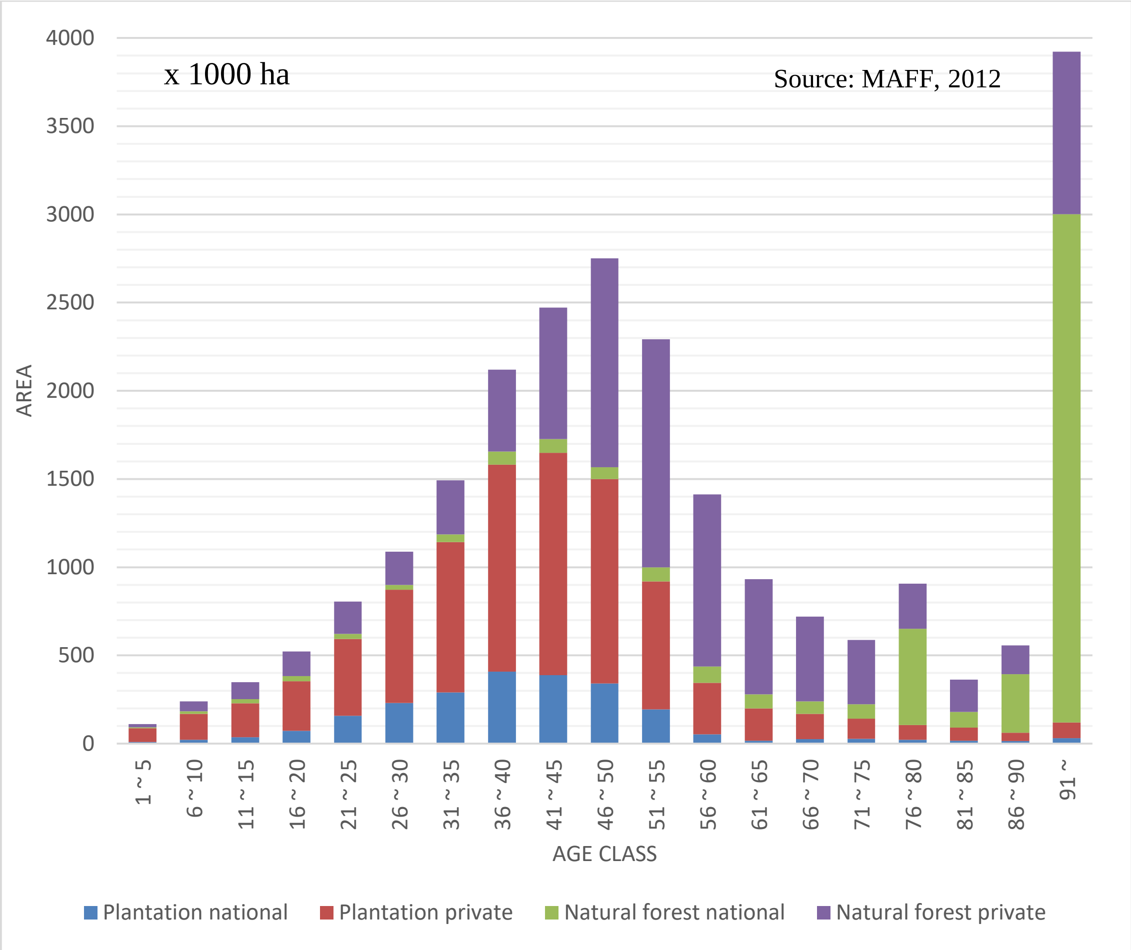


Figure 11: Forest age and ownership distribution in Japan

However, only owners holding a forest area of larger than one-hundred hectares, therefore not the majority of private owners that hold less than one hectare qualify for the Collective Forest Management Plan. Successful applicants receive special income and tax treatment, favorable conditions, government financing and promotion in other subsidy programs (MAFF, 2013). Although it is no direct criticism for Japanese forest management, such programs further increase the problem of policy fragmentation by providing special treatment and funding for only a specific group of forest owners, as criticized in other countries (Street, 2012).

4.3.3 Thinning

Forests are in need for continuous care in all growing stages for ideal forest development and thinning is an essential action to achieve this. It is one of the most important measures in forest care. It provides more room for proper root and crown development, makes more water and light available for optimal tree growth, maintains biodiversity to sustain the forest as an ecosystem and it arranges room for other important tree species to mix in-between. A tree needs a good surrounding environment in order to develop properly. A high tree density will delay or impede trees ability to develop a natural breast-height diameter ratio, which negatively affects both, the ecological and the economic factors of sustainable forest management. The primary aim for thinning is to increase income, but it is a necessary consideration for forest design (Neumann, 2003). Thinned forests are healthier, have a higher vitality and are more productive. It creates economic and ecological advantages, e.g. improved timber growth and the elimination of ecological risks that negatively affect surrounding ecosystems. The greater the gap between harvesting cost and the price for wood, the higher the importance of the economic role of thinning becomes. The Austrian Cooperation Agreement FHP (2000) suggests a basic rule for forest thinning: Early, moderately and frequently in order to achieve the full economic and ecological benefits. The German Study Group of Silvicultural Landscape Conservation, Ecomed (1991), however, adds that thinning should not be practiced uniformly and must be adapted to every forest's own unique characteristics.

Thinning for the Kyoto Protocol

SFM is promoted and thinning is supported nationwide by MAFF. However, the question arises whether thinning is mainly promoted in order to achieve the full economic and ecologic benefits of forests, or to meet the climate protection directives of the Kyoto Protocol, which anticipate a reduction of carbon emissions to tackle global warming. Japan's emission reduction commitment is 6% compared to the base year 1990. The first commitment period was from 2008 to 2012 (MAFF, 2011). One way to accomplish a reduction of carbon emissions is to reduce the nation's annual emissions generated by the industry, motorized vehicles and other sources that produce carbon dioxide. However, for industrialized nations such as Japan where, at the time being, carbon emissions cannot be reduced radically, the creation of additional carbon sinks is encouraged. Since trees are capable of storing CO2, increasing the amount of annually regrowing wood cannot reduce carbon emissions but it can increase carbon sinks to store more CO2. Japan's annual forests regrowth is approximately 80 million cubic meters, an increase of about 10 million cubic meters within the past decade. Only for comparison, Germany, a leading nation with highly effective, well developed forest management and with a forest area only 45% as large as that of Japan has a timber regrowth of far more than 120 million cubic meters per year (Holzabsatzfonds, 2009). Japanese forests regrow relatively slow. A faster growth would increase Japan's carbon sinks and help to fulfill the obligations of the

Kyoto Protocol and thinning is the key forest management action to achieve this. However, it is not a long-term measure of forest management as thinning is not a one-time action.

According to the Annual Report on Forest and Forestry in Japan (2012), figures for 2011 show that Japan is shortly fulfilling the requirements of the first commitment of the Kyoto Protocol and thinning took a major role in this achievement. Still, it can be argued whether Japan encouraged thinning mainly for meeting the goals of the Kyoto Protocol, instead of practicing it as a basic measure of forest care as forest reports did not promote it as such. In order to accomplish nationwide SFM, as promoted by the Ministry of Agriculture, Forestry and Fisheries, the true principles of thinning must be practiced by all forest owners as a self-evident action of forest care.

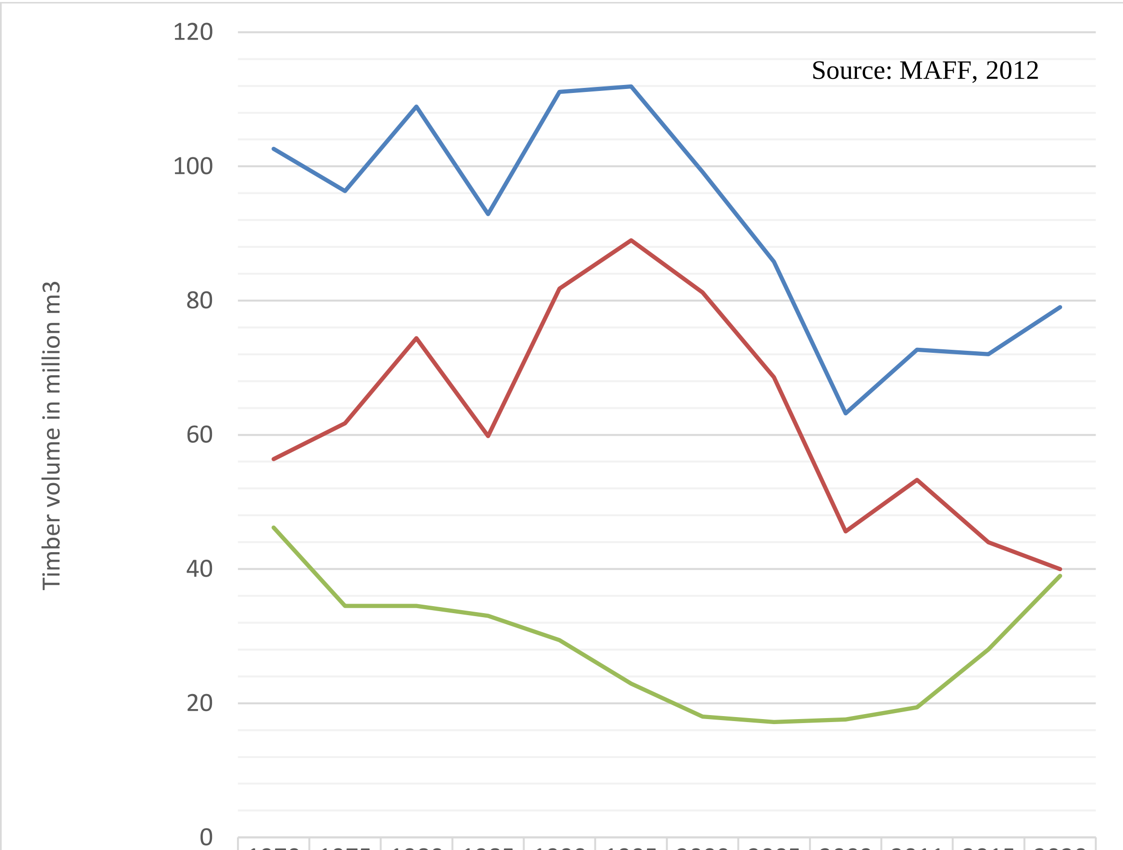
Thinning for Bio Energy

Japan is a nation that is highly dependent on fossil fuels for energy production. Approximately just 5% of energy being consumed is actually produced inside the country. Thinned wood may have the potential to decrease Japan’s dependency on fossil fuels. It is estimated that about 20 million cubic meters of thinned roundwood is left unused in forests each year. More forestland is target for annual thinning, but cannot be performed. One often reported reason is forest owners trying to avoid expensive thinning costs. Constant market price decrease for hinoki and sugi (Table 8) further complicate the application of thinning. Unused thinned wood can be used as a source of renewable energy. In July 2012 the Japanese government launched the its Feed-in Tariff (FIT) program aiming at the construction of biomass power plants to produce electricity at a fixed price throughout Japan. Numerous power plants are currently under construction (MAFF, 2013).

This development can have a positive impact on SFM. Creating new markets for thinned wood has the potential to increase forest owner motivation for active management. An example where renewable energy is currently well utilized is Germany. It is Europe’s largest producer of energy from solid biomass, with an annual volume of approximately 12,000 Mtoe (Megatonne of oil equivalent). As for electricity, in 2011, 16.3 billion kWh were generated from solid biomass in Germany (EurObserv’ER, 2012).

4.3.4 Roundwood Production and Market Overview

The Japanese government sets high future goals for the production of domestic roundwood. It expects an increase of more than twice the volume of the current annual common production, from approximately 18 million cubic meters to 39 million cubic meters, while also expecting an overall national increase of wood demand of approximately 10% by 2020. The increase of wood demand between 1985 and 1995 are explained by rapid increases in the number of newly built houses by economy stimulation strategies by the government and by an increase in demand for paper by the development of office automation (MAFF, 1998). The decrease of wood demand since then until 2009 is explained to be related to economic recession. The increase since then is due to an increase of newly built homes (MAFF, 2015).



	1970	1975	1980	1985	1990	1995	2000	2005	2009	2011	2015	2020
Demand	103	96	109	93	111	112	99	86	63	73	72	79
Import	56	62	74	60	82	89	81	69	46	53	44	40
Production	46	35	35	33	29	23	18	17	18	19	28	39

Figure 12: Wood Demand, Import and Domestic Production with Future Prognosis

As evident in Figure 12, domestic roundwood production has been slightly increasing after decades of continuous regression. However, Japan's goals for 2020 may look very optimistic when taking into account the fact that the domestic wood industry has degenerated as well. For instance, the number of sawmills and workers has been gradually decreasing for decades. About 40% of all consumed industrial wood is sawn wood. More than half of that is imported.

Plantations are starting to reach an age that qualifies them for harvest, however, 80% of all tree plantations are privately owned and prices for hinoki and sugi have dropped significantly in the past 30 years (Table 8).

Table 8: Hinoki and sugi Roundwood Price Development from 1980 to 2012

¥/m³	1980	2001	2012
Hinoki	76,400	37,800	18,500
Sugi	39,600	15,700	11,400

Source: MAFF, 2012

This price disadvantage, challenges forest managers to stay productive and may negatively affect Japan's optimistic 2020 production goals. In addition, it can be argued whether the Japanese industry is capable of processing 39 million cubic meters of roundwood by that year. The major wood processing industries, sawmills, chip mills, plywood mills and laminated wood mills as well as the number of workers have been shrinking (MAFF, 2013).

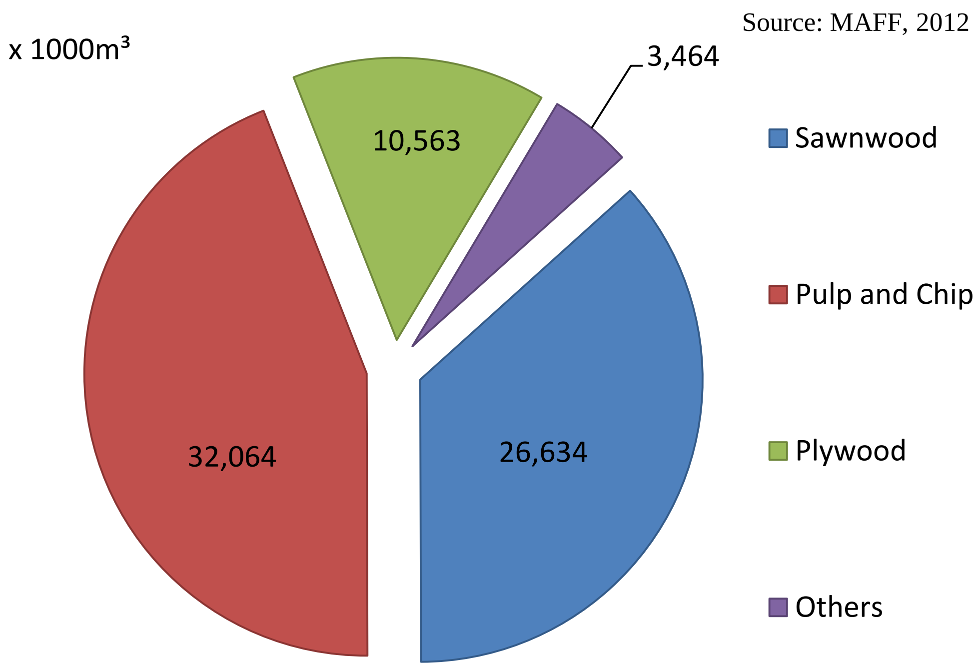


Figure 13: Combined Annual Wood Consumption of Japan

About 60% of sawn wood, 70% of plywood and 80% of pulp and chip is imported. A demand for more domestic wood is evident, but only an increase of capacities of the wood producing and processing industry, as well as improving the management of small-scale forest owners, will make it possible for Japan to reach the 2020 goals. In particular, the 80% of private tree plantation owners may want to consider waiting for better wood prices.

4.3.5 Forest certification development and comparison

Forest certification is a civil-societal method to label forests that are sustainably managed in order to ensure industry and consumers that the wood comes from a responsible source and to protect worldwide forests with their benefits on nature and climate. The principles and criteria of forest certifiers have been shaped by hundreds of independent stakeholders on forests such as environmental and consumer groups. The world's largest forest certifiers in the world are the Forest Stewardship Council (FSC) and the Programme for Endorsement of Forest Certification Schemes (PEFC).

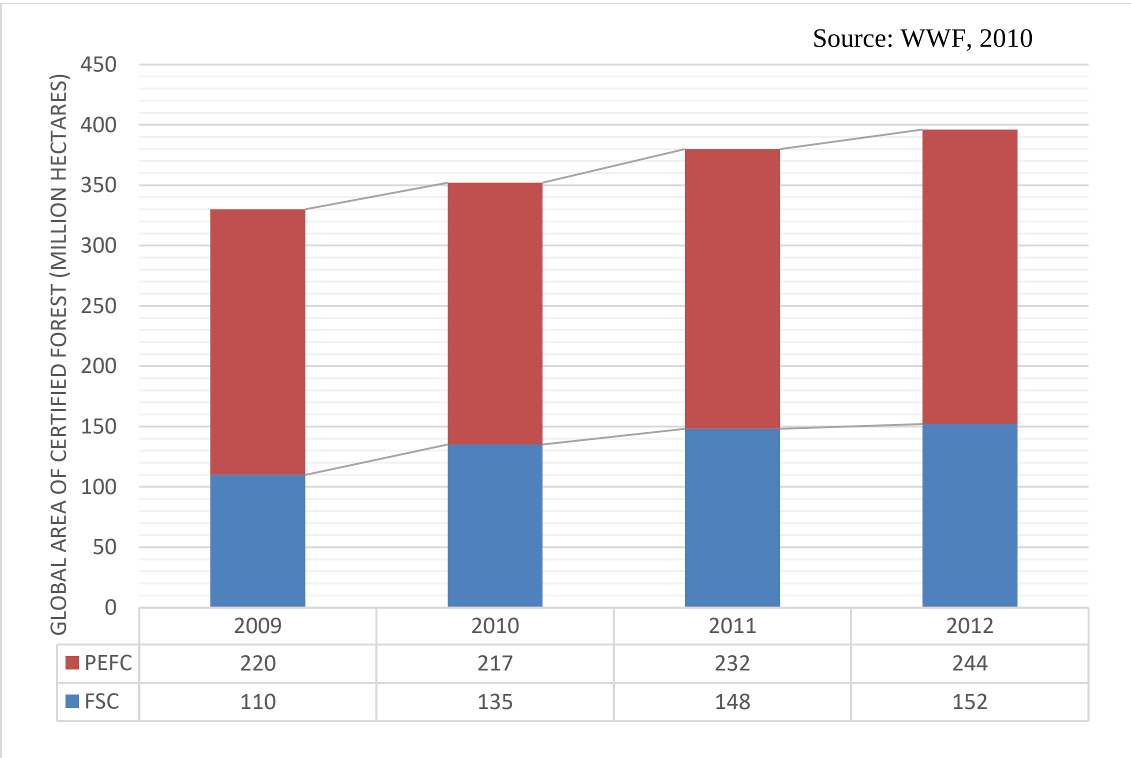
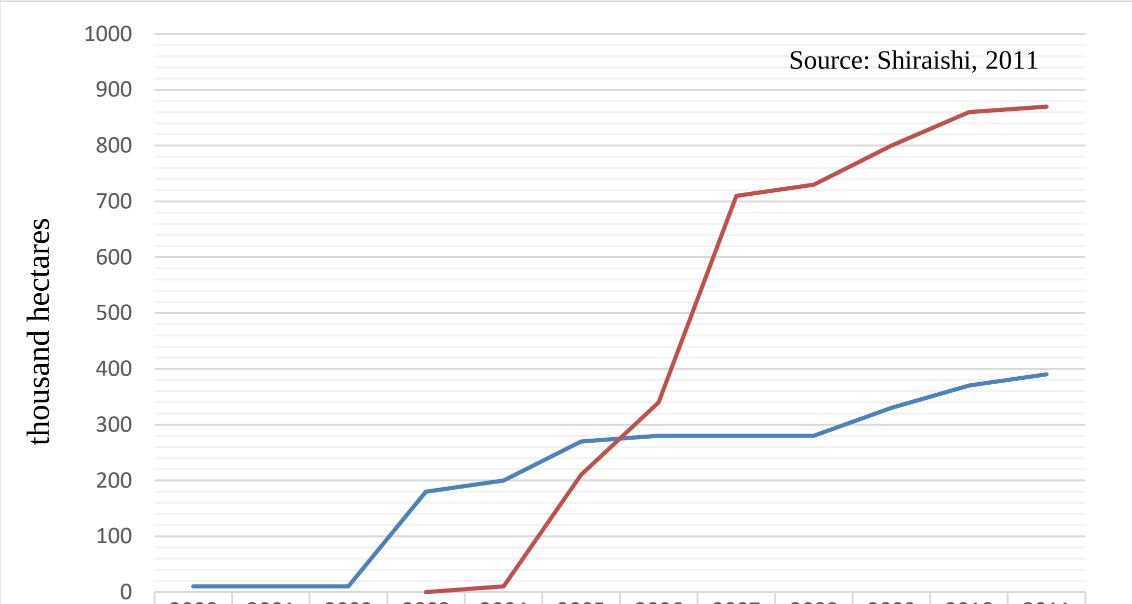


Figure 14: PEFC and FSC Global Certified Forest Area

All over the world, nearly 400 million hectares of forestland are certified (Figure 14). The WWF (2010) describes forest certification as the most important initiative of the last decade to promote better forest management.

Forest certification development in Japan

The first forest certification in Japan was issued in the year 2000. Since then the number of certifications and the total certified forest area has increased but the annual progress has decelerated since 2009 (Shiraishi, 2011) (Figure 15).



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
FSC	10	10	10	180	200	270	280	280	280	330	370	390
SGEC				0	10	210	340	710	730	800	860	870

Figure 15: Forest Certification Development in Japan

In 2003, the Sustainable Green Ecosystem Council (SGEC) was established in agreement with forestry and non-forestry organizations as a competitor to FSC, and as a unique forest certification system, suited to the Japanese forest environment. The number of its certifications increased sharply within the first four years. However, with all the success in early years, SGEC has also earned criticism. Shiraishi (2011) claimed that SGEC was established by an anti-FSC group to make forest certification free and independent in Japan. Accordingly, management reliability is insufficient as it does not show clear guidelines for independent on-site forest assessment, and does not follow processes to review international SFM standards similar to the major certifiers FSC and PEFC. To overcome these two issues of management reliability, SGEC was invited to join PEFC but talks have halted. Future expansion of certification is difficult to predict, as the market situation for certified wood is insufficiently developed in Japan. Better public understanding for the necessity of protecting forests, and how forest certification contributes to it is needed.

A certifier that follows international standards certifies approximately 400,000 hectares, or 1.5% of Japan's entire forest area. In comparison, almost 70% of Germany's forests, approximately 7.5 million hectares are certified by FSC, PEFC or are even dual certified by both.

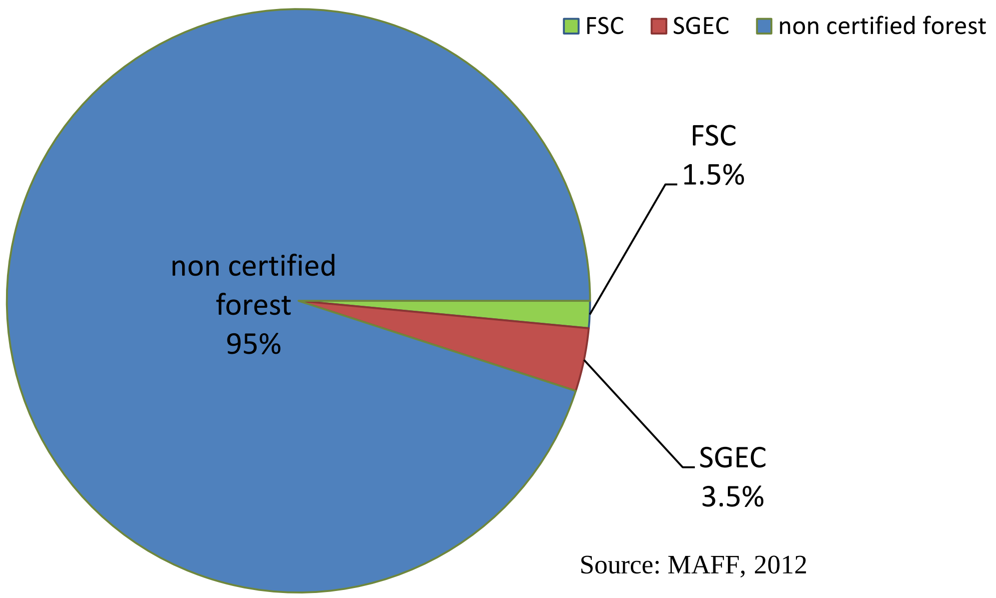


Figure 16: Forest area of certified forest in Japan (2012)

Forest certification as a potential tool towards SFM

There has been wide criticism for insufficient forest management in Japan. Although Japan's efforts towards proper SFM have been increasing significantly over the past years, the progress in the development of forest policy, which also obligates forest owners of proper forest management, may still be insufficient (Gain & Watanabe, 2013). Small-scale owners own the majority of Japanese forest, which requires complex multi-party management. It can be argued that Japan is, for the time being, not able to pass a strict forest law similar to that of Germany or other countries with strict SFM regulations. This is where the strengths of forest certification come in. A local-level promoted systematic implementation of accredited certification, which is based on internationally recognized SFM principles and is frequently supervised by independent assessment, will successively increase the amount of sustainably managed forest area in Japan. Combined improving national awareness on the importance of healthy forests, it can become a more effective substitute to deficient national forest policy.

4.4 Process flow of forest works of Kami FOA

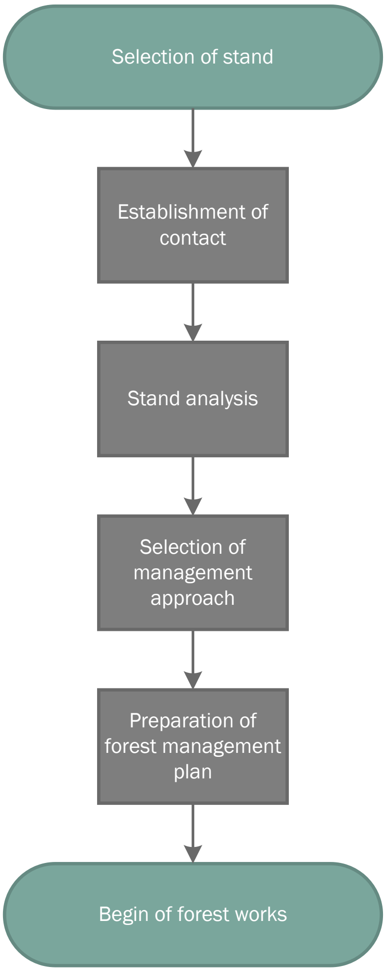
A task survey was conducted at Kami Forest Owners' Association and Kochi Forest Information and Technology Center. In interviews official were questioned about the typical work processes for thinning and clear-cutting operations from stand selection to the beginning of the work. Involvement of forest owners and Kochi Prefecture in decisions regarding management planning, design and project execution was included in this survey. Table 9 shows a breakdown of typical forest works, the type of utilized forest machinery and the distribution of each work at Kami FOA.

Table 9: Typical types of forest works, used machinery and work distribution in industrial forest at Kami FOA

Type of forest work	Type of used machinery	Percentage of works
strip thinning *restsujo-kanbatsu*	swing yarder	≥ 66% (four of six work teams)
selection thinning *kanbatsu*	tower yarder	≥ 16% shared (one of six work teams)
non-extraction thinning *kirisute-kanbatsu*	no heavy machinery	
clear cutting *kaibatsu*	winch or skyline applications	≥ 16% (one of six work teams)

Source: Interview with Kami Forest Owners' Association (2016)

As can be seen, four major types of forest works: six work teams conduct strip thinning, selection thinning, non-extraction thinning and clear cutting. Strip thinning is the main conducted forest work in Kami with four out of six work teams assigned. Swing yarders are the main used type of forest machinery used. One of the six work teams shares the work for selection thinning and non-extraction thinning. For selection thinning, a tower yarder of type MM Wanderfalke with Sherpa is used. For non-extraction thinning, the utilization of heavy forestry machinery is not necessary. One work team conducts clear cutting works. Depending on topographical conditions and forest area winch or skyline applications are conducted for extraction. Figure 17 shows a process flow diagram from the selection of a stand until begin of forest work of typical forest works at Kami FOA.



Source: Author

Figure 17: Process flow diagram of forest works at Kami FOA

Selection of stand

Stands are selected for forest works based on four main criteria.

(1) Establishing contact with forest owner is possible.
Establishing contact with a forest owner is not a matter of course. A number of forest owners cannot be contacted or even identified, often when they are suspected to have relocated or have newly inherited forestland without their knowledge. Others may be

suspected to have changed their contact details. In such cases, individuals such as friends and relatives who have access to the contact details of the forest owner may be asked to provide these details or to inform the forest owner to contact Kami FOA.

(2) Forest conditions qualify for forest works.

A stand is required to have reached a certain age and physical condition to qualify for thinning or clear-cut operations. In general, stand age is connected with the stand age requirements of the thinning subsidies of the Kochi Prefecture subsidy scheme for private forest. Stands that have reached the age requirements, and/or that have reached a degree of density that can negatively affect environmental productivity of the site (tree growth speed, reduction of biodiversity, carbon sequentiation, water purification etc.) qualify for forest works. In the latter case, a selection thinning, rather than a strip thinning is likely to be chosen to enhance and extended environmental productivity.

(3) Forest has access to a forest road.

A forest that has no access to a forest road does not qualify for timber extraction as forest machinery and transportation vehicles cannot come close enough to be used. In such cases, forest works may be postponed until a forest road has been established, for instance when short-term completion of a forest road is expected. When access to a forest road cannot be established within a necessary timeframe, a non-extraction thinning may be considered and suggested to the forest owner.

(4) Forest and road conditions allow the utilization of forest machinery.

Site conditions must meet certain criteria for the use of forest machinery. For instance, the harvesting capacity of a swing yarder is limited to log size and weight. Logs exceeding these limitations cannot be extracted without the risks of technical failure. A tower yarder on the other hand is capable of extracting logs of larger dimensions and weight, however, is required to have access to surrounding trees and/or stumps to attach anchor lines that prevent the tower from collapsing. These anchor points for guy lines must also meet the specification requirements of the machine itself and must for instance not be too weak.

A stand can be selected for forest works when the above conditions are met. Databases are used to assess the eligibility of a stand for selection. In addition to databases, a Kami FOA official may perform a brief on-site assessment to confirm points (2) to (4). Public forest administration is not involved in stand selection processes.

Establishment of contact

In about 95% of the time, Kami FOA contacts forest owners when their forests qualify for forest works. In this first contact stage, the forest owner is informed about the type of forest works eligible for their stand: strip thinning, selection thinning or clear-cut. Eligibility for financial support opportunities associated with the forest works are offered and explained. In the process, a first rough profit estimate is made based on type of tree species: usually sugi or hinoki, stand location including access to forest roads, stand condition, timber stock, and available financial support. In the last 5% of the time forest owners directly make contact with Kami FOA to ask for information about when their stands become eligible for forest works, as well as current financial support opportunities. Financial support is granted by national, prefectural and municipal forest administrations. Kami FOA does the application for support for thinning operations on behalf of the forest owner at Kochi Prefecture Forest Administration Offices. Kochi Prefecture Forest Administration itself is in any scenario not involved in the process of stand selection, the establishment of contact with forest owners, the clarification and proposal of suitable financial support including eligibility requirements, nor profit estimations.

Stand analysis

Once first contact between Kami FOA and a forest owner was established, and works and financial aspects were communicated, an on-site stand analysis is performed by Kami FOA officials in a timely manner. In this on-site stand analysis, a Kami FOA official assesses the economic value of the stand in a sample analysis. In this assessment, tree DBH, shape, possible damage and stand density are estimated. A second, more precise profit estimation is made for the forest owner. The forest owner may choose to be present or not present in this economic value assessment. In the event the forest owner chooses to be absent, assessment results are communicated via telephone. Kami FOA solely performs this economic analysis; Kochi Prefecture forestry officials are not involved. Biological, diversity, soil condition and other environment related analyses are not performed by Kami FOA, public forestry administrations or other qualified third parties. Environmental data is not part in stand analyses and is not utilized.

Selection of management approach

Once a stand was selected, contact with the forest owner is established, and an economic stand analyses was performed, a management approach is determined. Three scenarios are common.

(1) Selection thinning (either with or without extraction)

This management approach is utilized in sugi or hinoki stands, normally when the rotation period is planned to be extended to allow larger radial growth, when density of stand is considered to represent a risk for environmental damage, and/or when the environmental productivity of the stand is planned to be enhanced. Broadleaf rejuvenation from surrounding natural forest normally occurs shortly after the thinning. The spreading of broadleaf species is in many cases wanted as it increases environmental productivity and biodiversity. Natural rejuvenation of major tree species in the stand, often either sugi or hinoki, is uncommon and not expected. The stand is planned to continue as an even aged stand with some broadleaf underplanting until the next thinning or final clear-cut.

(2) Strip thinning (with extraction)

This management approach is the most commonly performed in sugi and hinoki plantations allowing relatively uncomplicated extraction. Industrial forest, being planted forest, is often arranged in vertical strips. When a thinning is performed, strips of trees are removed. Gaps between strips are determined based on forest conditions (age, density, local conditions). Compared to extraction in a selection thinning, extraction of timber in a strip thinning has a lower risk of damaging surrounding trees these are being pulled out of the stand. Natural rejuvenation of major tree species in the stand is not expected. Thinned areas often experience new growth of broadleaf species from surrounding natural forest.

(3) Clear-cut

This approach is the final management step in a rotation period. All timber is extracted and underplanting is removed. Depending on stand area, road and topographical conditions, different types of technology may be used for timber extraction including winch and skyline applications. Clear-cut stands may remain bare until reforestation decisions have been made. In most cases, clear-cut areas are replanted with seedlings of the same type of tree species as before and are intended to be managed as even aged forest. Bud caps and nets are often used on reforestation seedlings to prevent deer browse damage.

A suggestion to the forest owner for a suitable management approach is in most cases made by Kami FOA. In rare cases, forest owners make requests such as reforestation with alternative tree species after a clear-cut. Uneven-aged industrial forest management approaches which would avoid clear-cuts and loss of biodiversity, such as two-layered forest (*ni dan rin*) are not practiced by Kami FOA due to their advanced complexity and cost. Two-layered forest management is not offered as an option to even-aged forest, neither after a thinning nor after a clear-cut. According to the interviewed Kami FOA official, most forest owners are not aware of alternatives to even-aged forest, and there are no forest owners who would be interested in such an alternative. Kochi Prefecture is not involved in the offering, suggestion and selection of a management approach. A time for the begin of the forest works is negotiated with the forest owner. A timeframe for the works to be completed is estimated. A reasonability or sustainability check of the management decision is not performed.

Preparation of forest management plan

Once a management approach was selected, a forest management plan is prepared. In this plan, human and technical resources necessary for the execution of the project are determined. Human resources include the assignment of specialized personnel most suitable for the tasks. This assignment involves the consideration of specialized personnel with specific education and expertise in unusual tasks (e.g. installation of guy lines in low stability forests). In cases, extra preparatory works such as the removal of shrub and underplanting is necessary, an outsourcing of these tasks may be investigated. Technical resources include the preparation of all technical equipment needed. A financial quote for the application of financial support is prepared. Special work steps including special security measures are listed and explained in cases special care measures need to be taken.

Begin of forest works

In the final process stage, the responsible Kami FOA work team executes forest works. On-site observation and/or monitoring of forest works is usually not performed by public forest administration. Before-After photographs of works are taken by Kami FOA as work reference and forwarded to public administration where they are used as evidence for the type of work conducted. Extracted timber from the stand is temporarily gathered on designated forest road areas until further transportation, usually to stockyards, can be performed.

4.4.1 Criticism by Kami FOA for limited public administration involvement

The management of Kami FOA has expressed negative criticism for the lack of involvement of public forest administration in management processes.

(1) Financial support is granted for various thinning operations in private industrial forest, which is bound to various stand conditions such as stand age, DBH, expected environmental benefit etc. that need to be met. Kami FOA raised criticism for the responsibility of the assessment of stand conditions for financial support requirements. Kami FOA conducts this assessment rather briefly as reported by the interviewed Kami FOA official. Kami FOA welcomes more support regarding stand assessment for financial support.
(2) Kami FOA establishes contact with forest owners. Due to various earlier mentioned reasons, a considerably large number of forest owners cannot be contacted to discuss forest management related issues. The privacy law further complicates the identification of forest owners. Kami FOA welcomes more support regarding the establishment of contact with forest owners.
(3) The application of forest works by Kami FOA is associated with various tasks set by public administration. In general, Kami FOA would welcome a more effective relationship with Kochi Prefecture administration that involves more visits to actual work sites and a more effective communication about problem solving strategies.

Discussion

Evaluating the current process flow of forest works of Kami FOA and the criticism regarding the involvement of public administration in forest management related issues, a number of observations can be made about the forest infrastructure and the degree of attention of SFM principles in management decisions.

(1) Forest characteristics are uniform.

Industrial forest in Kami consists almost entirely of coniferous forest, mainly hinoki and sugi monocultures. For Kami FOA such one-sided forest characteristics bring little need for the adaptation of forestry technology and human resources to current stand characteristics. For instance, the head unit on processors in broadleaf stands must be capable of managing also non-coniferous logs. Thinning in stands with higher tree species diversity would require specialized expertise as crown areas become complex and trees could behave unexpectedly when felled. Although uniform forest characteristics provide easier application of forest works, there is a recognizable trend towards more sustainable mixed forests, especially in the European Union. With MAFF also setting a future goal for forest species diversity in Japan, Kami FOA may have to adapt technology and human resources once tree species diversity in industrial forest increases, including a mixture of coniferous and broadleaf tree species.

(2) Selection of stand seems to be limited based on accessibility to forest owners

Stands of owners that cannot be contacted are unselectable for forest works. These stands can cause degradation and loss of biodiversity when left untreated.

(3) Public administration is little involved in the communication with forest owners and stand assessment.

In approximately 95% of the time, Kami FOA contacts forest owners. In the remaining 5%, forest owners directly contact Kami FOA or public administration establishes contact in cases Kami FOA is unable. A number of forest subsidies target the improvement of the environmental condition of forest. Environmental stand assessment is not performed by public administration. Access to technology and human resources to assess the environmental stand condition and potential is also not provided to Kami FOA; a third party is also not consulted. In addition, the environmental condition of a stand does not seem to be a major criterion for the selection of a stand. Kami FOA argues that public administration should take over responsibility regarding environmental assessment and management.

(4) Limited options for stand management approaches

The majority of forest works is limited to strip and selection thinning, and clear-cut operations in even-aged industrial coniferous forests. Although ecological value of an even-aged stand can reach an acceptable level, this ecological value is temporary and removed with each clear-cut at the end of a rotation period. Ecological productivity maximization does not seem to be a criterion when selecting management approaches. Forest owners are not given management options besides even-aged management. Moreover, as argued by Kami FOA, forest owners are not interested in uneven-aged approaches, probably because of insufficient introduction and promotion of such approaches. CCF and site-specific close-to-nature approaches are currently not considered options for management and seen as technically too complex and economically inefficient. However, despite their higher complexity, these approaches would serve as options to increase environmental productivity and ecological stand value. Two-layered forest management for instance is reportedly a practiced uneven-aged forestry approach in some industrial forests in Kochi Prefecture. Although two-layered forests are not ideal strategies to maximize ecological productivity, clear-cuts would become obsolete and biodiversity could be preserved without interruption after rotation periods. For improving the implementability of national government sustainability goals such as the preservation of biodiversity and the creation of mixed-forests, public administration could take the initiative to promote two-layer forest management as an option to current one-layer management. For this promotion, however, the social benefit as well as the incentive must be clearly visible to improve the current low interest of forest owners for uneven-aged forest management.

4.4.2 Economic Value Added (EVA) in Kami

A simple comparison of average value added of roundwood production in Kami FOA (for species sugi and hinoki) and MM-Forsttechnik (for species spruce) for fiscal year 2015 is shown in Table 10. As can be seen, extraction and transportation cost of Kami FOA (approx. ¥12,500) appears to be more than double to those at MM Forsttechnik (approx. ¥5,100). In 2015, average operating profit for sugi was below zero. While in Kami subsidies have been used for cost compensation, MM-Forsttechnik was able to achieve an operating profit for its main species spruce of an average of ¥8,900 per m^3 without the dependency of subsidies. Figure 18 shows a historical price development of sugi, hinoki and spruce and their extraction and transportation costs (production costs) at MM-Forsttechnik and Kami FOA.

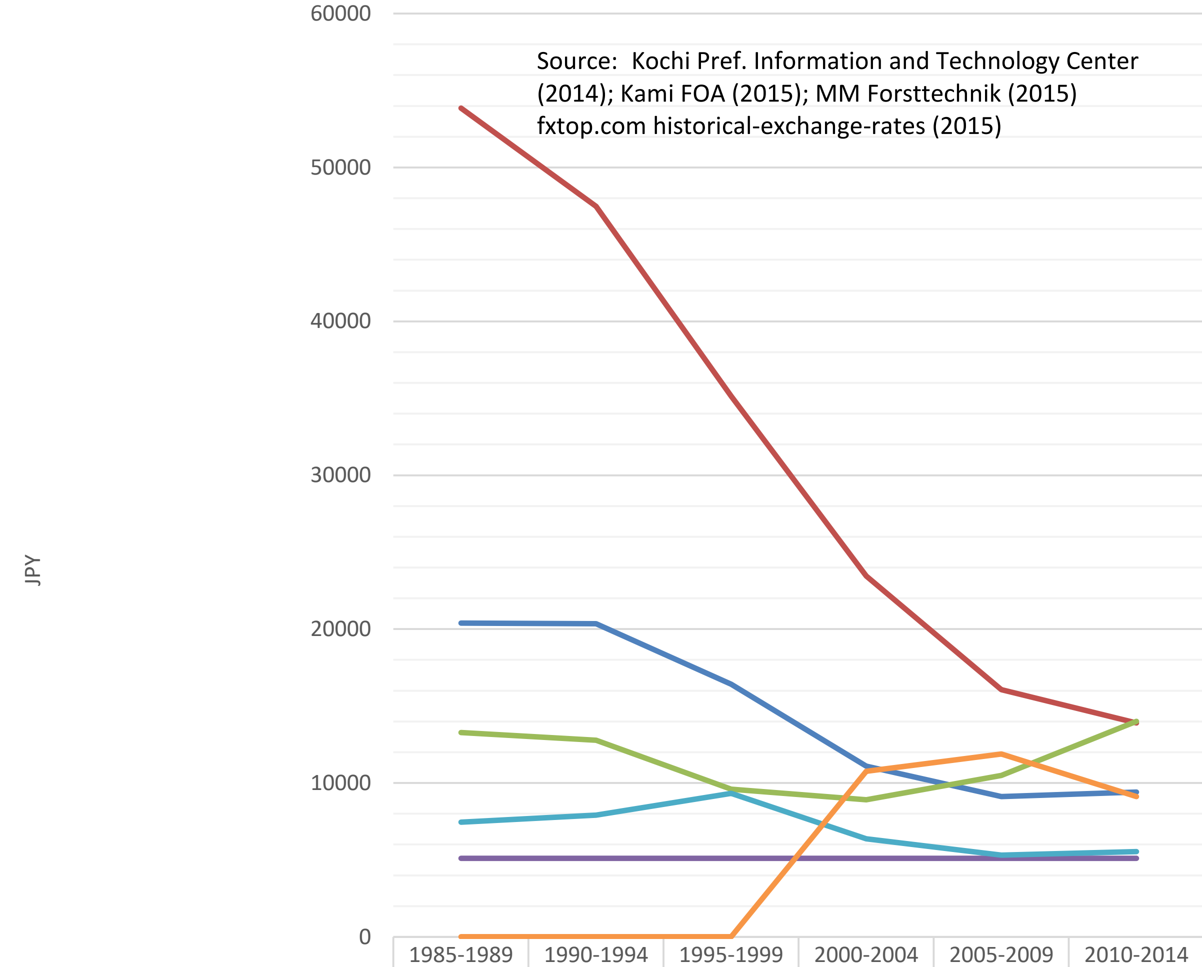
Table 10: Comparison of average value added per m^3 roundwood (2014)

	MM-Forsttechnik Steiermark, Austria Spruce	**Kami City FOA Kami-City, Japan Sugi**	**Kami City FOA Kami-City, Japan Hinoki**
Ø Return	¥14,000	¥9,400	¥13,900
Ø Extraction cost	¥3,800	Approximately ¥12,500 (thinning)	
Ø Transportation cost	¥1,300	Approximately ¥2,500 included in extraction cost (depending on single assessment)	
Ø Operating profit	¥8,900	¥-3,100	¥1,400
Ø Subsidies	¥0	Approximately 68% - 72% + municipality support of management cost (Detailed inform. regarding subsidies in Chapter 5)	

Source: Kochi Pref. Information and Technology Center (2014), MM Forsttechnik Austria (2015), Kochi Prefecture Forestry Dept. (2014)

Figure 18 shows a comparison of the history of roundwood price and roundwood production cost developments in Kochi and Steiermark/Austria. To avoid currency conversion errors, differences in price and cost were compared using the average annual exchange rate for each year. As can be seen, the prices for sugi and hinoki have experienced a sharp decrease since 1985 with the price of sugi adjusting to the price of spruce and fir between the years 2000 and 2004. A price increase of Steiermark spruce and fir and a further drop of the price for hinoki has resulted into a matching of these prices. The decrease of domestic roundwood prices is linked to an adaption of domestic prices to international market prices. The recent price increase is explained to (1) the overall increase of international wood prices and (2) more roundwood in Kochi reaching larger diameters due to more stands reaching maturity. To establish a relationship between Figures 12 and 18, a rapid decrease of imports is notable in Figure 12 from 2011. This can be explained by a matching of hinoki and spruce prices for that year (Figure 18) making hinoki for the first time competitive and substitutable in terms of price.

However, it can be noticed that there are two separate production costs in Kochi, one for the production of roundwood through thinning and one for clear-cuts. The difference is about 3600 yen for roundwood production through thinning. Reasons for Kochi/Kami FOA higher roundwood production in thinning operations costs can be drawn when discussing local market and topographical conditions, as well as economic value-added (EVA) and non-economic value added activities (NEVA). An interview with officials from Kami FOA and Kochi Pref. at the preparation meeting for the title: “European Sustainable Forest Management” lecture at Kochi Forestry School, which took place one week before the event, revealed that the problem of high production costs has been a matter of concern for Kochi Prefecture Forestry Department since the past. Especially complex topographical conditions of mountain areas in Kochi Prefecture (see Chapter 1, Figure 6) are seen as the main factor increasing production costs. Access to forest stands depends on the development of the forest road network which is in comparison to the Austrian average (forestry road 45m/ha; forestry road path 44m/ha) significantly lower in Japan (forestry road 13m/ha; forestry road path 4m/ha) (MAFF, 2011). An interview with the vice president of Kami FOA on May 3, 2015 revealed that the average length of forestry roads and forestry road paths in Kami City is comparable to the Japan average. Cost efficient cable-yarding systems for extraction works (Kami City uses an MM-Forsttechnik Wanderfalke with MM-Sherpa) have requirements regarding road conditions, especially road dimensions, slope and maximum weight. Although road conditions have been improved, this cable yarder and other heavy machinery cannot yet be utilized in remote stands where the requirements on road conditions cannot be met. In such cases, less cost efficient extraction strategies need to be applied such as winches and other skyline systems that do not require the use of heavy machinery, but, need more human resources.



	1985-1989	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014
Price Sugi Kochi	20381	20339	16427	11087	9120	9400
Price Hinoki Kochi	53867	47471	35144	23442	16072	13900
Price Spruce/Fir Steiermark	13284	12768	9594	8900	10500	14000
Cost Works Spruce Steiermark	5100	5100	5100	5100	5100	5100
Cost clear-cut Kochi	7450	7915	9326	6381	5307	5532
Cost thinning Kochi	Data not available			10765	11874	9114

Figure 18: Price/Cost development in Austria and Kochi 1985 - 2014

However, besides complex topographical and forestry road conditions that affect production costs, non-economic value added factors in production and logistics that may affect production costs have to be taken into consideration. Table 11 shows a list of typical economic value added and non-economic value added activities in the process of roundwood production of Kami FOA. Although a number of activities can be considered non-economic value added activities, it must be noted that these activities are necessary given current infrastructural conditions. For instance, DBH limitation suggests maximum log diameters of approximately 35cm in Kami. Larger diameters exceed the capacities of local sawmills which would have to be updated. Although radial growth of the main species sugi and hinoki slows once maturity has been reached.

Nevertheless, DBH limitation can be considered a non-economic added activity as research in Austria has shown that logs with larger diameters achieve higher market prices. Moreover, harvesting costs decrease due to higher wood-mass per log (Please refer to field trip summary in Appendix A).

Table 11: Economic Value Added and Non-Value Added activities comparison

Activity	Kochi Prefecture / Kami FOA	MM Forsttechnik
Infrastructure and policy influenced activities		
Late thinning	NVA	Not applicable
Owner contact establishment restriction	NVA	Not applicable
DBH limitation	NVA	Not applicable
Road infrastructure[1]	NVA	VA
Road infrastructure development	VA	Not applicable
Forest work activities		
Use of modern machinery	VA	VA
- **Selection thinning**	VA	VA
- **Strip thinning**	VA	VA
- **Clear cut**	VA	VA
- **Non-extraction thinning**	NVA	Not applicable
Efficient use of workforce	VA	VA
Use of wireless database technology	Not applicable	VA
Transportation to temporary storage site[1]	NVA	Not applicable
Moving within temporary storage site	NVA	Not applicable
Log quality and diameter assessment	VA	VA
Waiting for transportation to end-user	NVA	NVA
Loading for transportation to end-user	NVA	NVA
Operation and maintenance of temporary storage site	NVA	Not applicable
Reforestation and monitoring activities		
Stand reforestation through planting[2]	NVA	NVA
Stand reforestation through natural rejuvenation	Not applicable	VA
Stand-monitoring	VA	VA

1 Current forest road conditions in Kami makes large-scale transportation impossible.

2 Natural rejuvenation not possible or too complex in certain stands.

Another non-economic value added activity that shall be discussed due to its significance is the use of temporary storage sites. These storage sites (Shigeto and Monobe Storage Sites) are used to store and grade harvested timber until it is sold. Unlike on-the-fly strategies in which storage becomes obsolete or strategies where storage is done directly at the site of further processing, this temporary storage step in the supply chain involves running cost, which affects the economic value added flow (Figure 19).

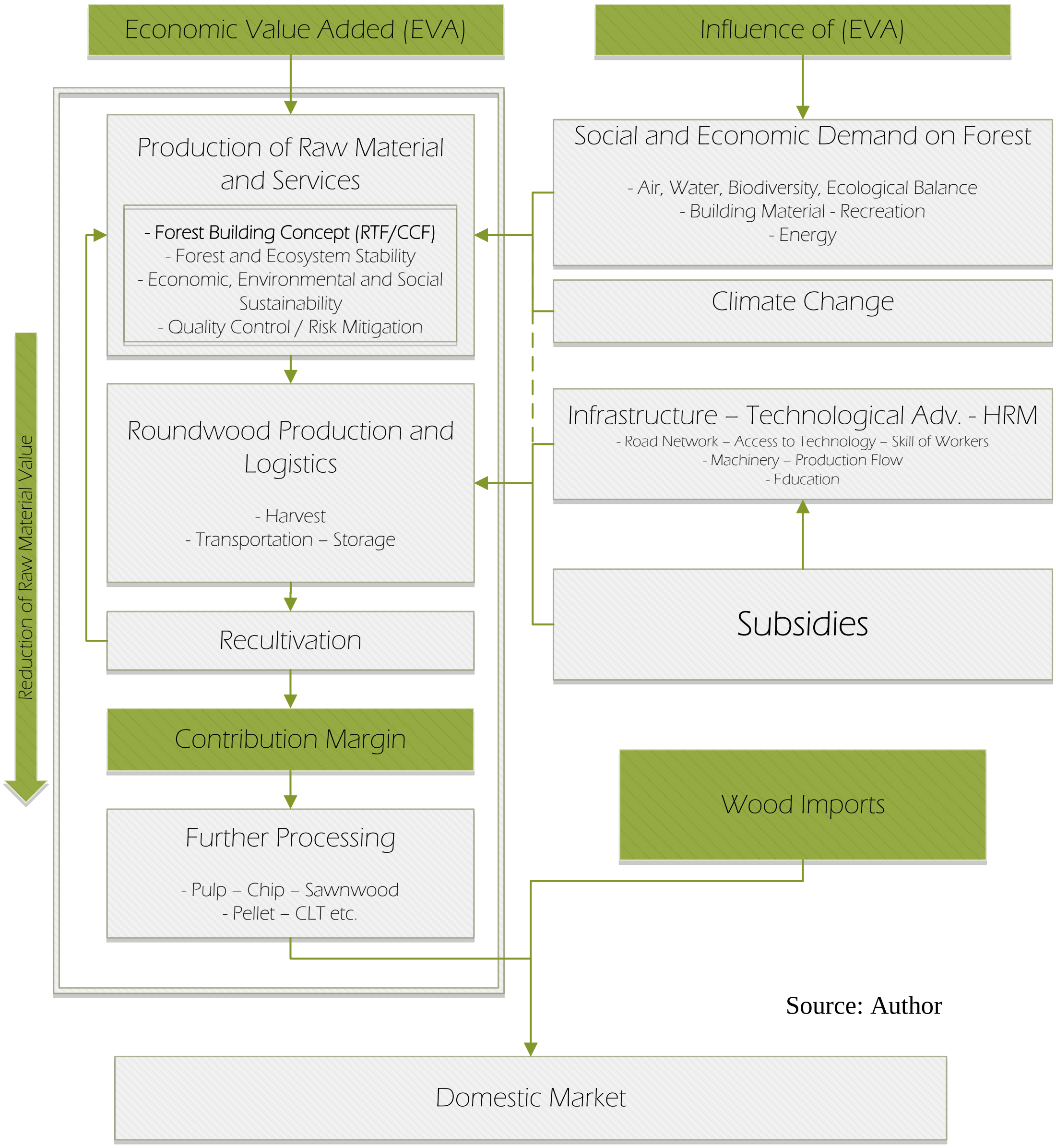


Figure 19: Economic Value Added flow in roundwood production in Kami/Kochi

However, it must be noted that this temporary storage step may be important given current local market and forest road conditions as discussed earlier. Given this discussion, improvement of economic value added can be achieved through adjustment in the following areas:

1. Increase the build-up of economic value during the growing stage of timber via SFM. This can be achieved through stand monitoring and the application of appropriate measures to preserve to trees and soil. Appropriate thinning plans should be made site-specifically and implemented when necessary. Reforestation should be performed through natural rejuvenation to exclude planting cost. However, in order to achieve SFM compromise must be achieved when choosing a forest building concept. Stand compositions must be chosen that are capable of achieving acceptable economic output, but that can also ensure the realization of environmental and societal goals. Alternative forest building concepts such as continuous cover forestry or even-aged plantations that consist of various tree species may be suitable.

2. Despite current infrastructure conditions, improvement of logistics within the supply chain should be made a long-term goal in Kami to lower management cost. This factor may be essential for the realization of SFM. Given roundwood price developments in the world, it may be uncertain and rather unlikely that roundwood prices in Japan reach peaks again as in the 1980s. If efficiency of production is not further increased, operating profit remains comparatively low. Low prospect for profit may lead to less investment in stand management and infrastructure development, making the forestry sector in Japan less attractive for investors. Now, Kami FOA is dependent on subsidies for the compensation of its on-site works. It is unclear if the Japanese government will continue financing forest works without interruption.

3. Social and economic demand of roundwood may decrease in the future due to demographic changes. The population of Japan is expected to decrease by approximately twenty million until 2050. This decrease in population is likely going to affect domestic wood demand, unless the resource wood will find new ways of utilization such as replacing plastic packing materials. The area of industrial forest may have to be reduced to avoid overstock. In addition, an integrative multispecies management approach that merges industrial forest and natural forest may be a way to adapt the area of industrial forest to demographic changes, to extend rotation periods, and at the same time, to benefit from the increased environmental value.

4. Climate research has shown a possibility for an increase of the Earth’s temperature. A change in temperature may affect growth and vitality of current species, which can disturb economic and environmental productivity. Alternative approaches to forest building including a replacement to alternative tree species may become necessary.

Such developments have been observed in various nations in Europe that now restructure forest to increase forest vitality that can cope with the effects of climate change.

4.5 Conclusion

The principles of SFM were born in Europe about 300 years ago to react to a wood shortage due to high wood demands by the public and industry. Whether this issue was of real or constructed nature is still under debate. However, the threat of global warming and climate change through uncontrolled logging and deforestation, in many parts of the world today, can be considered a real global issue, which directs large attention on the benefits of sustainable forest use. SFM has become a hot topic in forestry over the past two decades and is being promoted worldwide to create an optimal balance between economic use, nature conservation and societal demands. For global uniformity, international organizations have set similar criteria and indicators for the characterization of SFM. Japan's forest management activities; as wide areas show signs of degradation, mainly due to insufficient forest care such as thinning, have been largely criticized. Japan's rather imbalanced forest age structure shows that reforestation has not been practiced with a clear long-term forest management plan.

The Japanese government promotes thinning in its annual forest reports, however, it does not give the impression that the basic principles of thinning, as a frequent but non-systematic instrument of forest care, are fully understood and respected. Instead, it gives the impression that it is mainly used as a tool to increase carbon sinks to support and achieve the requirements of the first commitment of the Kyoto Protocol.

It can be agreed that frequent thinning is difficult to perform if there is no well-established market for thinned wood and decreasing wood prices. However, only proper forest care will provide all the benefits of SFM. Today, many insufficiently managed stands show improper breast-height diameter ratios, which affect extraction costs and log value. These unsustainable effects should have been taken more deeply into consideration during reforestation, as it can affect the competitiveness of Japan's forestry industry.

Seventy-five per cent of wood consumed in Japan is imported and the domestic forest industry has been declining. Although Japan is making strong efforts to overcome this issue, the forest and market infrastructure requires improvement and modernization.

Another issue that makes forest management difficult in Japan is high small-scale private forest ownership, the increasing number of ageing forest owners and untraceable forest owners. Without a binding national forest policy, building consensus among small-scale forest owners towards sustainable forest use, as promoted by the Japanese government, is complicated. Forming forest unions to combine forest area can help to reduce the total costs for care and harvesting, and will enable forest owners to deal timber in larger quantities to reach more potential markets.

The majority of forest management is executed by privately operated local forest associations. It is out of the question that their knowledge on sustainable forestry may be insufficient, but being a privately operated organization, it can be argued whether all three factors of SFM are treated equally. Local governments must take more responsibility to balance public and private interest on forests. Active support for small-scale private forest owners in the form of education, advice on management and forest unions is crucial to assist the national government's efforts to promote sustainable forestry. Similar structures have been present since the beginning of the 18th century in various parts of Germany with excellent success. With the reliance on foresters and their local and national support, Germany's healthy forests have become famous around the world.

Forest certification has been present in Japan since 2003, but compared to other developed nations it does not cover a large area. FSC is for the time being, the only internationally accredited forest certifier in Japan. SGEC was found as a competitor to make forest certification independent from international providers but assessment criteria are not clearly stated and are lacking transparency. Accredited forest certification has the potential to improve forest management on a local and national level in Japan. With every new local certification, another piece of forestland becomes sustainably managed and properly supervised based on international standards.

Economic value-added and economic non-value added activities during production and logistics of roundwood influence the development of production costs. Economic non-value added activities should be reduced to improve production efficiency.

Summary

Chapter 4 provided an analysis of Japan’s timber market, showed government efforts for implementation of SFM, and discussed the role of economic value added in the context of SFM.

A strong concentration of 40 – 55 years old forest was identified which can be traced back to extensive reforestation after WWII. Possible unfavorable effects of this age structure in terms of sustainable production of roundwood were discussed. Links to current issues regarding stem density and forest owner management were drawn and discoursed. The role of thinning in forest management and its significance in ensuring SFM was introduced. Efforts for thinning apart from reaching SFM, for the Kyoto Protocol and bio energy, and their implications were discussed. Following, an overview of current national roundwood production and market conditions was presented. The strong price decrease of sugi and hinoki since 1980 and its effect on self-sufficiency and wood imports, as well as forest owner motivation was demonstrated. The realization efforts of the production target of MAFF until 2020 and their challenges was briefly discussed. Succeeding, the concept of forest certification and the major certifiers PEFC, FSC and SGEC were introduced and briefly compared. It was demonstrated that the majority of Japan’s forest is yet uncertified. The potential of forest certification to contribute to local implementation of SFM in Japan was discussed. Next, economic value-added of roundwood production and logistics was discussed. It was shown that average production costs per m^3 of roundwood in Kami FOA are significantly higher than at competitor MM-Forsttechnik in Steiermark, Austria. A history of price and cost developments was presented. To comprehend possible reasons for this cost disparity, economic value added and non-value added activities of Kami FOA was listed. Lastly, four areas that may influence economic value added and possible strategies for mitigation were discussed.

References

BMELV (2013). *Illegaler Holzeinschlag.* Bonn.

Ecomed. (1991). *Waldlandschaftspflege - Hinweise und Empfehlungen für Gestaltung und Pflege des Waldes in der Landschaft.* Landsberg: Ecomed Verlagsgesellschaft.

EurObserv'ER (2012). Baromètre Biomasse Solide. *le journal des énergies renouvelables*(212).

FAO (2000). *Asia-Pacific Forestry Commission: Development of National-Level Criteria and Indicators for the Sustainable Management of Dry Forests of Asia: Workshop Report.* Bangkok, Thailand: United Nations.

Fernholz, K., & Kraxner, F. (2012). 10 Certified forest products markets, 2011 - 2012. (U. N. Europe, Ed.) *UNECE/FAO Forest Products Annual Market Review*, pp. 107-116.

FHP (2000). *Forst Holz Papier.* Retrieved July 31, 2013, from Publikationen/Durchforstung: http://www.forstholzpapier.at/index.php?option=com_virtuemart&page=shop.browse&category_id=7&Itemid=59

Gain, D., Watanabe, T. (2013). The contribution of forest regulations on the realization of sustainable forest management: a comparative law study of Japan and Germany. Internet Journal for Society for Social Management Systems , Vol. 3 SMS13-3086.

Graham, R., & Jain, T. (2004). Past, present, and future role of silviculture in forest management. (R. M. US Department of Agriculture, Ed.) *Silviculture in Special Places: Proceedings of the 2003 National Silviculture Workshop*, pp. 1-14.

Grober, U. (1999, November 25). *The Inventor of Sustainability.* Retrieved July 22, 2013, from Die Zeit Online: http://www.zeit.de/1999/48/Der_Erfinder_der_Nachhaltigkeit

Holzabsatzfonds. (2009). *Natürlich Holz - Forst- und Holzwirtschaft in Deutschland.* Bonn: Absatzförderungsfonds der deutschen Holz- und Forstwirtschaft.

JATAN (2010). *Japan Tropical Forest Action Network*. Retrieved July 13, 2013, from Japan's Timber Trade and Forestry: http://www.jatan.org/eng/japan-e.html

Lohberg, R. (2009). *Die Geschichte der Forstwirtschaft.* Retrieved July 21, 2013, from wald.lauftext.de: http://wald.lauftext.de/vom-wald-zum-forst/geschichte-der-forstwirtschaft/index.html

MAFF (1998). *Asia-Pacific forestry sector outlook study working paper series. Japan in-depth country study.* Bangkok: Regional office for Asia and the Pacific.

MAFF (2011). *Annual report on forest and forestry in Japan for FY2010.* Tokyo: Ministry of Agriculture, Forestry and Fisheries, Japan.

MAFF (2012). *Annual report on forest and forestry in Japan for FY2011.* Tokyo: Forestry Agency, Policy Planning Devision.

MAFF (2013). *Annual report on forest and forestry in Japan for FY2012.* Tokyo: Forestry Agency, Policy Planning Devision.

MAFF (2015). *Annual report on forest and forestry in Japan for FY2014.* Tokyo: Forestry Agency, Policy Planning Devision.

MAFF (2013). *The official homepage of the Ministry of Agriculture, Forestry and Fisheries of Japan.* Retrieved from Tree species by age class and area: http://www.rinya.maff.go.jp/j/keikaku/genkyou/h24/4.html

Matsushita, B., Xu, M., Onda, Y., Otsuki, Y., & Toyota, M. (2010). Detecting forest degradation in Kochi, Japan: ground-based measurements versus satellite (Terra/ASTER) remote sensing. *HYDROLOGICAL PROCESSES*(24), 588-595.

Mauro, F. (2011). Forests and Humans Throughout History. In E. a. Italian National Agency for New Technologies (Ed.), *Speciale Forest: a millenary heritage that guarantees us life*, (pp. 6-14).

MCPFE (2003). Improved Pan-European Indicators for Sustainable Forest Management. *Ministerial Conference on the Protection of Forests in Europe* (p. 6). Vienna: MCPFE Liaison Unit Vienna.

Neumann, M. (2003, November). Durchforstung: gestern, heute und morgen? (B. u. Wald, Ed.) *BFW-Praxisinformation*(2), pp. 3-4.

Ota, I. (2007). A forest owners’ cooperative in Japan: obtaining benefits of certification for small-scale forests. (F. a. Nations, Hrsg.) *Unasylva, 228*(58).

Peterken, P. (1993). *Woodland Conservation and Management* (2nd Edition ed.). London, UK: Chapman & Hall.

Popplow, M. (2002, June). *Abholzung und Aufklärung - Holzmangel im 18. Jahrhundert.* (D. R. Hohls, Ed.) Retrieved July 22, 2013, from H-Soz-u-Kult c/o Humboldt-Universität zu Berlin: www.hsozkult.geschichte.hu-berlin.de/tagungsberichte/id=58

Schmidt, A. (2011). *Der Wald in der Geschichte der Oberfalz.* Retrieved July 22, 2013, from Oberpfälzer Kulturbund e.v.: www.oberpfaelzerkulturbund.de

Shiraishi, N. (2011). International Workshop on Forest Certification. *The Progress of Forest Certification in Japan.* China: China Forest Certification Scheme.

Street, W. (2012, June 18). PEFC chairman at Forests: the heart of a green economy. *Rio+20 side event*. Rio de Janeiro.

The Montreal Process (2015). Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests.

WWF (2010, April). *WWF position on forest certification.* Retrieved August 4, 2013, from: http://awsassets.panda.org/downloads/wwf_forest_certification_pp_oct07.pdf

Chapter 5: Investigation III – Analysis of Kochi subsidy scheme for private forest – a focus group evaluation

This chapter presents an expert focus group evaluation of the subsidy scheme for private forest in Kami City, Kochi Prefecture, Japan, to determine whether the twelve currently available forest revitalization subsidies are designed to realize national goals. Subsidies for forestry practices have been criticized by various researchers worldwide for rarely achieving planned outcomes, for being non-beneficial to society, and in some cases for threatening the environment. Threats to natural balance have been observed in Kochi Prefecture, suggesting that current forestry subsidies may not be sufficiently achieving the objectives of the Japanese national government. Previous research on the sustainability of forestry subsidies in Japan has addressed the economic efficiency of Japanese forest subsidy schemes. Yet, to address the characteristics of sustainable forest management (SFM) fully, the potential environmental impacts of forest subsidies on private forests must also be considered. In this study, the utilization objectives, type of management intervention, application requirements, implementation area, intensity, and rate of the Kochi Prefecture subsidies for private forest were contrasted to the three forest multifunctionality objectives of the new National Biodiversity Strategy of Japan (NBSJ) 2012-2020, to identify potential structural and implementation weaknesses of the subsidy scheme. The study was carried out in three focus group discussions (FGD) with participants from three countries. It was asked for opinions whether the forest works associated with the subsidies directly and/or indirectly influence the NBSJ objectives. It was found that the subsidy scheme possesses weakness for integrative management not directly addressing forest diversity. Based on expert evaluations, comments and suggestions, and leaned on the Bavarian subsidy scheme for private forest, a proposal was made to improve the subsidy scheme in Kochi Prefecture in terms of realizing NBSJ goals by following an integrative management approach. Although design and implementation of subsidy schemes seems complex in Japan, integrative management would facilitate implementation of the NBSJ objective of realizing mixed forests and diversity, and reduce the likeliness for harmful environmental effects.

5.1 Introduction

Many nations in the world subsidize the management of forests with intentions such as landscape restoration, environmental benefit optimization, and the development of the forestry and wood industry. While forests for landscape restoration and environmental preservation are typically mixed forests, forests for industrial development are commonly organized as coniferous even-aged plantations, which are also subsidized in various nations worldwide. The application of forestry subsidies has led to an increase in forest area in various industrialized nations, however, with a larger increase of even-aged plantations (Barr and Sayer, 2012). Plantations are expected to exceed a worldwide area of approximately 300 million hectares within the near future (FAO, 2010). An average of 75% of plantation costs are subsidized worldwide, and to justify this strong financial support, governments usually point out the difficulty of maintaining forest multifunctionality, productivity and biodiversity (Bull et al., 2006; Enters et al., 2004). However, although subsidies in the natural resource sector are often justified in this way, their actual effectiveness and consequences can be complicated. Both direct and indirect positive and negative impacts on economic development and the environment may occur, in worst cases, transferring the cost for mitigation of negative effects to society as a whole (Bär et al., 2011; Goetzl, 2006; Robin et al., 2003).

Much research on especially subsidies for forest plantation management points out risks for negative environmental side effects, such as prevention of afforestation (Schmid, et al., 2007), loss of biodiversity (Bull et al., 2006), decreasing use of natural forest (Enters et al., 2004), and loss of old growth forest (Porter, n.d.). Moreover, plantation subsidies can also affect man-made capital, such as unfulfilled employment promises and low timber quality in degraded stands, as well as to natural capital by the application of biodiversity affecting management (Barrett and Trace, 1999). Such harmful subsidies are considered inhospitable for a sustainable development of society (Berg et al., 2011; Knirsch et al., 2006). To avoid further damage to man-made and natural capital, and to trigger a sustainable development of society, harmful subsidies must be eliminated (Barr and Sayer, 2012; Pearce, 2002). To eliminate harmful forestry subsidies, action plans are being implemented worldwide (Bär et al., 2011; Bruvoll et al., 2011; Valsecchi et al., 2009) such as Finland’s Biodiversity Action Plan which targets the identification and reallocation of subsidies that have high risk in damaging biodiversity (Heikkinen, 2007).

In Japan, as stated by the Japan Ministry of Agriculture, Forestry and Fisheries (MAFF), subsidizing forest plantations is a strategy that follows two main objectives. The first objective is to increase man-made capital by improving the profitability of the domestic forestry industry against imported low-cost primary timber products. The second objective is to enhance natural capital by maintaining and improving the multifunctional role of forests as a provider of forest resources, and as a natural habitat for the human being and wildlife. Some of these subsidies require private forest to be put under the national forest planning system in order to qualify for financial support2. Forest works are then carried out by local forest owners' associations or other qualified forestry bodies. Given the worldwide trend towards sustainable forestry, attention to the latter objective has been growing. As a result, the Japan Ministry of the Environment (MOE) has adopted the new National Biodiversity Strategy of Japan (NBSJ) 2012-2020. According to NBSJ, natural capital is to be enhanced by promoting the establishment of forests that maintain or improve their multiple functionality by creating "a good balance of forests". To achieve balanced forests, enhanced policy and management strategy development is targeted. One of these management strategies is the promotion of mixed forests. In detail, forest owners are recommended to develop their stands into multi-storied mixed forests with coniferous and broad-leaved species by using the abilities of nature (MOE, 2012, p. 154). As current research suggests, such a mixed forest strategy has the potential to improve natural capital through enhanced vitality and forest robustness, while mitigating the environmental effects of climate change (Pawson et al., 2013; Ciccarese et al., 2012; Jäckel and Roth, 2004).

Approximately 58% of Japanese forestland is privately owned with about 41% being planted forest (Hasegawa et al. 2013; Niskanen et al., 2007). Approximately 2.5M of these private forest owners hold forest areas of less or equal to one hectare (MAFF, 2013). Due to this large area of fragmented private forest, the execution of effective management has been a great challenge. It can therefore be expected that subsidy schemes for private forest are designed to embody MOE objectives appropriately. As previous research has shown, forestry subsidies seldom fulfill their economic and environmental objectives (Sayer et al., 2004). Forestry subsidies in Kochi are no exception. Notably, large areas of Japanese red pine (Pinus densiflora) plantations show strong signs of degradation (Matsushita et al., 2010). Unsustainable developments raise the question whether current subsidy schemes are formulated and implemented in a way to contribute to the realization of the sustainability goals of the NBSJ (Komatsu et al., 2012).

Until today, few researchers have raised the issue of effectiveness of Japanese forestry subsidy schemes. Nakajima et al. (2010) have analyzed economic benefit and suggest an alternative

[2] The Japan Forestry Planning System has been the major forest management implementation program since 1897. It is a national management system for management implementation at local level in support with local management bodies to realize national forestry goals (Fujisawa, 2004).

management approach for improving economic efficiency. However, economic efficiency is only one important aspect of SFM; economically driven forest management can affect environment and society (Pukkala, 2011). Therefore, research needs to be conducted to evaluate whether subsidy schemes for local private forest are designed appropriately to reach national objectives.

The purpose of this study was (a) to arrange focus groups of experts for the evaluation of the currently available subsidy scheme for private forest in Kami City/Kochi Prefecture, Japan, in reflection to the NBSJ forest goals: (1) Development of Diverse Forests, (2) Forest Conservation and Management, and (3) Control of Wildlife Damage to Forests. Based on this evaluation, (b) to discuss subsidy differences between this scheme and its counterpart in Bavaria, Germany and (c) suggest applicable measures to improve the subsidy scheme currently in place in Kami City/Kochi Prefecture in terms of realizing NBSJ objectives. As forestry subsidy schemes for private forest are similar throughout Japan, results could be of relevance for practitioners in other prefectures.

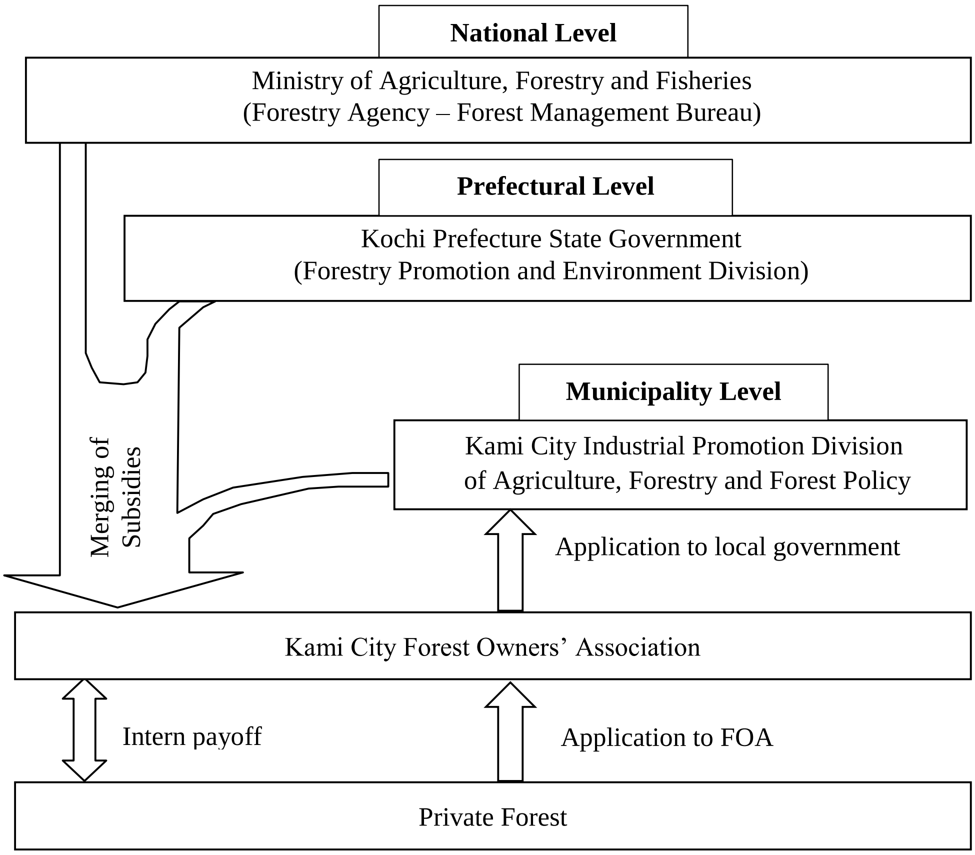
5.2 Materials and Methods

Study site

Nearly 91% of the 19,516 ha of forest are held by private small-scale forest owners. Of these 91% of private forest, approximately 75% are industrial plantations, which almost completely consist of sugi (*Cryptomeria japonica*) and hinoki (*Chamaecyparis obtusa*) monocultures. The majority of these monocultures have recently, or will soon be reaching merchantability. However, despite merchantability, roundwood prices have been declining critically by over 250% over the past decades, and have fallen to near average thinning costs. Although prices have stabilized with a slight increasing trend, thinning in sugi stands is especially affected by this negative price development. Close to 100% of private forest qualifies for, or receives direct financial management support for thinning operations. Figure 20 shows an application network of the subsidy scheme in Kami City. As shown, financial distribution of subsidies is divided by more than one public authority.[3] In addition, some of these subsidies are exclusively provided

[3] Private forest owners are encouraged to apply for financial support at municipality government offices in charge. However, this scenario is rather uncommon, and application is in most cases provided by the responsible forest owners' association.

in cooperation with the national and prefectural government, while remaining subsidies receive additional support from the municipality government (Tables 12-14).



Source: Kami FOA

Figure 20: Subsidy application network in Kami

Material collection and preparation

Official objective statements and descriptions of currently available forestry subsidies for private forest have been acquired from Kochi Prefecture Administration. For verification purposes, the same set of data was collected from Kami Forest Owners' Association where it is used for management negotiation purposes with private forest owners. According to the collected data, twelve subsidies are currently available. These twelve subsidies were categorized into subsidy groups (1-3) according to administrative characteristics as follows:

1. Subsidies for forestation, afforestation, bird habitat protection, shrub removal and stands affected by forest road establishment under forest management plans (Table 12)

Table 12: Subsidies for forestation, afforestation, bird habitat protection, shrub removal and stands affected by forest road establishment under forest management plans

Type of subsidy	Stand age (years)	Type of management	Area (ha)	Intensity (thinning)	Support requirements	Subsidy rate (N,P)[a]	Subsidy rate (M)[b]
1. Improvement thinning	~25	Negative selection of low quality and infectious trees	0.1+	N/A	Stands approved for forest management scheme Stands approved for silviculture scheme Stands under particular thinning promotion plan based on the Special Measures Law	68%	10,000 Yen/ha
2. Early thinning	~35	Negative selection of low quality and infectious trees	0.1+	30%		68%	10,000 Yen/ha
	no limit	Negative selection of low quality and infectious trees (Average DBH ≥ 18cm)	0.1+	30%		68%	10,000 Yen/ha
3. Commercial thinning	~60	removal of marketable wood without negative selection	0.1+ (5+)[c]	30%	Stands approved for forest management scheme Stands approved for silviculture scheme but target for enforcement plan Stands under particular thinning promotion plan based on the Special Measures Law but target for enforcement plan	68%	1,000 Yen/m^3
4. Renewal thinning	~90	negative selection and commercial thinning	0.1+ (5+)[c]	30%		68%	1,000 Yen/m^3
5. Thinning for environmental development	~60	Negative selection of low quality and infectious trees	0.1+	30%	No public forest unless contracted out to a private person No forest held by forest owners' associations or non-governmental organization unless contracted out to a private person	36% 72%[d]	10,000 Yen/ha

[a] N: National government; P: Prefectural government

[b] M: Municipality government

[c] Stands under forest management implementation plan in the business of a particular thinning promotion plan based on the Special Measures Law.

[d] Stand must be expected to deliver high environmental benefit

Source: Kochi Pref. Forest Administration (2015)

2. Subsidies for self-administered forest management, environmental enhancement and timber production (Table 13)

Table 13: Subsidies for self-administered forest management, environmental enhancement and timber production

Type of subsidy	Stand age (years)	Type of management	Area (ha)	Intensity (thinning)	Support requirements	Subsidy rate (N,P)[a]	Subsidy rate (M)[b]
6. Commercial thinning	~35	Removal of non-utilizable and infectious timber. Commercial thinning. Transportation.	0.1+	30%	≥1m^3/ha, Works in accordance with Article 11 of forest law and admitted by governor. Works executed within one fiscal year.	~236,000 Yen/ha	N/A
7. Improvement thinning	11-25	Negative selection of low quality and infectious trees	N/A	N/A	Presence of timber selected for removal after reforestation project and young stand care.	54,000 Yen/ha	10,000 Yen/ha
8. Early thinning	11-35	Negative selection of low quality and infectious trees	N/A	N/A		35,000 Yen/ha	10,000 Yen/ha
	11-45	Negative selection of low quality and infectious trees (Average DBH ≥ 18cm)	N/A	N/A		30,000 Yen/ha	10,000 Yen/ha
	11-45	Negative selection of low quality and infectious trees	N/A	N/A		23,000 Yen/ha	10,000 Yen/ha
9. Thinning	11-60	Negative selection of low quality and infectious trees (Public Forest Conservation and Maintenance Project)	0.1+	30%	Protective forest or forest with difficult to achieve high expected public value.	80,000 Yen/ha	10,000 Yen/ha
	31-60	Commercial thinning (Forest Maintenance Support Project)	0.1+	30%	Forest not target of other subsidy scheme	183,000 Yen/ha	30,000 Yen/ha

[a] N: National government; P: Prefectural government

Source: Kochi Pref. Forest Administration (2015)

3. Subsidies for reforestation and protection from wildlife damage (Table 14)

Table 14: Subsidies for reforestation and protection from wildlife damage

Type of subsidy	Support requirements	Subsidy rate (N,P)[a]	Subsidy rate (M)[b]
10. Reforestation 11. Protection from deer damage 12. Shrub removal	Works administered by third party. S11 and S12 are carried out in combination	68%	~22%

[a] N: National government; P: Prefectural government

[b] M: Municipality government

Source: Kochi Pref. Forest Administration (2015)

Each group was subcategorized for type of forest interventions, applied work descriptions, intervention intensity, stand age requirement, area and general support requirements, as well as the subsidy rates. As far as applicable, rates were further classified into funds from national, prefectural and municipality governments. Irrelevant subsidies addressing infrastructure development, such as road construction, machinery etc. were excluded from this study.

Methodology

For this study, a methodology applying focus group discussions (FGD) was followed. In general, focus groups are moderated interacting individuals of common knowledge, that come together to explore and clarify issues on complex issues which may not be possible using other methods (van Giersbergen, et al., 2016). Evaluation of subsidies through FGD are applicable in this study due to the complexity of possible future outcomes of long-term forest growth affecting policies and works, especially when targeting an enhancement of forest diversity.

Through FGD, information gained from participants is transferred into a group opinion through interaction by process factors such as cognition, negotiation, generation of knowledge power relations, which are next to learning processes, important FGD criteria (Kraaijvanger, et al., 2016). A nonthreatening and relaxed discussion environment supports the acquisition of these cognitive and emotional perceptions (Wyatt, et al., 2008). This acquired group opinion provides a means of evaluation to help improve the planning and designing of potentially better performing program alternatives in the future. For instance, FGD were used to evaluate the effectiveness of a government supported networking program in Flanders as a means for effective design of programs of such kind (Van Cauwenberge, et al., 2013). In similar context, FGD were used in a study in Malawi to evaluate an agricultural subsidy scheme (Dorward, et al., 2008). FGD were also used to identify influence of subsidies for decisions of landowners regarding sustainable forestry (Jacobson, et al., 2006). To maximize elaboration, a reasonable group size for FGD is important and ranges from four to twelve, depending on the expertise of participants and the complexity of the topic. Smaller groups from five to eight are recommended when participants are experienced with the topic, as larger groups may lead to shortened and trivial answers (Krueger and Casey, 2000).

FGD of the Kochi Prefecture subsidy scheme for private forest were conducted with experienced forestry practitioners in Japan (n=6), Germany (n=6) and Austria (n=6). Practitioners from Germany and Austria were included in this evaluation due to local communities in these countries having a long implementation history of SFM and may evaluate differently to the Japanese focus group. In Kami City, the concept of SFM has only recently gained consideration among local stakeholders. The focus groups were arranged in five steps. (1) Practitioners with relevant professional forestry experience were selected (foresters, forest workers, active forest owners, silviculture experts, forest engineers and forest administrative officers with a minimum experience of at least 10 years). (2) Practitioners were clarified about the procedure and were made familiar with the local forest conditions and infrastructure in Kami City. (3) A questionnaire was designed and executed. In this questionnaire, the three general on-site management related NBSJ objectives for private forest (a) Development of diverse forests, (b) Forest conservation and management, and (c) Control of wildlife damage were selected. After a three question warm up phase, expected direct and/or indirect influence of each subsidy on these objectives (a, b and c) was asked to be evaluated by each focus group. Direct influence of a subsidy was demonstrated if site management is expected to contribute to one or more NBSJ objectives. Indirect influence was demonstrated if site management was expected to contribute to one or more NBSJ objectives implicitly, not directly aimed by subsidy statement. No influence was demonstrated if site management is not expected to contribute to one or more NBSJ objectives. (4) Critical comments from participants were documented. Following FGD, significant answers and comments were discussed and the subsidy scheme was compared to the Bavarian one reflecting integrative and segregative management theories. The Bavarian subsidy scheme is applicable in Kami City for effectively redesigning forest structure. Consequently, the Bavarian subsidy scheme was an important source of reference for contrasting the expert opinions obtained from the discussion that followed the individual questionnaires.

5.3 Results and Discussion

Table 15 shows the FGD results for direct and indirect influences of the subsidies (S1 – S12) in groups G1 – G3 on the three selected NBSJ forest management objectives. On observation, evaluations by all three focus groups have been performed similarly with focus towards direct influence of subsidies on NBSJ objective 2 – Forest Conservation and Management, and indirect influence of subsidies on NBSJ objective 1 – Development of Diverse Forests. Subsidy group G1 shows a different evaluation of the S4 – Renewal Thinning subsidy by the Japanese and German groups evaluating it as directly contributing to the development of diverse forest. The Austrian focus group evaluated it as an indirect contributor to this objective. Evaluation of subsidies S10 – S12 in subsidy group G3 show different and multiple opinions regarding the influence of these subsidies on NBSJ objectives. These results shall be discussed alongside selected critical comments and suggestions by the focus groups for possible ways to improve the current subsidy scheme.

Table 15: Focus group results for Japan (J); Austria (A) and Germany (G)

Type of subsidy	Development of diverse forests		Forest conservation and management		Control of wildlife damage to forests	
	direct	indirect	direct	indirect	direct	indirect
Subsidies for forestation, afforestation, bird habitat protection, shrub removal and stands affected by forest road establishment						
1. Improvement thinning		**J A G**	**J A G**			
2. Early thinning		**J A G**	**J A G**			
3. Commercial thinning		**J A G**	**J A G**			
4. Renewal thinning	**G**	**J A**	**J A G**			
5. Thinning for environmental development		**J A G**	**J A G**			
Subsidies for self-administered forest management, environmental enhancement and timber production						
6. Commercial thinning		**G**	**J A G**			
7. Improvement thinning		**J A**	**J G**			
8. Early thinning		**J A**	**J G**			
9. Thinning		**J A G**	**J G**			
Subsidies for reforestation and protection from wildlife damage						
10. Reforestation	**G**	**J**	**J A G**			
11. Protection from deer damage[a]	**J**	**G**	**A G**		**J A G**	
12. Shrub removal		**G**	**A G**	**J**		

5.3.1 Summary of critical group comments and suggestions

Concern on effectiveness of subsidy scheme for the development of diverse forest

Subsidies S1-12 possibly can – if applied with adequate care and knowledge of ecological correlations – lead to higher diversity in mixed forests, however it is not very likely in monocultures unless surrounding species have a chance to rejuvenate in a stand that was recently thinned. All subsidies will probably have a direct positive effect on forest conservation and management of existing stands. (German focus group)

This comment by the German group of experts (a) can be explained by means of subsidy statements. Management measures of subsidies S1-5 target three major intervention strategies: removal of low quality timber, unmarketable timber, and contaminated timber. Each measure is based on stand age and median diameter at breast height (DBH). S3, S4 and S5 support removal of marketable timber. While S1 and S2 target enhancement of forest development, specific nature development goals are not mentioned, raising the concern that subsidies S1 and

S2 contribute to the development of monocultures for improvement of economic efficiency. S10 does not clearly separate species and their distribution that qualify for this subsidy.

Concern about effectiveness of improvement thinning for the development of diverse forest

Subsidies for improvement thinning (S1, S7) can bring positive effects for forest conservation and management. However, the effect regarding the development of diverse forests should be low or in cases even negative. The planned measures such as removal of low quality trees suggest a uniform type of forest, likely consisting of few species and/or monetarily valuable species, and/or low age difference and/or less diverse tree shapes. It is also unclear what is meant by "quality". Quality regarding industrial utilizability, natural conservation or soil protection?
Suggestion: If development of diverse forest is desired, it should be clearly formulated in the subsidy statement. Forest works should include access to measures such as the planting of additional species. (German focus group)

Comments and suggestions by the German focus group (b) point out the possibility of a loss of diversity for works associated with current improvement thinning subsidies S1 and S7. Detailed formulation of subsidy statements and forest works for the development of diverse forest is an important suggestion to ensure correct implementation of multi-species management.

Criticism against way of renewal thinning

Although conversion to a mixed-culture can be achieved, we criticize the current intensity for the subsidy for renewal thinning (S4). A sudden extensive thinning can result into the conversion of a well-balanced mixed stand into a monoculture, in the event seed trees not being sufficiently available.
Suggestion: A thinning should be planned to incorporate flexible intensity and the level of tree maturity. On-site assessment is necessary to make sure species develop and rejuvenate as planned. (German focus Group)

Comments by the German focus group regarding renewal thinning (c) suggest careful planning of the extraction of tree species to avoid loss of diversity. The level of tree maturity and ability to rejuvenate must be taken into account when planning and executing thinning works. On-site assessment is needed to control and monitor implementation of such management.

Concern regarding commercial thinning

If in commercial thinning only well marketable trees are removed, stand structure will change. However, it may lead to both, an increase or decrease of biodiversity. If mainly one tree species is removed, it will affect biodiversity. If a balance of several tree species is removed, biodiversity is likely to increase and other more indigenous species get a chance to spread.
Suggestion: On-site assessment is important to make sure the latter. (Austrian focus group)

Concern regarding forest establishment and bird habitat protection

Subsidies for forestation, afforestation, bird habitat protection and stands affected by forest road establishment are not sufficiently addressed, given most subsidies targeting thinning. Although an indirect positive effect is likely to be achieved, there should be separate subsidies or measures that directly target these goals.
Suggestion: For the development of diverse forests, there should be a clear definition if and how broadleaf species qualify for reforestation. (German focus group)

Suggestion for wildlife management and natural rejuvenation

S11 has potential to reduce wildlife damage through appropriate protective measures. If browsing causes increased damage, renewal thinning with followed natural rejuvenation can lead to increased food availability, and as a result reduce young tree damage by browsing.
Suggestion: Such an approach should be explained in subsidies in more detail. (Austrian focus group)
Evaluation of S11 Control of Wildlife Damage to Forests was comparable in each nation. The reason for this answer (f) can be explained as: (1) an increase of forestland also increases the amount of available food sources which likely results into a reduction of damage by browsing in small areas. (2) The direct application of artificial tree protection is part of this subsidy. However, the approach as suggested by the Austrian focus group could be considered as a natural low cost alternative. Yet, such an approach would require regular on-site assessment.

Necessity of the current subsidy scheme

The subsidy scheme creates consensus with forest owners. Given the current low roundwood prices, subsidies are necessary to meet annual logging goals. Without subsidies, most forest owners would not agree to any type of management that would involve private investment. (Japanese focus group)

5.3.2 Contrast to Bavarian subsidy scheme

Similar to the Kochi subsidy scheme the Bavarian scheme for private forest aims at the conservation of forest resources and health, the preservation of multifunctionality and climate tolerance (StMELF, 2015). Both schemes were designed to implement national goals for the establishment of diverse forests with the Bavarian scheme further referring to EU sustainability regulations. In the Bavarian scheme, promotion focuses on the establishment and redesign of coniferous monocultures into site-adapted climate tolerant mixed- and broadleaf forest by planting and/or natural rejuvenation. In all cases, broader sustainability issues are covered.

The promotion of broadleaf forest receives the highest financial support, coniferous forests are supported only on specifically designated sites in which coniferous species have been and should be naturally present. Stand and forest floor management incorporates support for tending for stands younger than 15 years. Natural rejuvenation is favored over planting. Forest establishment is determined by number and type of trees rather than hectares. The advantage of natural rejuvenation and singletree management is the possibility for managers to apply close-to-nature forestry to manage sites with higher structure flexibility. For instance: species mixing, density and layer management, correction of insufficiently naturally rejuvenated areas, and inventory repair after windthrow, pest and other natural hazards. Adequate soil management further supports the successful establishment of sustainable forest. Measures for pest control are granted based on site assessment.

Extraction from stands that require the use of cost intensive skyline systems such as in mountain forest and especially wetlands receive cost compensation. Commercial timber is not limited to tree age and log diameters, which allows longer rotation periods. To ensure equal treatment of all forest functions, integrative forest function management is encouraged and supported, including the preservation of rare, local and site-adapted species, old seed trees, wetlands and other specially designated habitats. Soil protective extraction is supported by the use of horse, traction winch and small-sized tower yarders. In the event of flood and forest fire, damage partial financial support is granted. Commercial extraction is not financially supported.

5.3.3 Integrative vs. segregative management

In comparison to the Kochi subsidy scheme, the Bavarian scheme incorporates wider measures necessary for the establishment of site-adapted climate tolerant mixed- and broadleaf forest based on forest development strategies. These measures are key components of integrative forest management for achieving multifunctionality. In the case of Kami, as focus group evaluation suggests, the subsidies do not effectively contribute to the scheme objective that targets multifunctional forestry, so arguably not an effective integrative approach. The terms multifunctionality and environmental preservation in the subsidy objective statements are too broad to be achieved by mainly thinning works. Therefore, with this scheme, a segregation of forest functions towards commercial use of forest rather than sustainable integration of functions is observable.

Forest function segregation can often be observed in various economic, logistic and socio-demographic situations: Economic pressure due to low timber prices and/or high harvesting costs of logging companies, fast rising timber demand, difficult to access forest areas, population decrease, and insufficient management activity by small-scale forest owners. All these five examples for segregation could be observed in Kami City. Production costs are close to timber price for especially sugi; annually set logging goals by the government are increasing; wide areas of private forest are difficult to access due to a still not sufficiently developed forest road network, and construction difficulty of roads due to complex topographical conditions; and a very large distribution of small-scale forest owners. Segregation of forest functions brings a number of ecological disadvantages: important ecological management aspects become neglected, and a tendency to even-aged coniferous monoculture approaches which lead to a reduction of rotation time can be observed. In such even-aged monocultures natural capital can become even negative when, for instance, root density affects water and air productivity of the soil. Especially in specific nature protection areas, the protection of natural resources can be significantly affected by root density. The social recreation aspect can also be affected by segregation. For instance, forests that are designed and managed to allow extensive use of machinery often offer little optical incentives for a visit (Bechter, W., 2006).

5.3.4 Proposal to achieve NBSJ objectives

A proposal shall be made for the improvement of the Kochi subsidy scheme towards integrative management of forest functions. This proposal incorporates expert comments and suggestions, and possible applicable strategies from the Bavarian subsidy scheme into account by considering local conditions, and the general need for subsidies to meet annual logging goals.

Role of subsidy scheme

Japan's legal framework does not allow the passing of legally binding prefecture-level forest laws, and national forest policy addresses SFM in an undetailed sense (Gain and Watanabe, 2013). The current subsidy scheme is an on national level designed tool to contribute to achieving NBSJ objectives. To improve forest conditions locally, concrete guidelines for the establishment of forest structure and its management in Kochi, as suggested by the German and Austrian group of experts, should be introduced to the current subsidy scheme to achieve NBSJ objectives. To achieve this, an extension of subsidy scope becomes necessary which should be planned and implemented by local forest managers.

Scope and formulation of subsidy scheme

Strategies regarding how mixed stands are subject to financial support should be formulated more clearly with terminology regarding the improvement of "quality" being formulated in more detail. These strategies should then be accompanied by defined guidelines in which clear statements are given regarding forest development varieties, mixed stand establishment and the respective management. Such guidelines have to be formulated also within subsidy statements targeting thinning regimes for the involvement of respective underplanting of new species, as well as reforestation. (1) Natural rejuvenation as a strategy to increase food availability for food ability for forest protection from wildlife damage must be considered and explained in detail. (2) Support for the preservation of rare and threatened species, as well as naturally, valuable locations must be added to degeneralize the terminology of forest. In addition, subsidies addressing forestation, afforestation and bird habitat protection should be separated and practical measures should be specifically adapted. (3) To avoid risks during and after thinning operations, and to ensure an effective increase of biodiversity, regular qualified on-site assessment needs to be introduced. (4) Stand age limitation for the applicability of measures should be removed to allow permanent-cover strategies as alternatives to clear-cuts for forest owners. (5) The use of skyline thinning systems and other forest soil protective extraction strategies should be promoted separately from those implying higher risks for forest floor damage. This should be further supported by risk mapping of areas that are very sensitive to erosion and measures cost-intensive measures to stabilize these areas should be supported separately (6) In the current case of Kochi, commercial extraction receives identical, and in some cases even higher financial support than thinning for forest preservation. Justification for financial support for commercial extraction should be present in detail in the subsidy statement to provide transparency.

Prefectural and municipality level granted financial support could specifically aim at the implementation of these scope extensions to ensure efficient site-specific management at local level in addition to current national objectives.

5.4 Conclusion

Reflecting results of the focus group evaluations, the present subsidy scheme for private forest in Kami City/Kochi Prefecture suggests focus on the revitalization of existing single layered coniferous plantations. Based on expert evaluation, this focus implies a segregative forest management approach insufficiently addressing NBSJ objectives. Concern was raised that practical measures in the current subsidization strategy could result into loss of biodiversity and sustainability. This would indicate the risk of this scheme to include subsidies that can be considered to bring harmful effects, as discussed in various previous research. Up to 72% of cost is subsidized; a rate close to average in Asia (Bull et al., 2006). At such a relatively high rate, and without access to alternative silvicultural support options, private forest owners are seemingly obligated to maintain, expand or even develop new areas of even-aged forest. For environmental forest policy to be effective, it must be designed to motivate forest owners of all typologies to change behavior corresponding to forest policy objectives (Boon and Meilby, 2007). Besides, to achieve the desired environmental benefits as suggested by NBSJ, the subsidy scheme itself requires adjustment and should include measures that directly lead to integrative multifunctional management. Such a site adaptation strategy for economic efficiency, site stability and climate tolerance through mixed forests, as targeted and supported in Bavaria, is the appropriate strategy for implementing national sustainability goals at local level. This has to be supported by concrete management advice and the inclusion of research on silviculture, plantation management, and the utilization of multispecies forests. A kind of cost-benefit analysis of the forestland being used between practitioners and conservationists should prove useful to harmonize productivity and naturalness (Cannell, 1999).

Currently, the Kochi subsidy scheme is a universal forest management support tool where financial support is granted for the application of pre-determined forest works to a given forest area, the exact way it is described in the scheme. These forest works are mainly executed by FOAs whose main interest is profit maximization, with focus on timber extraction works and sale, rather than forest establishment, development and care. Most of current management is carried out to qualify for financial support without long-term perspectives (Fuchigami et al., 2016). Without decision-making based on site characteristics, such an approach results into non-site-specific management which is unlikely to achieve sustainable forestry the way it is discussed worldwide today, and the way it is promoted by the Japanese government. The Bavarian subsidy scheme on the contrary can be described as a non-universal pool of financially supported resources and on- and off-site assessment and management services, managers have access to, to preserve, structure or re-structure forest in a way that goes in accordance with national forest sustainability goals. This approach promotes close to nature forestry and offers financial compensation to managers for site-specific management, which reportedly has a larger potential to achieve national sustainability goals such as those described in the NBSJ. The six-point proposal made to restructure the current subsidy scheme in Kochi Prefecture/Kami City can be used as a model for local long-term oriented forest management in Japan. Regular sustainability on-site assessment, as suggested by the focus groups, will be the crucial aspect for successful implementation. This approach has the potential of enhancing local forest policy to balancing environment and production at local level as demanded by previous research in Japan (Ota, 2010). Balancing production and environment is capable of not only supporting the Japanese forest industry to stand on its own, but to sustainably benefit society as a whole by also protecting environmental values, the way it is promoted by the NBSJ

However, design of subsidy schemes and their local implementation seems complex in Japan. Unlike other industrialized nations, many areas in Japan do not yet have access to qualified foresters that would be capable of acting as a source of professional silvicultural expertise, or to act as a mediator to negotiate the wants and needs of local stakeholders. Healthy forests are of general public interest, however, with increasing forestry dynamics forest management itself has become more uncertain (Spiecker, 2003) further complicating local management. Integrative forestry delivers the framework for sustainable development, but it is not a concept to eliminate uncertainty (Lindner et al., 2014; Day and Pérez, 2013; von Detten, 2011). Uncertainty remains a problem in decision-making processes (Wintle and Lindenmayer, 2008). Because of the unique characteristics of each forest and their surrounding habitats subsidies for site adaptation and area specific management seems a logical step towards successful implementation of integrative policy in Kochi Prefecture/Kami City.

References

Bär, H., Jacob, K., Meyer, E., Schlegelmilch, K., 2011. Wege zum Abbau umweltschädlicher Subventionen. Abteilung Wirtschafts- und Sozialpolitik der Friedrich-Ebert-Stiftung. Available from: http://www.polsoz.fu-berlin.de/polwiss/forschung/systeme/ffu/publikationen/2011/11_WISO_Baer_et_al/WISO_Diskurs_Abbau_umweltsch__dlicher_Subventionen.pdf?1367711999 (accessed 22.10.14)

Barr, C. M., Sayer, J. A., 2012. The political economy of reforestation and forest restoration in Asia–Pacific: critical issues for REDD+. Biological Conservation 154, 9-19. doi:10.1016/j.biocon.2012.03.020

Barrett, A., Trace, F. 1999. The impact of agricultural and forestry subsidies on land prices and land uses in Ireland. Dublin: The Economic and Social research Institute. Available from: http://www.esri.ie/UserFiles/publications/20060831091003/PRS35.pdf (accessed 22.10.14)

Bechter, W., et al., 2006. Integrative Waldwirtschaft versus Segregation der Waldfunktionen. Verein für Forstliche Standortskunde und Forstpflanzenzüchtung e.V. Freiburg, Germany.

Berg, H., Burger, A., Thiele, K., 2011. Environmentally harmful subsidies in Germany. Dessau, Germany: Federal Environment Agency. Available from: http://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/4123.pdf (accessed 22.10.14)

Boon, T. E., Meilby, H., 2007. Describing management attitudes to guide forest policy implementation. Small-scale Forestry 6, 79-92. doi:10.1007/s11842-007-9006-2

Bruvoll, A., Skjelvik, J. M., Vennemo, H., 2011. Reforming environmentally harmful subsidies: how to counteract distributional impacts. Copenhagen: Nordic Council of Ministers. Available from: http://www.diva-portal.org/smash/get/diva2:700594/FULLTEXT01.pdf (accessed 22.10.14)

Bull, G. Q., Bazett, M., Schwab, O., Nilsson, S., White, A., Maginnis, S., 2006. Industrial forest plantation subsidies: impacts and implications. Forest Policy and Economics 9, 13-31. doi:10.1016/j.forpol.2005.01.004

Cannell, M. G., 1999. Environmental impacts of forest monocultures: water use, acidification, wildlife conservation, and carbon storage. New Forests 17, 239-262.

Van Cauwenberge, P., Bauwhede, H. V., Schoonjans, B., 2013. An evaluation of public spending: the effectiveness of a government-supported networking program in Flanders. Environment and Planning C: Government and Policy 31, 24-38.

Ciccarese, L., Mattsson, A., Pettenella, D., 2012. Ecosystem services from forest restoration: thinking ahead. New Forests 43, 543-560. doi:10.1007/s11056-012-9350-8

Dorward, A., Chirwa, E., Kelly, V. A., Jayne, T. S., Slater, R., Boughton, D., 2008. Evaluation of the 2006/2007 agricultural input subsidy programme, Malawi. Final Report. Michigan State University. Department of Agricultural, Food, and Resource Economics. Food Security Collaborative Working Papers.

Enters, T., Durst, P. B., Brown, C., Carle, J., McKenzie, P., 2004. What does it take? The role of incentives in forest plantation development in Asia and the Pacific. Food and Agriculture Organization of the United States.

FAO, 2010. Planted forests in sustainable forest management: a statement of principles. Food and Agriculture Organization of the United Nations. Available from: http://www.fao.org/docrep/012/al248e/al248e00.pdf (accessed 22.10.14)

Fuchigami, Y., Hara, K., Uwasu, M., Kurimoto, S., 2016. Analysis of the mechanism hindering sustainable forestry operations: A case study of Japanese forest management. Forests 7, 182. Doi:10.3390/f7080182

Fujisawa, H., 2004. The forest planning system in relation to the forest resource and forestry policies. Journal of Forest Research 9 (1), 1-5.

Gain, D., Watanabe, T., 2013. The contribution of forest regulations on the realization of sustainable forest management: a comparative law study of Japan and Germany. Internet Journal for Society for Social Management Systems , Vol. 3 SMS13-3086.

Goetzl, A., 2006. Subsidy or incentive? Seneco Creek: ITTO Tropical Forest Update. Available from: http://www.itto.int/fellowship_detail/id=27110000 (accessed 22.10.14)

Heikkinen, I., 2007. Saving nature for people, National strategy and action plan for conservation and sustainable use of biodiversity in Finland 2006-2016. Ministry of the Environment. Helsinki. Finland.

Jäckel, A., Roth, M., 2004. Conversion of single-layered scots pine monocultures into close-to-nature mixed hardwood forests: effects on parasitoid wasps as pest antagonists. European Journal of Forest Research 123, 203-212. doi:10.1007/s10342-004-0030-x

Jacobson, M. G., Straka, T. J., Greene, J. L., Kilgore, M. A., Daniels, S. E. 2006. Financial incentives for practicing sustainable forestry on private forest lands. Society of American Foresters.

Knirsch, J., Mittler, D., Kaiser, M., Sack, K., Thies, C., Edwards , L., 2006. Deadly subsidies. Amsterdam: Greenpeace International. Available from: http://www.greenpeace.org/international/Global/international/planet-2/report/2006/7/deadly-subsidies.pdf (accessed 22.10.14)

Komatsu, T., Nakaya, S., Uraiwong, P., Watanabe, T., 2012. Multi-stakeholder mental model in monobe river improvement and maintenance. Internet Journal for Society of Social Management Systems, SMS12-9459.

Kraaijvanger, R., Almekinders, C.J.M., Veldkamp, A., 2016. Identifying crop produtivity constraints and opportunities using focus group discussions: A case study with farmers from Tigray. NJAS – Wageningen Journal of Life Sciences 78, 139-151.

Krueger, R. A., Casey, M. A., 2000. Focus groups: A practical guide for applied research, 3rd Edition. Sage Publications, Inc. Thousand Oaks, USA.

Lindner, M., Fitzgerald, J. B., Zimmermann, N. E., Reyer, C., Delzon, S., van der Maaten, E., . . . Hanewinkel, M., 2014. Climate change and European forests: what do we know, what are the uncertainties, and what are the implications for forest management? Journal of Environmental Management 146, 69-83. doi:10.1016/j.jenvman.2014.07.030

Ministry of Agriculture, Forestry and Fisheries, Japan (MAFF), 2011. Annual report on forest and forestry in Japan for FY2010. Tokyo: Ministry of Agriculture, Forestry and Fisheries, Japan. Available from: http://www.rinya.maff.go.jp/j/kikaku/hakusyo/22hakusho/pdf/22_e.pdf (accessed 22.10.14)

Ministry of Agriculture, Forestry and Fisheries, Japan (MAFF), 2012. Annual report on forest and forestry in Japan for FY2011. Tokyo: Forestry Agency, Policy Planning Devision. Available from: http://www.rinya.maff.go.jp/j/kikaku/hakusyo/23hakusyo/pdf/23_e.pdf (accessed 22.10.14)

Ministry of Agriculture, Forestry and Fisheries, Japan (MAFF), 2013. Annual report on forest and forestry in Japan for FY2012. Tokyo: Forestry Agency, Policy Planning Devision. Available from: http://www.rinya.maff.go.jp/j/kikaku/hakusyo/24hakusyo/pdf/h24summary.pdf (accessed 22.10.14)

Matsushita, B., Xu, M., Onda, Y., Otsuki, Y., Toyota, M., 2010. Detecting forest degradation in Kochi, Japan: ground-based measurements versus satellite (Terra/ASTER) remote sensing. Hydrological Processes 24, 588-595.

Ministry of the Environment (MOE), 2012. The national biodiversity strategy of Japan 2012-2020. The Ministry of the Environment, Japan. Available from: http://www.env.go.jp/en/headline/file_view.php?serial=528&hou_id=1989 (accessed 22.10.14)

Nakajima, T., Kanomata, H., Matsumoto, M., Tatsuhara, S., Shiraishi, N., 2010. Cost-effectiveness analysis of subsidy schemes for industrial timber development and carbon sequestration in Japanese forest plantations. Journal of Forest Research 22 (1), 1-12.

Niskanen, A., Lunnan, A., Ota, I., Blatner, K., Herbohn, J., Bull, L., . . . Hickey, G. M., 2007. Policies affecting forestry entrepreneurship. Small-scale Forestry 6, 233-255. doi:10.1007/s11842-007-9025-z

Ota, I., 2010. Forest law and policy developments in Japan. Working Papers International Series Forest Policy and Forest Economics, pp. 3-11.

Pawson, S. M., Brin, A., Brockerhoff, E. G., Lamb, D., Payn, T. W., Paquette, A., Parrotta, J. A., 2013. Plantation forests, climate change and biodiversity. Biodiversity Conservation 22, 1203-1227. doi:10.1007/s10531-013-0458-8

Pearce, D., 2002. Environmentally harmful subsidies: barriers to sustainable development. London, UK: Organisation for Economic Cooperation and Development. Available from: http://www.oecd.org/site/agrehs/35215571.pdf (accessed 22.10.14)

Porter , G., 2002. Subsidies and the environment: an overview of the state of knowledge. OECD Workshop on Environmentally Harmful Subsidies. Available from: http://www.oecd.org/site/agrehs/35217152.pdf (accessed 22.10.14)

Pukkala, T., 2011. Optimizing forest management in Finland with carbon subsidies and taxes. Forest Policy and Economics 13 (6), 425-434. doi:10.1016/j.forpol.2011.06.004

Richtlinie für Zuwendungen zur Förderung waldbaulicher Maßnahmen im im Rahmen eines forstlichen Förderprogramms (WALDFÖPR 2014). Available from: http://www.stmelf.bayern.de/mam/cms01/wald/waldbesitzer/dateien/waldfoerpr_2014.pdf (accessed 22.10.14)

Robin, S., Walcott, R., Quintela, C. E., 2003. Perverse subsidies and the implications for biodiversity: a review of recent findings and the status of policy reforms. Durban: Vth World Parks Congress: Sustainable Finance Stream. Available from: http://conservationfinance.org/guide/WPC/WPC_documents/Overview_PanB_Wolcott_v2.pdf (accessed 22.10.14)

Sayer, J., Chokkalingam, U., Poulsen, J., 2004. The restoration of forest biodiversity and ecological values. Forest Ecology and Management 201, 3-11. doi:10.1016/j.foreco.2004.06.008

Schmid, E., Sinabell, F., Hofreither, M. F., 2007. Phasing out of environmentally harmful subsidies: consequences of the 2003 CAP reform. Ecological Economics 60, 596-604.

Spiecker, H., 2003. Silvicultural management in maintaining biodiversity and resistance of forests in Europe—temperate zone. Journal of Environmental Management 67, 55–65. doi:10.1016/S0301-4797(02)00188-3

StMELF, 2015. Bavarian State Ministry of Food, Agriculture and Forestry. Richtlinie für Zuwendungen zu waldbaulichen Maßnahmen im Rahmen eines forstlichen Förderprogramms WALDFÖPR 2014 (in German).

Valsecchi, C., ten Brink, P., Bassi, S., Withana, S., Lewis, M., Best, A., . . . Kaphengst, T., 2009. Environmentally harmful subsidies: identification and assessment. Final report for the European Commission's DG Environment, November 2009. Available from: http://ec.europa.eu/environment/enveco/taxation/pdf/Harmful%20Subsidies%20Report.pdf (accessed 22.10.14)

Van Giersbergen, M.Y., Ozsaker, E., Dirimese, E., Alcan, A.O., 2016. The operating room experiences of nursing students: A focus group study. Journal of PeriAnesthesia Nurses 31 (2), 146-153.

von Detten, R., 2011. Sustainability as a guideline for strategic planning? The problem of long-term forest management in the face of uncertainty. European Journal of Forest Research 130, 451-465.

Wintle, B. A., Lindenmayer, D. B., 2008. Adaptive risk management for certifiably sustainable forestry. Forest Ecology and Management 256, 1311-1319. doi:10.1016/j.foreco.2008.06.042

Wyatt, T.H., Krauskopf, P.B., Davidson, R., 2008. Using focus groups for program planning and evaluation. The Journal of School Nursing 24 (2), 71-82.

Chapter 6: Investigation IV – International comparison of Forest Law and Policy

The purpose of this comparative law study is to compare the Japanese Forest and Forestry Basic Act with the German National Act on Forests (Bundeswaldgesetz – BWaldG), the Bavarian Act on Forests (Waldgesetz für Bayern – BayWaldG) and the Austrian Forest law (Forstgesetz für Österreich – ForstG). Researchers worldwide are criticizing Forest management in Japan for various reasons that make the implementation of SFM difficult. Clear-cutting and forest degradation are existent nationwide affecting surrounding ecosystems and biodiversity. The Japanese forest products industry is further losing competitiveness in the world, even to developed nations with substantially smaller forest areas and lower domestic wood consumption. Moreover, lacking awareness of the public on the importance of the ecological role of forests and forestry is of growing concern to the Japanese government. It can be argued that the implementation of effective forest management relies on various input factors. National policies take a fundamental role by providing instructions and guidance on how efficient forest management is to be accomplished. Limitations and drawbacks in the Japanese forest and biodiversity acts that have the potential to impede an effective realization of sustainable forest management (SFM) in Japan were identified and contrasted to the forest laws of Germany and Austria, nations which are leading producers and exporters of wood products, and where SFM has been successfully practiced for centuries. Concrete formulations of law articles were examined to analyze their practicable execution for successful application of SFM in the respective nations. Emphasis was given on the analysis of law purpose, forest preservation, protection, promotion, supervision as well as future sustainability in account to the respective forest conditions and forest owner structures of each nation. It was found that the Japanese Basic Act and the German national forest law address SFM criteria and indicators lower than the Bavarian BayWaldG and the Austrian ForstG. As there are no individual forest laws at prefecture level in Japan, results suggest diverse editing of forest regulations. A number of future application challenges and chances are discussed.

6.1 Introduction

Sustainable forestry has been a hot topic in forest management for more than 20 years. International conferences around the world have set fundamental key indicators and criteria on

how effective sustainable forestry should be implemented and accomplished on a national and regional level. Intergovernmental working groups around the world provide assistance to their member states to realize sustainable forest management (FAO, 2008).
Laws, acts and policies are important parts of society in order to make sure that every person in it knows what he or she can or cannot do. In this way, a society can run peacefully and efficiently. Regulations on forests and forestry share similar objectives; to balance economic, ecological and social needs and their demands on forest products and forest services. These objectives include the regulation of forest use and forest management actions such as felling, reforestation, the maintenance of a sustainable supply of wood as an industrial material and the preservation of natural functions such as biodiversity, climate conservation and pollution control.

Forests are protected by means of regulations throughout the world. However, implementation efficacy of these rules can differ greatly among nations. For effective conservation of forestland, with all its beneficial characteristics to society, it is necessary to address a large number of criteria and influencing factors that contribute to the forest ecosystem construct. Policies are made through stakeholder communication, by balancing out the needs and wants of each stakeholder. Consensus on an issue at a national level, can develop into the passing of a law and must therefore be followed by every individual residing in that country to avoid prosecution. This is the point where the efficacy of forest policy can strongly fluctuate, because the formation of policy and law are generally very different from nation to nation. Table 16 provides a comparison of the central differences of forest policy and forest law (FAO, 2010). Forest laws have an equal effect on everyone in a society and are protected by law enforcement. Violation can or will result in legal action. A policy does not possess the same legal power as a law. The efficacy of forest policy is therefore highly dependent on successful stakeholder communication, as well as successful consensus among stakeholders. Policies are not legally binding and cannot be prosecuted by legal enforcement. In an environment that is not protected by forest laws, only successful stakeholder consensus can enable the implementation of forest policies. Without stakeholder consensus, effective forest and forestry preservation is difficult.

Table 16: Key differences of forest law and forest policy

Forest Law	Forest Policy
1. Legally binding	Not legally binding
2. Lists rights and duties that are based on policy vision and goals	Delivers support by indicating visions, goals and ways to achieve them
3. Explicit formulation to enable equality across jurisdiction	General formulation to enable room for adaption
4. Approved and passed by parliament or Head of State through legislation procedures	Can be approved and modified in various ways through stakeholder communication
5. Legal procedures necessary for modification	Modified by those that approved the policy
6. Violation is punished by judicial powers	Violation is not punished or only dealt with light actions

Source: Lindsay et al. (2007)

Both forest law and forest policy are highly complex regulation structures; as they involve effective balancing of multiple stakeholder interest. They must address a good balance of nature conservation and the economic importance of wood as a resource material. Important factors that need to be taken into account when formulating forest regulations is international agreements on environment and trade, property rights of forest owners, indigenous cultures, genetically modified organisms as well as forest certification and labeling (Lindsay, Christy, Di Leva, & Takoukam, 2007). Due to the large amount of stake in forests and forestry, building consensus among all stakeholders is a very complex and time consuming achievement. On a national level, however, compared to forest law, a non-legally binding, inexplicitly worded forest policy, without legal enforcement, is much less effective at taking sufficient control of the large variety of forest's needs and wants.

This research study was conducted to target the assessment of three forest laws, the German national BWaldG, the Bavarian BayWaldG and the Japan Forest and Forestry Basic Act in regards to the criteria and indicators for sustainable forest management devised by Forest Europe and the Montréal Process, and the key characteristics of forest laws and policies. It aims to identify, evaluate and discuss the level of effectiveness of contributing to sustainable forestry. To achieve this, all three forest laws are scanned for information based on the derived criteria and indicators which are then analyzed for detail and evaluated. Emphasis will be given on the detail of the expression of relevant law articles.

Significant legal framework differences between Germany, Austria and Japan

Legally binding, state enforced forest policy has a long history in Germany. A quickly expanding iron, glass and mining industry in Germany in the 15th century, significantly increased the already high wood demand at that time. Forests were used by both the industry and public to deliver wood as a resource for heat energy, but also as a source of livelihood by hunters and farmers. In addition, the services of forests to provide protection from natural impacts, such as storms, ice and avalanches were also very important. In order to protect all the important forest functions for society, authority structures in Germany began to understand the importance of sustainable forest management. First actions were the rationalization of felling, criminal prosecution of illegal cutting and the implementation of reforestation strategies, to gain control of wood production and consumption (Lohberg, 2009). The protection of forests with all the services and products that they provide became an essential part of legislations in Modern Times Germany.

Today, there is one national forest law in Germany - the German Federal Forest Law - (Bundeswaldgesetz – BwaldG) which dates from 1975 (last revised in 2010). The aims of the law are the preservation and protection of forests on a federal and federal state level (reforestation responsibility, clearing permission etc.) and the promotion of forestry for effective wood production. The law itself states general provisions which the 16 federal states of Germany are obligated to address in federal state forest regulations. It is legally binding and stands above federal state law. It does not, however, implicate law enforcement measures on the management of forest in order to avoid interference with federal state forest laws.

Figures 21, 22 and 23 show the legislative scope of forest laws on national, state (prefectural) and regional level in Germany, Austria and Japan (Basic Act).

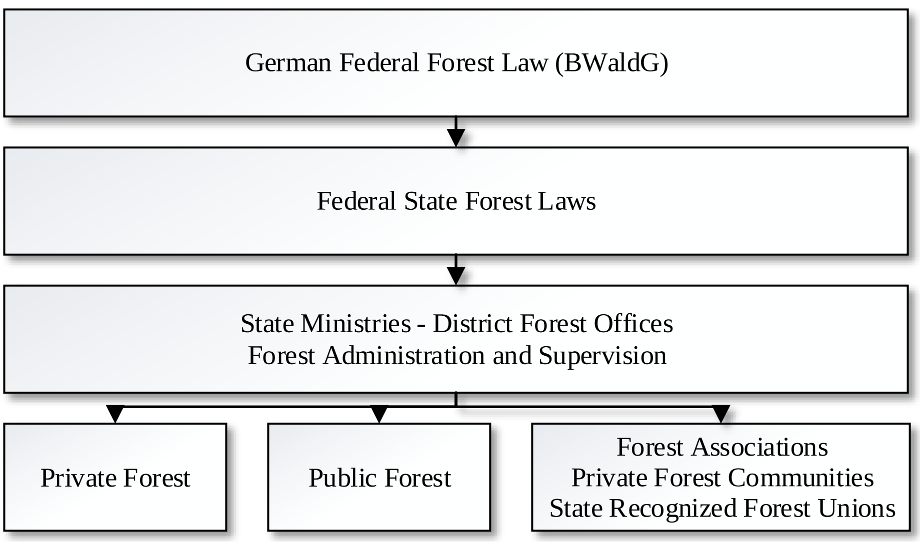


Figure 21: Forest Law Application Process (Germany)

In Austria, regulations regarding the management of forest have been in use for more than 160 years. Since 1975, the federal forest law (ForstG) provides a system of enforceable rules for the sustainable management of all forests in the nine federal states. Before the passing of ForstG, regional forest regulations were used as guidelines for the implementation of multifunctionality strategies regarding the management of forests. Aims of ForstG are the preservation of forest and forest soil, the ensuring of the productivity of forest soil, and the ensuring of a sustainable management of forest of all functions. Old regulations in the states of Austria that have existed prior to the passing of ForstG became obsolete.

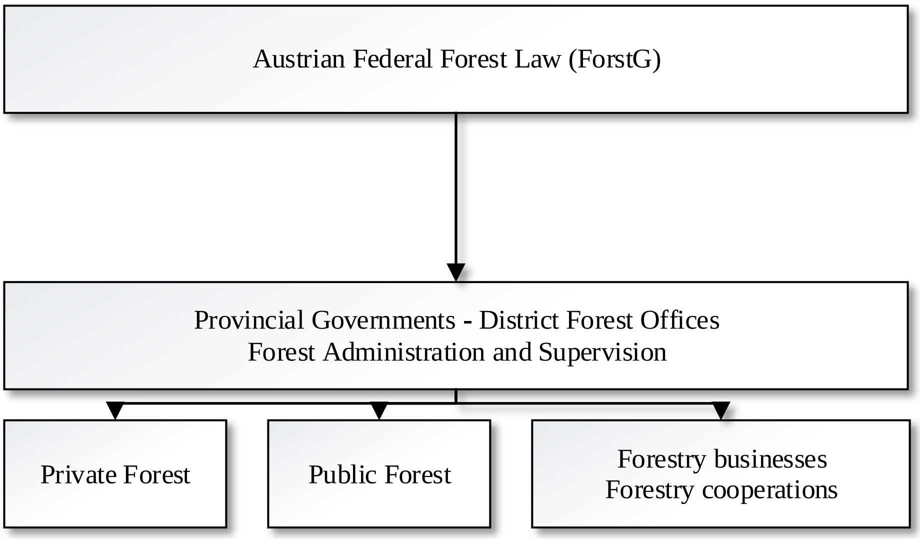


Figure 22: Forest Law Application Process (Austria)

On the other hand, forest legislation in Japan seems to be more complex. There are six forestry related laws in Japan. The three major ones are the Forest Law from 1951, the Forest Owners Association Law from 1987 and the Forest and Forestry Basic Law from 1964. The main objectives of the 1951 Forest Law are the implementation of a nationwide forest planning system, to protect Japan’s forests and to promote its forestry. The Forest Owners Association Law from 1987 aims to raise the socioeconomic position of forest owners and to improve processes for roundwood production. The Forest and Forestry Basic Law from 1964 aims to improve the performance of sustainable forestry by balancing the three fundamental key functions of sustainable forest management: economy, ecology and society (Ota, 2010).

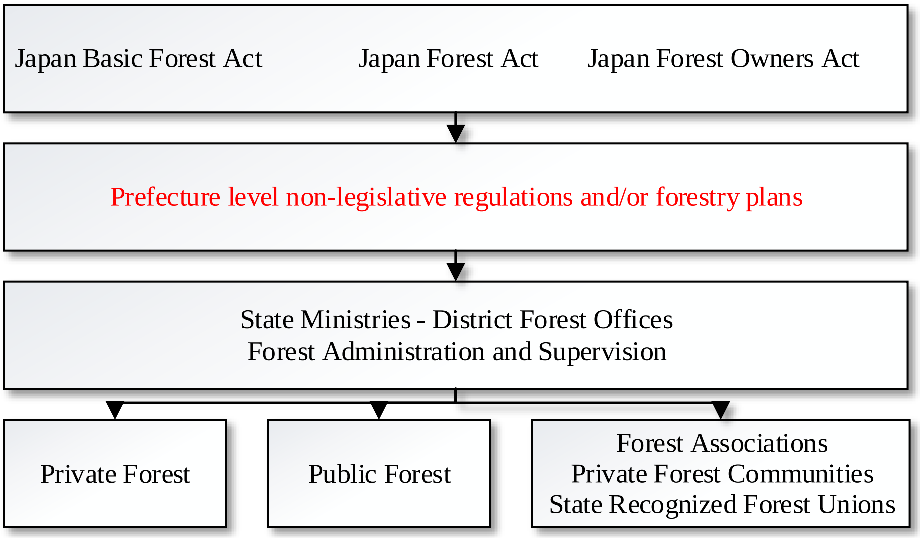


Figure 23: Forest Law Application Process (Japan)

Applicability of SFM Criteria and Indicators

The Montréal Process is the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests. It is one of several other intergovernmental working groups such as Forest Europe (MCPFE), the Food and Agriculture Organization of the United Nations (FAO) and the International Tropical Timber Organization (ITTO). First starting as an initiative of the government of Canada, the Montréal Process was found in 1994 in response to the United Nations Rio Earth Summit in 1992. Japan is one of the 12 member states which together account for approximately 50% of the world's entire forest area. All 12 member countries have agreed to its criteria and indicators on sustainable forest management. The internally established Network of Knowledge enables states to share experiences, knowledge, opinions and ideas on the application of forest management. Germany is a member of Forest Europe (MCPFE). Criteria and Indicators are very similar to those of the Montréal Process and are also leaned on those of the 1992 UN Earth Summit (MCPI, 2009)

6.2 Methodology

Japan is a nation that is very internationally participative to support processes towards sustainable forest management. For instance, the Liaison Office of the Montréal Process is currently hosted by Japan. The headquarters of the International Tropical Timber Organization, for which Japan is one of the main financial donors, is in Japan.

However, since Japanese forestry is still being criticized for its poor management – it has led to widely-stretched degraded forest areas, as claimed by Matsushita, Xu, Onda, Otsuki, & Toyota (2010) - the question arises, how effectively Japanese forest regulations – besides all of the promotion efforts and forest programs by the Japanese government – contribute to the realization of sustainable forest management within Japan. The main idea of the criteria and indicators for sustainable forest management were formed about 20 years ago, and were approved by the Japanese government. Until now, have they been implemented in national and regional forest policy? And if yes, how well?

As claimed by Ota (2010), the Forest and Forestry Basic Law of 1964 aims to improve the performance of sustainable forestry in Japan. In order to answer the research question how well the UN indicators and criteria for effective forest management are employed in the Japanese Forest and Forestry Basic Law of 1964, it shall be compared to the German Federal and Bavarian Forest Laws according to the criteria and indicators derived from the Montréal Process, Forest Europe and the 1992 UN Earth Summit Forest Report. German forest laws were chosen because the country's forestry industry is one of the world leaders in technology, market and innovation. Moreover, the concept of sustainable forest management is claimed to be born in Germany (Grober, 1999). Bavaria is one of the states with the least natural resources in Germany, so unlike other federal states, forestry remained one of the most important economic sectors.

Each individual law is systematically analyzed for information regarding the derived criteria and indicators, with what detail they are being addressed within the law and whether legislation measures for law enforcement, including prosecution, are existent. The sustainable forest management criteria and indicators were subdivided into three subgroups. (A) General Principles for Forests and Forestry, (B) International SFM Criteria and Indicators, (C) Unaddressed 1992 UN Earth Summit SFM Values. (A) General Principles for Forests and Forestry represent typical forest and forestry values including definitions for forestland, forest ownership, forest management, as well as forest conservation measures and monitoring. Subgroup (B), International SFM Criteria and Indicators, derives the norms for sustainable forest management of the Montréal Process and Forest Europe which are the working groups of the two countries that are part of this research study. These norms are based on the forest management standards released at the 1992 UN Earth Summit. Subgroup (C), Unaddressed 1992 UN Earth Summit SFM Values, lists ideals of the 1992 UN Earth Summit that were neither adopted by the Montréal Process nor Forest Europe, which are however, relevant factors with the potential to effectively contribute to sustainable forest management and are therefore, although considered of minor importance, worth addressing. Each forest law will lastly be evaluated in respect to the key differences of forest law and forest policy.

Limitations

Japanese forest legislature is very complex on both, national and prefectural level. There are mainly three forestry related laws in Japan. The Forest and Forestry Basic Law of 1964 explicitly targets the enhancement of the performance of sustainable forestry in Japan. However, certain management and non-management related factors of this research study may also be addressed in other Japanese forest laws. Therefore, a factor that may be unaddressed, or only briefly addressed, may appear in more detail in another law. Only the assessment of the performance of the Japanese Forest and Forestry Basic Law of 1964 (lastly revised in 2003), in contrast to the German national forest law and the Bavarian forest law, is element of this research. Each federal state of Germany has its own forest law based on the general statutory framework of the German national forest law. Law purpose, objectives, prescriptions and legal application are very similar among each federal state and only differ on a larger scale with regards to the degree of law enforcement and the determination of the severity of legal measures; such as penalties and fines.

Japanese forest legislation, on a prefectural level, is unequal and sometimes provides little detail. Often, only a minor part of forest management; mainly the changes of the character of forest land with their administrational application is addressed. This includes the proposal for permission to the governor of each respective prefecture for clear-cutting or any other forest management action that comprises a change of forest land character. Penalties and fines differ greatly among prefectures, should they apply. General forest laws that cover all major aspects of forest management in every prefecture, such as in Germany, do not exist in Japan. Because of this inequality, prefectural regulations cannot be taken into account in this comparative forest law research study.

6.3 Results and Discussion

The comparison of the German federal, Bavarian federal state and the Japanese Forest and Forestry Basic Act, as demonstrated in Table 17 and with regard to the preset internationally agreed sustainable forest management criteria and indicators, result in partly similar, but in certain areas also quite diverse outcomes. The German Federal Forest Law is only intended to provide general provisions for federal state forest legislation. Therefore, law article formulation detail and the number of regulated criteria and indicators is significantly lower compared to its Bavarian counterpart, where the majority of SFM criteria and indicators are addressed in rich detail of the highest order.

Table 17: BWaldG, BayWaldG, Forest Basic Act, ForstG SFM C/I Comparison

Degree of Detail not addressed: - briefly addressed: + addressed in detail: ++ addressed in detail and law enforced +++	Germany BWaldG	Germany Bay WaldG	Japan Basic Act	Austria ForstG
(A) GENERAL PRINCIPLES FOR FOREST AND FORESTRY				
Definition of forest and forest land	++	++	-	++
Sustainable forest use, management and development	++	++	++	++
Forest conservation	++	++	++	++
Classification of forest functions	++	+++	+	+++
Protection of forest functions	++	+++	+	+++
Types of forests and forest owners	++	+++	+	+++
Forest owner rights and obligations	++	+++	++	+++
Support for forest owners	+	+++	++	+++
Supervision of forest and forest policy	-	+++	+	+++
Forest monitoring	+++	+++	+++	+++
Forest monitoring for climate preservation	+++	+++	-	+
(B) INTERNATIONAL SFM CRITERIA AND INDICATORS				
B1 Conservation of biological diversity				
Conservation of ecosystem diversity	-	+++	-	+ (enf.)
Conservation of species diversity	-	+++	-	+ (enf.)
Conservation of genetic diversity	-	+++	-	+ (enf.)
B2 Maintenance of productive capacity of forests				
Preservation of area and type of forest	+++	+++	++	+++
Sustainable production of wood products	+	+++	+	+++
Sustainable production of non-wood products	+	+	+	+
B3 Maintenance of forest ecosystem health and vitality				
Biotic impacts on forests	-	+++	+	+++
Natural and human-induced abiotic impacts on forests	++	+++	++	+++
B4 Conservation and maintenance of soil and water resources				
Protective function of forests to society	+++	+++	+	+++

Maintenance of forest soil	+++	+++	+	+++
Maintenance of aquatic systems	+	+++	+	+++
B5 Maintenance of forest contribution to global carbon cycles				
Importance of forests to global carbon cycles	-	-	-	-
Role of forests on global climate	++	+++	+	+
Role of forests as a provider for renewable bio-energy	-	+++	-	+
B6 Maintenance and enhancement of long-term socioeconomic benefits to meet the needs of societies				
Contribution of forest products to domestic economies	+	+	++	+
Environmental services of forests	++	++	++	+
Maintaining and enhancing socio-economic benefits	++	+++	++	+
Importance of employment and community needs	+	+	++	+
Forests for recreation	+++	+++	-	++
Protection of cultural, social and spiritual connection	+	++	+	+
B7 Legal, institutional and economic framework for forest conservation and sustainable management				
Importance of regulations to support SFM	+++	+++	++	+
Taxation and economic strategies to support SFM	-	-	-	++
Programs to support SFM	-	+++	+	+++
Research and technologies to support SFM	-	+	++	+++
Clear land ownership information	++	++	-	++
Partnerships to support SFM	+++	+++	++	+
Public participation in conflict management	-	-	+	-
Report of progress on SFM	+++	+++	+++	+
Enforcement of forest laws	++	+++	-	+++
Prosecution and penalties	+++	+++	-	+++
(C) UNADDRESSED 1992 UN EARTH SUMMIT SFM INDICATORS				
Promotion of women in forest management	-	-	-	-
Conservation and sustainable development of policies	-	-	-	-
Strengthen education and training on SFM	-	+++	++	+++
Promotion of domestic forest products	-	-	++	-
Control of pollutants	-	-	-	+++

Note: +(enf.) = briefly addressed and enforced
Source of indicators: Montreal Process

Table 18 displays the frequency of appearance of the criteria and indicators of each forest law in each detail category.

Table 18: Frequency of appearance of criteria and indicators in comparison

Forest law	-	+	++	+++
Germany BWaldG	16	7	13	10
Germany BayWaldG	7	4	6	29
Japan Basic Act	15	14	15	2
Austria ForstG	5	15	6	20

6.3.1 General principles for forest and forestry

The results in this group show significant disparity in six of the eleven principles of two or more detail categories. In BWaldG, two of eleven principles are regulated. In BayWaldG, eight of eleven principles are regulated. In the Japanese Basic Act, only one of eleven principles is regulated by legislature. The Japanese Basic Act does not include a definition of the characteristics of forest and forestland. Classifications of forest functions, protection of forest functions, description of types of forests and forest owners, the supervision of forest and forest policy are mentioned, but not addressed in detail in the Japanese Basic Law. Support for forest owners is briefly mentioned in BWaldG, whereas is it described in detail and is regulated in BayWaldG. Supervision of forest and forest policy is not mentioned in the German BWaldG, but addressed in detail and regulated in BayWaldG. Forest monitoring for climate preservation is not mentioned in the Japanese Basic Act, but addressed in detail and regulated in both German forest laws subject in this research study. Evaluation for Austria ForstG shows that forest monitoring for climate preservation is addressed in the law only briefly.

6.3.2 International SFM Criteria and Indicators

Results of subgroup B1 “Conservation of biological diversity” show that neither in BWaldG nor in the Japanese Basic Act the preservation of biological diversity in forests is mentioned, while it is addressed in detail and law enforced in BayWaldG. In regards to realizing SFM, this seems a big problem for the Japanese Basic Act because of two reasons. (1) Preservation and increase of biological diversity is a core component of SFM. Especially species diversity is relevant for Japan’s industrial forest, as it would address one of the main weaknesses of even-aged management.

Subgroup B2 “Maintenance of productive capacity of forests” shows that the sustainable production of wood products is meticulously addressed and regulated in BayWaldG, while it is briefly addressed in BWaldG and the Japanese Basic Act. The sustainable production of non-wood products is briefly addressed in all four forest laws. For the Japanese Basic Act, a more specific explanation based on international standards of the term "sustainable production" is necessary to avoid misunderstanding.

Results for the effects of biotic impacts on forests in subgroup B3 "Maintenance of forest ecosystem health and vitality" are not mentioned in BWaldG but are addressed in detail and are enforced in BayWaldG and ForstG. In the Japanese Basic Act biotic impacts are briefly addressed. This is a weak result as especially even-aged monocultures are fragile to biotic impacts, for instance by rapid spreading of organisms due to lack of natural predators.

All three indicators in subgroup B4, "The conservation and maintenance of soil and water resources", are briefly addressed in the Japanese Basic Act. This is a weak result as water and soil condition influences the environmental productivity of stand and surrounding ecosystems. Especially soil erosion and water quality risks, as discussed in Chapter 1, are direct results of insufficient soil and water conservation.

The indicators of subgroup B5 "The maintenance of forest contribution to global carbon cycles" are only partly addressed in all three forest laws. The importance of forests to global carbon cycles is not mentioned in any of the four forest laws. The role of forests on global climate is briefly mentioned in the Japanese Basic Act. The role of forests as a provider for renewable bio-energy is only referred to and addressed in detail and regulated in the Bavarian BayWaldG forest law.

Subgroup B6 "Maintenance and enhancement of long-term socioeconomic benefits to meet the needs of societies" shows reasonably similar results among the four forest laws. The contribution of forest products to domestic economies, as well as the importance of employment and community needs, is addressed in detail in the Japanese Basic Act, whereas, it is only briefly mentioned in both German forest laws and ForstG. However, the recreation aspect of SFM is not mentioned in the Japanese Basic Act, while it is addressed in detail and regulated in both German forest laws. The Japanese Basic Act mentions in Article 2 "Fulfillment of Multifunctional Role of Forests", the preservation of public health. However, an explicit explanation of the role of recreation in SFM is missing. This is a weak result as recreation is one fundamental aspect of SFM (Chapter 1, Figure 1).

Subgroup B7 "Legal, institutional and economic framework for forest conservation and sustainable management" shows a diverse picture among the four forest laws. The Japanese Basic Act does not include a definition of the different types of forest ownership. This is a weak result as ownership information is crucial for establishing stand access. Public participation in conflict management is briefly addressed in the Japanese Basic Act, but is not addressed in the other three forest laws. This is an interesting result as it may address the need of public participation when conflicts cannot be settled based on enforceable law, which is the most significant contradiction among the four forest laws. While BWaldG, BayWaldG and ForstG list sanctions in case of law violation, the Japanese Basic Act does currently not prosecute law violations.

6.3.3 Unaddressed 1992 UN Earth Summit Values

The results for the selection of 1992 UN Earth Summit values for SFM, which have not been added to the criteria and indicators of the forest working groups Forest Europe and the Montréal Process, show an advantage of the Japanese Forest and Forestry Basic Act. Neither the promotion of women in all aspects of forest management, the conservation and sustainable development of forest policies, nor the control of pollutants is mentioned in any of the three forest laws. However, the strengthening of forest education and training is addressed in detail the Japanese Basic Act and regulated in BayWaldG. The promotion of domestic forest products is addressed in rich detail in the Japanese Basic Act but is not mentioned in the respective German forest laws, BWaldG and BayWaldG.

6.3.4 Evaluation based on Forest Law and Policy Model

In Table 19: Evaluation of Forest Laws based on Principles for Forest law and Policy, the four forest laws were compared based on the six key elements of forest law and forest policy model of Lindsay et al. (2007).

(1) Legally Binding

Forest law was passed by Head of State and its articles are legally binding for all people.

(2) Rights & Duties on Vision and Goals

Forest law specifies rights and duties based on a national forest vision and/or goals.

(3) Explicit Formulation

Forest law is explicit enough to settle judicial dispute in an equal and universal fashion.

(4) Approved & Passed by Head of State

Forest law is amended and adopted by Head of State through legal or constitutional procedures.

(5) Legal Action Necessary to Modify

Forest law requires constitutional or another legal procedures to make amendments.

(6) Law Enforcement and Penalties

Forest law has judicial powers to punish law violation.

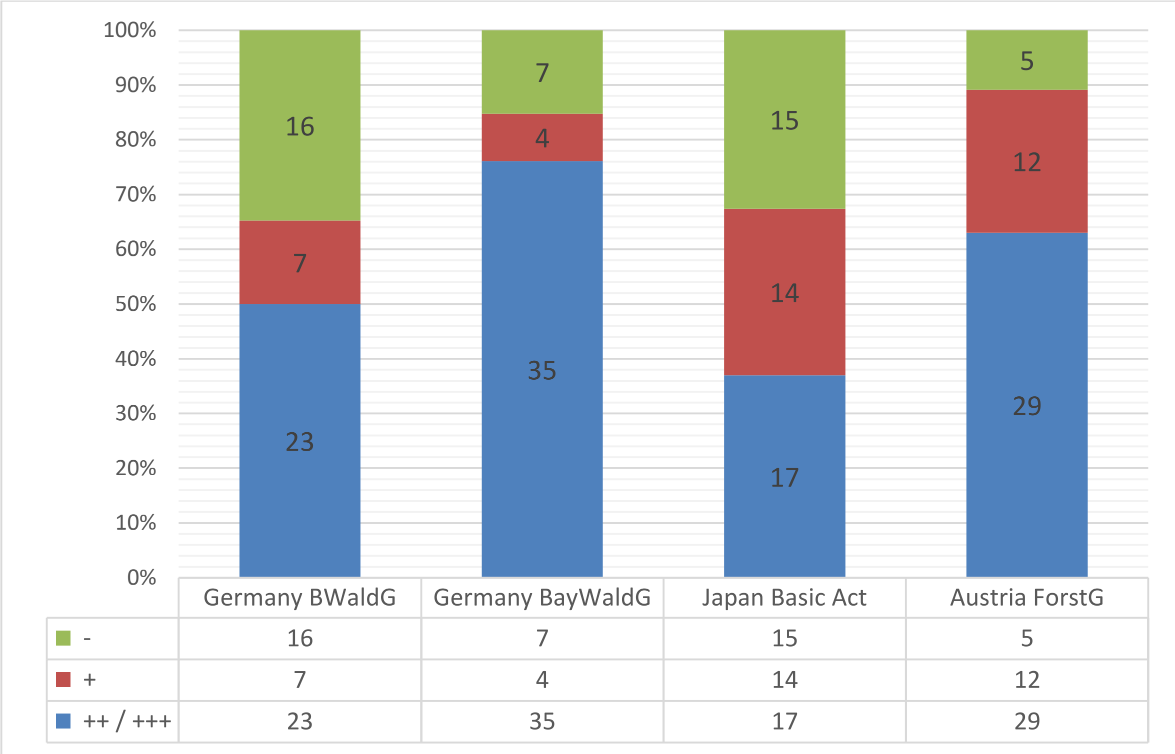
BWaldG and the Japanese Basic Act were evaluated as not meeting the model requirements for Explicit Formulation because criteria and indicators are addressed in detail fifty per cent or less (Figure 24). In addition, the Japanese Basic Act did not meet the requirement for Law Enforcement and Penalties, as it does not list judicial measures to punish non-compliance (Table 17, B7).

Table 19: Evaluation of Forest Laws based on Principles for Forest law and Policy

Key Elements of Forest Law	BWaldG	BayWaldG	Japan Basic Act	ForstG
Legally Binding	✓	✓	✓	✓
Rights & Duties on Vision and Goals	✓	✓	✓	✓
Explicit Formulation	X	✓	X	✓
Approved & Passed by Head of State	✓	✓	✓	✓
Legal Action Necessary to Modify	✓	✓	✓	✓
Law Enforcement and Penalties	✓	✓	X	✓

Source of model: Lindsay et al., 2007

The number of briefly formulated articles in the Japanese Forest and Forestry Basic Act, that are related to the predefined and analyzed SFM criteria and indicators, is approximately twice as high compared to BWaldG and in comparison to BayWaldG, more than three times as high. Of the 46 analysed SFM criteria and indicators, 29 are either briefly or not mentioned in the Japanese Basic Act. 17 of the 30 criteria and indicators that are mentioned in the Basic Act are addressed in detail. On the other hand, in the Bavarian BayWaldG, 11 of the 46 criteria and indicators are either briefly or not mentioned. 35 of the 39 criteria and indicators that are mentioned in BayWaldG, are well addressed in detail. As for BWaldG, of the 46 criteria and indicators, 30 are mentioned and half are addressed in detail. A comparison of forest law formulation detail of the four forest laws compared, is shown in Figure 24. ForstG shows similar characteristics to BayWaldG and has the least number of unaddressed criteria and indicators.



Note: + (enf.) included in ++/+++ of ForstG

Figure 24: Summary of forest law degree of detail

Law violation punishment is the second forest law characteristic the Japanese Basic Act does not meet. Unlike BWaldG and BayWaldG, the enforcement of forest laws by use of prosecution and penalties, in case of law violation, is not stated within the law.

6.4 Conclusion

Forest laws and policies are important instruments to facilitate, achieve and maintain SFM in order to take best advantage of the benefits that forests deliver to society. The forest law analysis of BWaldG, BayWaldG, ForstG, as well as the Japanese Forest and Forestry Basic Act has delivered insights to the strengths and weaknesses of each law in regards to SFM. The Japanese Basic Act does not address the preservation of biodiversity. To address biodiversity, Japan has a separate law, the Basic Act on Biodiversity, however, biodiversity is a significant factor in forest management and must also be thoroughly addressed in a forest law, also to decrease the likeliness of misinterpretation.

The Japanese Forest and Forestry Act is the least detailed forest law of the four. Moreover, it does not include any penalties and prosecution measures in the event of law violation. It does not meet two of the six requirements of a forest law based on the key elements of forest law and forest policy model by Lindsay et al. (2007). In order to improve the SFM aspect of the Japan Forest and Forestry Basic Act, it needs to be amended to address and enforce more SFM criteria and indicators. Especially criteria and indicators in the subgroups B1-7 require amendment. Also, law enforcement must be added to fully fulfill the requirements of a forest law.

International working groups suggest that SFM criteria and indicators need to be sufficiently addressed. However, none of the four analyzed forest laws addresses all criteria and indicators of Forest Europe and the Montréal Process. Comparing the two German forest laws, it can be noted that BayWaldG contains twelve more criteria and indicators in detail than its national counterpart. However, as specified in BWaldG, this law is simply providing a general framework of visions and goals and points out the areas of responsibility of state forest law for local implementation.

Interestingly, BWaldG and the Japanese Forest and Forestry Basic Act address visions and goals in a somewhat similar way due to the comparable degree of detail. However, unlike its German counterpart, Japan does currently not have prefecture level forest legislation, which addresses SFM more specifically for local implementation. If Japan wants to improve nationwide forest management and lead it towards sustainability, prefecture-level forest legislation should be considered, or national forest law should be amended to become more SFM specific. The Austrian ForstG shows that detailed national forest law is possible.

In addition, unlike the German forest laws, Japanese forest legislation does not address forest monitoring and supervision. In order to maintain healthy forests, it is crucial to regularly inspect forests by trained professionals. The German public forester system has proven to be effective in monitoring and balancing the needs of ecology, economy and society, regardless of public or private. Japan has a larger and more complex forest area than Germany and supervision through foresters can support the quality of forest management significantly. Japanese forest law describes a vision, but it does not formulate nor implement strategies in the form of enforceable law. The implementation of a forester system could be the next significant challenge of Japanese forest legislature.

Summary

Chapter 6 provided a comparative analysis of four forest laws in three countries measuring how detailed Criteria and Indicators of SFM are addressed in each of these laws. This analysis was performed to discuss the effectiveness of each law as a local implementation tool. After an introduction in which the concept of SFM and its part in international forest legislation was briefly presented, the differences of Japanese, Austrian and German forest law in terms of application process were shown. The applicability of SFM Criteria and Indicators in each of the compared nations was highlighted. Following, the methodology of the analysis and its limitations were explained. Relevant results of the analysis were discussed in detail. It was discovered that the Japan Forest Basic Act and the German BWaldG show similar characteristics in terms of addressing SFM Criteria and Indicators. Implications were discussed. After this discussion, each of the four forest laws was evaluated by the model for principles of forest law and policy by Lindsay et al. (2007). It was shown that the Japan Forest Basic Act shows stronger characteristics of a forest policy than of a forest law. Weaknesses for local implementation of SFM were derived and discussed. The study was concluded with a discussion regarding the advantages of forest law enforceability.

References

Bavarian Forest Law. (2005). *Waldgesetz für Bayern (BayWaldG).*

FAO. (2008). *What is sustainable forest management*. Retrieved August 30, 2013, from FAO: http://www.fao.org/forestry/sfm/24447/en

FAO. (2010). *Developing effective forest policy - A guide.* Rome, Italy: Electronic Publishing Policy and Support Branch.

Fujiwara, T. (2002). *Integration of biological diversity in new policies for forests and forestry in Japan.* Forestry and Forest Products Research Institute, Japan. Accra, Ghana: CBD/UNFF Workshop on forest and biological diversity.

Gain, D., & Watanabe, T. (2013). Forest Management in Japan: Application Issues of Sustainable Forestry and the Potential of Improvement through Accredited Forest Certification . *Symposium on Social Management Systems*.

German Federal Forest Law. (1975). Bundeswaldgesetz (BWaldG).

Grober, U. (1999, November 25). *The inventor of sustainability.* Retrieved July 22, 2013, from Die Zeit Online: http://www.zeit.de/1999/48/Der_Erfinder_der_Nachhaltigkeit

Japan Forest and Forestry Basic Act. (1964).

Lindsay, J. M., Christy, L. C., Di Leva, C. E., & Takoukam, P. T. (2007). *Forest law and sustainable development - Addressing contemporary challenges through legal reform.* Washington DC: The International Bank for Reconstruction and Development / The World Bank.

Lohberg, R. (2009). *Geschichte der Forstwirtschaft.* Retrieved July 21, 2013, from wald.lauftext.de: http://wald.lauftext.de/vom-wald-zum-forst/geschichte-der-forstwirtschaft/index.html

Matsushita, B., Xu, M., Onda, Y., Otsuki, Y., & Toyota, M. (2010). Detecting forest degradation in Kochi, Japan: ground-based measurements versus satellite (Terra/ASTER) remote sensing. *HYDROLOGICAL PROCESSES*(24), 588-595.

MCPI. (2009). *Criteria and indicators for the conservation and sustainable management of temperate and boreal forests.* Retrieved August 28, 2013, from The Montréal Process: http://www.montrealprocess.org/documents/publications/general/2009p_4.pdf

Ota, I. (2010). Forest law and policy developments in Japan. *Working Papers International Series Forest Policy and Forest Economics*, pp. 3-11.

Chapter 7: Institutional Analysis

7.1 Introduction

Various sustainability approaches have been developed to improve ecosystem services in planted industrial forest for the improvement of stand stability and vitality. Governments promote sustainable forest and multifunctionality to maximize ecosystem services. But, despite this promotion, local level forest management is often not as effective as expected. Recent research analyzes the management of industrial forest from an ecosystem perspective to identify institutional, site situational and stand management related factors that cause, prevent or mitigate ecosystem service damage. Forest ecosystem services can be generally categorized into three main sustainability functions, and be of economic (production of wood and other tangible forest resources), societal (protection from wind, landslides or snow, recreation and human health), and environmental (biotic and genetic diversity) nature. Taking full advantage of ecosystem services minimizes the risk of forest damage which may affect one or more of these three functions. Planted industrial forests suffer from ecosystem service hazards by external or internal, man-made or natural forces. The consequences of ecosystem service damage can lead to serious damage to forest inventory, poor water purification, loss of biodiversity, or result in the spread of hard to control pests. As planted industrial forest is a man-made ecosystem, damage cannot be prevented or effectively mitigated without addressing risks generated by the relevant organizational and institutional environments. This study presents an institutional analysis of unsustainability risk causality in private industrial forest from an ecosystem perspective in Kochi Prefecture, Japan, using common ecosystem service damage that affects the three main sustainability functions. Kami Forest Owners' Association (FOA) in Kami City was selected as the main FOA, as it is considered one of the most influential FOA in Kochi Prefecture and even in whole Japan. This research offers basis for a less complicated analysis of ecosystem service hazards and provides causal clarity at different institution levels.

7.2 Literature Review

Much research in forest management in recent years has focused on the application of sustainable forest management (SFM) into public policy aiming the preservation of the Earth's forests (FAO, 2012; Sanjay and Audun, 2003). Most forest goods and services are not marketable but are of essential value for sustaining human life. SFM targets environmental conservation and the sustainable production of wood and non-wood resources (Chen and Innes, 2013; Day and Perez, 2013; Sato et al., 2006). SFM provides an optimum balance of ecosystem services (also frequently referred to as environmental services) through focus on multifunctionality, while mitigating the effects of climate change (Smith, 2002; Kirschbaum, 2000). It is generally accepted that SFM has become an important key element towards sustainable development (Knauf, 2014; Stupack et al., 2011).

Much attention has been paid in Japan to improve the condition of industrial forest through the implementation of multifunctional forestry into local communities. As a result, the forestry industry and surrounding ecosystem management has become refined to:

(1) understand the issues for local implementation, and improve the technological efficiency and international competitiveness of timber production from the planting stage to harvest,

(2) improve communication and involvement of private forest owners for stand access,

(3) assess growth characteristics of forest areas in terms of long-term productivity,

(4) improve legal frameworks including governmental support schemes, and introduce certification schemes for a fair and effective realization of multifunctional forests.

In Japan, wide areas of mountain forests lost their forest cover due to high utilization of wood during WW2. These areas were widely reforested as hinoki (Chamaecyparis obtusa) and sugi (Cryptomeria japonica) even-aged monoculture industrial forest during Japan’s postwar reforestation project (Totman, 1998). Such plantations, if viewed from an economic perspective, can be considered an effective return on investment. However, coniferous monocultures are reported to be coupled with powerful long-term threats to sustainability affecting ecosystem services (Rist and Moen, 2013) Plantations, especially even-aged monocultures, sustain insufficient wildlife diversity, act as ideal habitats for rapid and difficult to control population increase of certain creatures, due to missing natural predators (Cannell, 1999).

In the literature, forest ownership can be categorized into four classes: industrial, non-industrial, institutional and public class (Kant and Alavalapati, 2014). Responses among these classes regarding economic objectives and institutional mechanisms to influence them can differ remarkably, with industrial and institutional owners usually operating towards profit maximization goals (Anderson and Lundmark, 2016). Ownership of nearly 80% of Japan's industrial forest is distributed among mainly non-agricultural small-scale private owners which makes industrial forest ownership in Japan highly fragmented. Of the approximately 2.5 million private forest owners, close to 1.5 million owners hold each less than one hectare of forestland (Ota, 2007). Therefore, the behavior of these forest owners takes a central role in sustaining forest ecosystem services (Schmidthüsen and Hirsch, 2010) and in the SFM implementation efforts of the Japanese national government, in accordance with the sustainability criteria and indicators of the Montreal Process (2015). The Montreal Process is an international working group found in 1994 which targets the development and implementation of criteria and indicators for the conservation and sustainable management of forests in temperate and boreal regions. Japan is one of its twelve member states which together account circa 50% of the world's forests (Japan Forest Agency, 2009).

Institutional drivers influence the behavior of forest owners in regards to strategies that impact sustainability promoting criteria. Such drivers commonly include education, regulation, technical and management assistance, and financial incentives (Jacobson et al., 2009). As forest regulation is not enforceable in Japan (Gain and Watanabe, 2013), subsidy schemes are currently the main instrument to motivate forest owners to engage in forest management activities that promote sustainability, and as a result, to increase access to private industrial forest by sharing the cost of timber production. However, such cost-sharing incentives are reported to have little impact on changing owner behavior, raising the question if financial incentives are an appropriate instrument for promoting SFM (Schaaf and Broussard, 2006). In the study site of Kochi Prefecture, the subsidy scheme for the revitalization of private industrial forest is used as such a monetary incentive to increase the access to private forest. Previous research has shown forestry subsidies seldom fulfill their economic and environmental objectives (Sayer et al., 2004). Forestry subsidies in Kochi Prefecture are no exception. Notably, large areas of Japanese red pine (Pinus densiflora) plantations show strong signs of degradation and damage of the forest ecosystem (Matsushita and Taguchi, 2011). In addition, Kochi Prefecture has frequent reports of browsing incidents especially in newly planted industrial forests. Viewing planted industrial forests from an ecosystem perspective is a way of evaluating the causation of unsustainability risk as a whole, instead of focusing on specific forest functions.

Institutional Analysis

Institutions are socially constructed rules and norms governing individual or group behaviors (Schotter, 1981). Institutional factors explicitly explain growth processes. North (1990) demonstrates that institutional factors (e.g., rules, norms, habits etc.) can affect growth processes and explain differences across countries. Acemoglu and Robinson (2008) explore development processes of several countries based on their institutional settings. The authors found that institutions could affect individuals, as well as organizations. Rodrik (2003) provides similar results where institutions influence growth and development processes. According to Thornton et al. (2011), institutional analysis is a helpful research method for improving entrepreneurial decisions. Researchers applying institutional analysis in entrepreneurship related topics are numerous (Aidis et al., 2008; Salimath and Cullen, 2010; Urbano and Alvarez, 2014). In addition, institutional analysis has also been frequently applied in the field of construction management (Rowlinson and Jia, 2015), nuclear disaster research (Aoki and Rothwell, 2013), and water management (Franzen et al., 2015). In the field of forestry, institutional analysis studies can also be found. For instance, Primmer (2011) conducted an institutional analysis of the integration of biodiversity conservation into forestry in Finland by combining policy implementation and organizational adaptation. Results indicate the necessity of combining these two traditionally segregated approaches. Caballero (2015) conducted institutional analysis of community-based forest management in Galician. The results highlight the importance of communal forests in Galician. These previous studies have demonstrated the suitability of institutional analysis to identify causalities of certain issues showing interconnections of institutional factors while highlighting areas for adaptation of regulation.

In this analysis, institutions refer to man-made rules used by agents at various levels when vertically interacting within systemic, environment related situations (Ostrom, 2005), which then horizontally affect forest owner behavior at each level. Looking at this vertical-horizontal relationship is a significant new step to observe how factors affect forest owner behavior. A growing number of researchers are particularly interested in the way institutions positively or negatively influence processes related to ecosystems (North, 2009; Aoki, 2001). Most ecosystem services are common-pool goods or resources necessary to sustain life. Institutional analysis has not yet been conducted to identify unsustainability risk causality in private industrial forest in Japan. As forest management issues are complex in Japan and field operations do not operate with a clear long-term strategy (Fichigami et al., 2016), we believe that institutional analysis from an ecosystem perspective is a necessary and helpful way for the identification of factors responsible for this situation. Institutions need to be effective in preventing damage and destruction to common-pool goods and resources (FAO, 2005). Therefore, the identified factors affecting sustainable growth and development at each institutional level in the study site will provide useful information for forest managers to improve management instruments and policies for long-term sustainable forestry in private industrial forest.

7.3 Methodology

This study espoused an inductive method and was conducted through a bottom-up approach. Specifically, an exploratory approach was applied to investigate institutional factors at national, prefectural and municipality levels that influence forest owner decisions and field operations, which as a result influence the quality of ecosystem services produced in local forest management. Data was coded with institutional analysis, which was adopted based on the five components of institutional analysis by Hollingsworth (2000) (Table 20), and combined with theoretical coding as the core process in a grounded theory approach (Glaser, 1978; Strauss and Corben, 1990). Institutional analysis can be perceived as the analysis of stakeholders in the governmental sector, NGO, and private organizations that implement or support decisions that lie behind a policy. Deviation analysis was performed as an additional analysis to classify the factors contributing to ecosystem hazards and unsustainability risk at each respective institutional level. A similar approach was adopted by Rowlinson and Jia (2015) to identify factors that contribute to proactive and reactive interventions of illness induced by heat in construction workers. Organizational mapping was employed for an ex-ante examination of the interrelationships of the actors responsible for policy implementation, and to additionally demonstrate the current flow of financial resources. In this additional step we argue that the management of ecosystem services requires autonomy from national governmental planning, to be planned and conducted at local-level to reduce unsustainability risk. This argument is supported by previous research on the mechanisms hindering sustainable forest management in Japan, in which the authors conclude that under current systematic conditions, long-term oriented sustainability strategies can only be implemented if Japan’s forestry can stand on its own (Fuchigami et al., 2016).

Table 20: The five components of institutional analysis

Institutions	norms, rules, conventions, habits and values
Institutional arrangements	markets, states, corporate hierarchies, networks, associations, communities
Institutional sectors	financial system, system of education, business system, system of research
Organizations	
Outputs and performance	statutes, administrative decisions, the nature, quantity and the quality of industrial products, sectoral and societal performance

7.3.1 Collection of data

Data was collected over the course of three years with the aim of developing sustainable forest management (SFM) in private industrial forest in Kochi Prefecture, Japan. Participants and informants included stakeholders from various forest management related institutions and organizations at national, prefectural and municipality levels in Japan, as well as public and private foresters and practitioners, forest owners, forest and ecosystem researchers, and workers in the local wood industry in Steiermark, Austria, and Freiburg, Germany, who are fully or partly familiar with the current forest management situation in the study area. The stakeholders in Japan involved officials from national, prefectural and municipality governments, and forest owners, workers in FOA, forest management students, Environmental NGO representatives, environmental management researchers, and forest technicians in the study area. Of this stakeholder population, a SFM Committee was formed which was involved at different stages of the process of the research. The members of this SFM Committee were representatives of the Prefectural Forestry Department, the Prefectural Forest Information and Technology Center, Kami Forest Owners' Association, and a forester from Austria with an advisory role for ecosystem service management. In addition to discussions in five committee meetings regarding site structure management and the improvement of ecosystem services, the main source of data was a law and policy analysis including subsidy schemes, as well as field notes on the wants, needs and opinions of stakeholders. In a two-day inter-institutional data protocol, 71 questionnaires were collected from stakeholders in Kochi prefecture with professions ranging from student of forest management and forest owner to chief of forest management in Kochi Prefecture.

The questionnaires included questions on perceptions about SFM as a concept and measures regarding effective local implementation, as well as possible short, mid, and long-term unsustainability risks of current management. Data from the questionnaires was separated to reveal quantitative and qualitative data, the latter, to act as a parameter for 13 follow-up semi-structured on-site interviews. These on-site interviews were conducted from April 2014 to

March 2015 in six different predominantly cypress and cedar forest sites where clear-cuts and selective loggings had been performed, with forest workers and supervisors for the collection of more detailed information about ecosystem service damage causalities from where forest works are actually being performed. The on-site interviews involved questions on the procedures regarding stand selection, stand ecosystem evaluation, type of management and future site development. In addition to the two-day inter-institutional data protocol and the follow-up on-site interviews, a focus group discussion (FGD) of forest management experts was conducted in May 2016 to evaluate and discuss the systemic aspect of the Kochi Prefecture Subsidy Scheme for private forest for realizing diverse forest and sustainability from the viewpoint of SFM. In this FGD, focus was put on the effectiveness of this subsidy scheme towards the realization of the forest sustainability goals of the National Biodiversity Strategy of Japan (NBSJ). Lastly, for data coordination purposes, the SFM Committee went on a field trip to Steiermark, Austria to discuss with experienced Austrian private and public foresters the causality of ecosystem damage in the study area given the quantitative and qualitative data collected. This decision was made to get independent feedback from forest managers from a country where private industrial forest is managed from an ecosystem perspective.

7.3.2 Data analysis

Levels of actors were organized into five levels: National level, Prefectural level, Municipality level, Field operation level, and Ecosystem level, with the latter embodying a non-human actor which develops its ecosystem as a result of site conditions and man-made interventions into the forest structure on the Field operation level. The ability of forest to self-develop its ecosystem is the reason why the ecosystem level was added to the analysis. Structural and qualitative developments within the private industrial forest ecosystem has impact on the development of sustainable capital: natural capital (FAO, 1994), institutional capital (or cultivated capital) (Holland et al., 2000) and social overhead capital (Mohammed et al., 2000). The collected data then underwent vertical and horizontal institutional analysis for each of the five factors in Table 20, for theoretical coding in the grounded theory approach (Strauss and Corbin, 1990). Ongoing theoretical sampling was performed for constant comparison and for comparative analysis (Hernandez, 2009). Theoretical sampling was conducted until theoretical saturation was reached. In this core stage of the grounded theory approach, memoing (Glaser, 1978) was conducted to document theories and hypotheses by establishing interconnections among institutional factors (Holton, 2007).

Table 21: Forest ecosystem sustainability criteria

Variable	Criteria
Conservation of biological diversity	Ecosystem diversity; Species diversity; Genetic diversity
Maintenance of productive capacity of forest ecosystems	Forest land and net area of forest land available for wood production Stock and annual increment of tree species available for wood production Plantations of native and exotic species Annual harvest of wood products by volume and percentage of net growth or sustained yield Annual harvest of non-wood forest products
Maintenance of forest ecosystem health and vitality	Forest affected by biotic processes and agents Forest affected by abiotic agents
Conservation and maintenance of soil and water resources	Forest whose designation or land management focus is the protection of soil or water resources Forest management activities that meet management practices or legislation to protect soil resources Forest land with significant soil degradation Forest management activities that meet management practices or legislation to protect water resources Water bodies with significant change in physical, chemical or biological properties from reference conditions
Maintenance of forest contribution to global carbon cycles	Total forest ecosystem carbon pools and fluxes Total forest product carbon pools and fluxes Using forest biomass for energy instead of fossil fuels
Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies	Production and consumption Investment in the forest sector Employment and community needs Recreation and tourism Cultural, social and spiritual needs and values
Legal, institutional and economic framework for forest conservation and sustainable management	Legislation and polices Cross-sectoral policy and program coordination Taxation and other economic strategies Clarity and security of land and resource tenure and property rights Enforcement of laws related to forests Programs, services and other resources Development and application of research and technologies Partnerships Public participation and conflict resolution Monitoring, assessment and reporting on progress

Potential risk factors of ecosystem hazards at each of the levels were then identified through deviation analysis through the criteria and indicators of sustainable forest management as described by the SFM working group The Montreal Process (2015) as shown in Table 21. The risk factors identified through this analysis were then connected to the coded data through institutional analysis and discussed for verification of cause and effect in current stands where ecosystem damage was reported. The relationships of identified risk factors and causes and effects, were organized through the grounded theory approach as described.

7.4 Results

Organizational process mapping in the form of a top-down macro/systems fund flow system among institutions is demonstrated in Figure 25. The forest owner takes a dependent role among five institutional levels being affected by decisions on each respective level. The effects of institutional factors are categorized as effects on ecosystem service performance and effects on the forest owner. The order of results is organized in a bottom-up pattern starting with factors at Ecosystem level as the location of creation of ecosystem service outputs and performance, and ending at the national level where national objectives for SFM are being initialized and transferred to the other institutional levels.

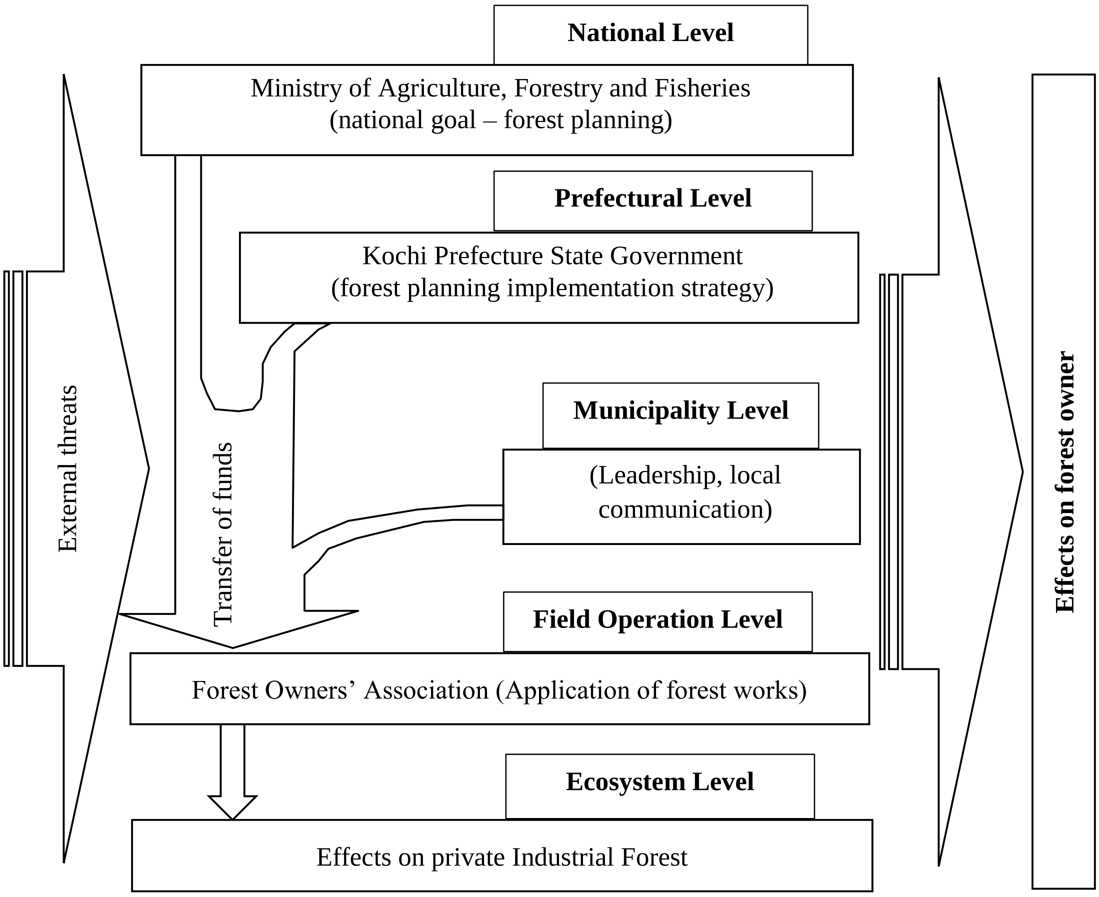


Figure 25: Forest Management fund flow system (macro/systems level processes)

Table 22: Institutional factors affecting forest ecosystem and forest owner

Institutional level	Institutional factors	Effect of factor on forest ecosystem	Effect of factor on Forest owner
Ecosystem level	Site conditions	Understory and soil condition, site productivity	Alertness to on-site and off-site symptoms
	Stand structure	Vertical structures, stand density, species diversity, tree age distribution	
	Surrounding Ecosystems	Surrounding water bodies, natural forest	
Field operation level	Management system	Type(s) of available interventions	Characteristics of owner land use goals
	Thinning	Determinant of operation efficiency and international competitiveness	
	Stand assessment	Basis for type of management	
	Worker behavior	Influences quality of site related works	
	Technology access	Access to technical applications for ecosystem friendly on-site management	
	Non-value added activities	The types of activities within the supply chain that negatively affect value added of merchantable timber	
Municipality level	Leadership	Role in coordinating consensus among local stakeholders	Readiness
	Public behavior	Knowledge of SFM management of the public	
	Public involvement	Active involvement of the public in forest management related decision making	
	Owner integrity	Effort to integrate forest owners in management related decisions	
	Consensus building	Effort to balance local stakeholder forest wants and needs	
Prefectural level	Subsidy scheme	Characteristics of scheme to realize SFM and preserve ecosystem services	Owner response behavior towards financial support mechanisms
	Forest function integration	Integration of forest functions for ecosystem service preservation	
	Education and training	Industry and public knowledge regarding management strategies, technology and importance of preserving and enhancing ecosystem services	
National level	Policy and legislation	Access to private forest, Ownership information, Enforcement and penalties, Characteristics of policy, Description of biodiversity, Conservation and maintenance of soil and water resources	Awareness of principles of SFM and forest ecosystem as determiner for self-action and risk perception
	Power of NGOs	Status of NGOs in management decisions	
	Forest planning	Top-down planning, forest segregation	
	Market structure	Foreign competition, Economy of scale	

7.4.1 Ecosystem level

At the ecosystem level, factors that influence long-term sustainability of forest ecosystems include site conditions and the internal structure of forests, which determines the growth pattern, stand structure, surrounding ecosystem, wildlife threat and climate change.

Site conditions

Site conditions play an important role in the internal development of radial and vertical tree structures and shape the foundation for stable and vital forest. Forest degradation, mainly in unmanaged stands, was found to affect the condition of the forest floor leading to erosion in Japanese cypress stands. This further associates unsustainability risk for forest degradation and landslides. A lack of communication and action to adequately mitigate and avoid a worsening of site conditions at the ownership, municipality and prefectural levels is a sign for insufficient multi-stakeholder management.

Stand structure

The major stakeholders at the level are identified as FOA and the national forestry agency. However, with the trend going towards SFM a conflict between management for production and management for ecosystem can be observed. FOA, which are responsible for local on-site implementation of national forest management strategies, execute the ecosystem enhancement measures such as environmental thinning when access to financial support is provided, however, not with a long-term sustainability perspective in mind. At the end of a rotation period, a final clear-cut determines the temporary end of the forest ecosystem.

Surrounding ecosystems

The quality of surrounding ecosystems, especially water bodies, are direct indicators for the health of the forest ecosystem. Lack of supervision to evaluate environmental outputs of surrounding ecosystems on a regular basis associates with the risk of reaching “a point of no return” where mitigation would not bring sufficient improvement to both forest and its surrounding ecosystems.

7.4.2 Field operation level

At the field operation level factors influencing sustainability by the implementation of on-site management include management systems, the cost of thinning operations, the assessment of the condition of the forest ecosystem, the skill of workers, access to technology and value-added activities.

Management system

FOAs currently execute mainly five types of management interventions in private industrial forest: strip thinning, selective thinning with and without extraction, clear-cutting and reforestation through the planting of new even-aged coniferous forest. Browse protectors are sometimes applied in areas with high browsing risk. The problem of these current management systems is that they do not offer forest owners ecosystem service oriented alternatives to even-aged management such as uneven-aged permanent forest approaches. This is manifested in the attitude of FOA to conduct management for profit maximization. Forest management is only carried out to get access to subsidies, and mid- or long-term perspectives are not considered (Fuchigami, 2016).

Thinning

Forest management interventions including thinning accumulate costs for the use of human and non-human resources on site. The cost of applying these resources is a determinant for efficiency and competitiveness of field operations. While topographical and road infrastructural factors also influence thinning cost due to different intervention complexity, it was identified that the cost of thinning is nearly double the cost of a clear-cut in the study site. This high cost shows the necessity of financial support to compensate for the cost of production cost and the actual monetary timber value. As man-made forest requires care in forest growth stages for ideal development of the forest ecosystem, thinning cannot be neglected. A breakdown of thinning cost is needed. Such transparency in how the cost for thinning is determined by FOA provides detailed understanding for the practices necessary to lower these costs.

Stand assessment

Assessment of forest condition is found to be focused on monetary rather than ecosystem values. For example, FOA provide an estimate of stand value based on tree size and quality criteria alone. An evaluation of the forest ecosystem is not performed which could be used as a basis whether management intervention is needed to improve ecosystem services. Human resources capable of administering ecosystem assessment under SFM sustainability criteria shapes the basis for the mitigation of stand unsustainability risk.

Worker behavior

The behavior of workers in applying on-site management has an impact on how much damage is caused during an intervention period. Effective skill is capable of minimizing the amount of stand damage, such as soil and stem damage, which directly contributes to the preservation of the forest ecosystem. It was found that workers apply works and utilize machinery with sufficient care which has kept intervention related site damage to a minimum. This associates unsustainability risk causality with planning and strategy related factors at the respective national and prefectural levels.

Access to technology

The application of technology, especially heavy machinery such as harvesters and cable yarders, can influence the amount of damage caused to soil and the risk of damage to stem and understory vegetation. Certain soil harming application such as winches pull logs out of the stand damaging the forest floor. A link between technology and ecosystem service damage is through the selection of harvesting technology that offers an unacceptable tradeoff between cost, profit and conservation, when other, more soil friendly technology is available.

Non-value-added activities

Reasons for FOA higher thinning costs can be drawn when discussing non-value-added activities at field operation level which cause an increase of operating cost. Value-added activities are activities within the supply chain of merchantable timber from stand to log processing that do not unnecessarily lower timber value when progressing among stages. Many non-value-added activities are associated with static, non-human related factors such as complex forest topography. Interviews with FOA officials and the Kochi Prefecture Forestry Division highlighted the problem of high thinning cost through non-value-added activities as a matter of concern. For instance, diameter at breast height limitation suggests maximum log diameters of approximately 35cm. Larger diameters exceed the capacities of local sawmills although larger radial log dimensions possess higher volumes.

Another common non-value-added activity is the frequent moving of timber between harvesting sites, temporary and final stockyards and locations for further wood processing. This leads to two consequences. The first consequence is that managers at the field operation level tend to suggest and produce unsustainable forest structures that deliver as much wood per hectare as possible to reduce harvesting time and cost. The second consequence is that cost factors leave little room for producing more ecosystem effective diverse forest structures that incorporate broadleaf species for which a market is missing at the national level.

7.4.3 Municipality level

Factors at the municipality level define resource management which include leadership, public knowledge and involvement, owner integrity and consensus building.

Leadership

Unlike many nations In Europe where municipality governments guide the on-site management of forestry businesses, and the needs and wants of private forest owners to go in accordance with sustainability principles exists, such local leadership is currently not available in Kochi Prefecture. Yamaba and Nakagoshi (2000) show the need for multi-stakeholder participation due to dynamics in the wood market, as well as policy development. A serious problem in Japan is the increasing loss of interest of private forest owners in managing their forest land. Subsidies are no longer enough of an incentive for active participation in many areas (Matsushita and Taguchi, 2011; Hasegawa et al., 2013).

Leadership shapes the priority of forest management implementation in the way resources are allocated from and to the forest site. For example, a forest-site-coordinator communicates the necessity of ways to enhance ecosystem services in a selected private industrial forest stand providing practical solutions for short-, mid- or long-term realization. Such leadership could be an effective way to gradually adapt the willingness of forest owners and FOA to rethink management objectives from profit maximization to ecosystem service maximization, similar as in the theory of Integrated Governance where practices need to be accomplished in order to develop a shared sustainable strategy (UNEP, 2014).

Public behavior

Public behavior influences the attitude of the public towards the management of forest. It can stimulate or enables the application of measures to mitigate the risks for ecosystem hazards. It describes the feeling and appreciation of an individual for the ecosystem services forests provide and the wish for its conservation. The fact that degrading forest sites, large areas of clear-cuts, and poor quality of water bodies are not generally recognized is a sign of lacking public behavior. Public behavior is important as a driver of forest ownership and the industry to steer management for the equal production of ecosystem services.

Public involvement

Public involvement is the governmental acceptance and consideration of active public attitude in events of sensible hazards that may indicate damage or a neglecting of one or more forest ecosystem services. Public involvement can range from individual reporting of hazards to relevant administrative offices, to public mobilization of resources for improvement or mitigation. Currently, public involvement can be observed in cases where waste can be found in forest but other ecosystem service conservation related cases which include forest structure related issues are still uncommon. Public involvement can be utilized as a source of human resources for shaping local sustainability.

Owner integrity

The forest owner is the fundamental stage of forest management. The attitude of the forest owner is in many cases conclusive in how forest structure is established and how its long-term management is applied. Owner integrity is the effort to involve the forest owner in forest management related decisions. In the current system, most forest owners who do not wish to take part in the management of their forest are encouraged to temporarily transfer the rights for the management of their land to a local FOA. With a simple signature, the responsibility of forest owners to engage in management related decisions is completely transferred to the FOA. Owner integrity is a necessary condition in which owners must be committed in the sustainable management of their forestland.

Consensus building

Consensus building is needed when conflicts of opinion collide and hinder decision-making. However, consensus is necessary for the shaping of decisions that go in harmony with all relevant stakeholders. An example for insufficient consensus building is the effort of NGO to improve the condition of river banks which are part of forest in one area of the study site. In many cases money could not be raised to address the identified ecosystem issues in these river banks unless they could be mitigated with currently available thinning subsidies. The systemic inflexibility regarding the consensus building for alternative forest management measures should be reconsidered to make sure ecosystem service management is not restricted to institutional factors.

7.4.4 Prefectural level

At the Prefectural level, factors refer to issues related to the supply chain of the forestry industry, and the preparation of management strategies for the implementation of SFM. These include the Kochi Prefecture subsidy scheme for private industrial forest, the integration of forest functions in decision-making processes regarding forest structure, and education and training in relation to SFM.

Subsidy scheme

The Kochi subsidy scheme for private industrial forest is designed at national level to realize national forestry objectives. Up to 72% of thinning cost is subsidized. This is a rate which is close to average in Asia (Bull et al., 2006). The problem in regards to the management of ecosystem services is that at such a relatively high rate private forest owners are encouraged to maintain or afforest new areas of similar coniferous even-aged forest instead of forest with higher tree species diversity that possess more varieties of vertical structures. Currently, the subsidy scheme is necessary as a tool to create consensus with forest owners. Due to low roundwood prices, subsidies are needed to meet annual logging goals. Without these financial incentives, most forest owners would not engage in management. However, focus group discussions have revealed that excessive thinning at 30% intensity, as suggested by the subsidy scheme, may be counterproductive in the effort to design forests with higher species diversity.

Forest function integration

Forest function integration refers to management that focuses on all forest functions rather than on one exclusively in order to make sure that certain ecosystem services are not lost. Forest function segregation is observed in a variety of economic, logistic and socio-demographic stress conditions. Economic pressure because of falling timber value, high extraction costs, rapidly rising demand of wood, forest areas that are difficult to access, demographic change, and forest owners not engaging in forest management. These five factors that often lead to a segregation of the management of forest functions are present in Kochi Prefecture. Focus group discussions showed that the above mentioned subsidies do not contribute to multifunctional forestry which would be an integrative approach. The terms multifunctionality and environmental preservation in the subsidy objective statements are too broad to be achieved by mainly thinning works.

Education and training

Forest management education is still a lack of prospect, or lack of prospect opportunity in Kochi Prefecture. What reasons, other than profit are there to be or become a forest owner? What benefits, other than personal profit maximization are there that make it worth to be or to become a forest owner. How can a forest owner be actively involved? How should FOA change to provide more alternatives to even-aged forest management? Access to education that addresses these questions and that addresses alternative management opportunities may greatly increase reasons for forest owners to be actively involved in forest management. Content-based education with specific practical examples of the advantages of forest integration, and how to implement the concept of SFM for ecosystem service maximization in Kochi, can stimuli the interaction between the socio-cultural system and the forest ecosystem.

7.4.5 National level

Factors identified at the national level contain type of policy and legislation, power of non-governmental organizations, forest planning, societal culture and market structure

Policy and legislation

Forest laws and policies are important instruments for the local implementation of SFM to maximize forest ecosystem services. An analysis of the Japan Forest and Forestry Basic Act has delivered insights to the strengths and weaknesses in regards to SFM implementation. The Japan Forest and Forestry Basic Act aims the implementation of sustainable forestry in the prefectures of Japan (Ota, 2010). It was found that the analyzed law:

- does not warrant access to private forest

In general, access to forest is necessary for the application of management. Without this access, factors contributing to a damage of many ecosystem services such as water purification, biotic diversity, or the production of high quality timber, cannot be mitigated which may lead to degradation and long-term unsustainability.

- insufficiently describes the characteristics of forest ownership

Clear description of forest ownership is necessary for the identification ‘when’ and ‘how’ one becomes a forest owner. This includes forest area, species and location related information, and information how ownership should be treated in events where ownership is transferred to a third party or by inheritance. This conflict affects the assignment of manageable forest, especially in events when intervention is necessary to improve or mitigate the ecosystem aspect of forest.

- does not provide a benchmark for the enforcement and penalization of law violation

Forest laws have an equal effect on everyone in a society and are protected by law enforcement. Violation can or will result in legal action. A policy possesses lower legal power than a law. The Japan Forest and Forestry Basic Act does not address the enforcement of forest law.

- shows characteristics of being a forest policy rather than law

Based on the key elements of forest law and forest policy model of Lindsay et al. (2007), the Japan Forest and Forestry Basic Act did not meet the requirements for being a forest law in two elements: Law enforceability and penalties, and explicit formulation (Gain and Watanabe, 2013).

- does not address the preservation of biodiversity

To address biodiversity, Japan has a separate law, the Basic Act on Biodiversity, however, biodiversity is a significant factor in forest ecosystem services and should be addressed in forest law in a specialized way.

- only briefly addresses the importance of conservation and maintenance of soil and water resources.

Water and soil condition influences the environmental productivity of stand and surrounding ecosystems. Soil erosion and a drop in water quality are direct results of insufficient soil and water conservation.

Power of NGOs

NGOs play an important role in balancing stakeholder wants and needs and in shaping the type of forest-structure related management to ensure that focus on the production of ecosystem services remains on all forest functions. They provide sources to insight, research and expertise to enhance the forest ecosystem. A key factor for current ecosystem risks in Kochi private plantations is the lack of NGO power and NGO consultation. This can be explained in the one-sided approach of governmental bodies in implementing national and prefectural forest plans at local level. Governmental structures allow little room and resources for alternative management methods.

Forest planning

Through the Forest Planning System national, prefectural and municipality forestry strategies are planned and implemented in private industrial forest. This plan is updated every five to fifteen years (Fujisawa, 2004). Forest planning focuses on even-aged monoculture management strategies which leave little acceptance for alternative management methods, which would involve stand structures more capable of producing balanced ecosystem services. The ecosystem aspect of forest is mentioned, but the chances of improving ecosystem services by, for instance, increasing tree species diversity or introducing permanent forest concepts, for ensuring long-term sustainability, are not yet part of this system.

Market structure

(1) Production and allocation inefficiency

A market is a place where supply and demand operate and where buyers and seller interact to trade goods and services. In Kochi, the production of wood in industrial forest is supported with public funding to compensate for high extraction costs. The production of the forest function recreation can be considered as low as monocultures do not aesthetic incentives for a visit. In addition, access to private industrial forest is restricted. In comparison, in many European nations recreation is a free accessible, non-rivalrous public good and not a club good as in Kochi. Due to the even-aged, monoculture structure of industrial forest, the production of most public goods is low. Carbon storage is very high, however, undynamic due to an even-aged forestry approach.

(2) Monopoly

In Japan, the majority of forest works are conducted by FOA, which have no obligation to maximize value-added timber (Fuchigami et al., 2016). Only a very small portion of works is conducted by self-administered management by forest owners or small private businesses. This centralized monopoly structure allows FOA to set prices for forest works relatively effortlessly.

(3) Missing markets

Markets for broadleaf timber are still widely undeveloped in Japan. Works that involve broadleaf timber extraction can insufficiently be compensated by the sale of broadleaf wood. Markets for broadleaf timber fail to form due to focus on coniferous species.

(4) Incomplete market

Production of roundwood in even-aged coniferous monocultures is considered the most cost efficient approach in forest management. However, production in even-aged coniferous monocultures fails to take into consideration the negative effects of this approach on passively related third-parties, and the environment, which are indirectly affected. Many public goods of forests are produced inefficiently (lack of public goods) and may cause environmental damage and unbalance as spillover effects. The market fails to prevent these spillover effects.

7.4.6 Effects on forest owner

At the horizontal level, decisions influencing forest owner behavior include alertness to on-site and off-site symptoms, the characteristics of land use goals, readiness, Owner response behavior towards financial support mechanisms, and the awareness of principles of SFM and forest ecosystem as determiner for self-action and risk perception.

Alertness to on-site and off-site symptoms

Knowledge incorporates all the different factors of the ecosystem aspect of forests from functions, biodiversity, carbon sequestration, water purification etc. This knowledge provides the forest owner with awareness to be and stay alert for making responsible and timely decisions regarding sustainable forest establishment, structure and management. Alertness is active attention by sensory awareness. Alertness includes qualities of being observant to on-site and off-site symptoms, and the preparedness to response in a timely manner.

Interviews revealed that even the fundamental multifunctional role of forest as an ecosystem service provider was not widely known among owners. Some owners interpreted the cause of low or damaged forest ecosystem services solely to the lack of thinning. Without adequate education and training available, answers indicate that current knowledge was likely accumulated through experience, or from other sources at the municipal and prefectural level.

Characteristics of owner land use goals

Personal goals at the ownership level are a driver to invest in stand management to reach a certain desired output. Whilst there are many different attitudes of forest owners ranging from passive and active managers to profit maximization and recreation focused managers, two main characteristics of forest owners were identified: managers for profit maximization and passive managers who want to keep their forest but not be involved in management decisions. This finding relates to ecosystem services that forest managers with an environment focus bring important facilitation in applying management approaches that target the preservation of ecosystem services.

Readiness

Readiness is the preparedness and prompt willingness to engage in management activities when it becomes necessary to preserve the forest ecosystem. Readiness is an important factor for timely response to prevent mid- and long-term hazards. The main factor held accountable for lack of readiness is unsatisfactory profitability of timber. Although financial incentives can improve the readiness of forest owners, however, self-motivation, which is not solely based on economic output but also ecosystem factors, needs to be acquired through education at the municipality and prefectural levels and through a more precise ecosystem approach in general at the field operation level which is stimulated on the national and prefectural levels.

Owner response behavor towards financial support mechanisms

Financial incentives through the subsidy scheme shape the attitude regarding forest management approaches shifting personal priorities. In many cases, introducing financial incentives for public forest management projects, as frequently executed by the Japanese forest planning system, bring about a mere “purchasing” of forest owner participation. This problem has been observed in previous research (Lutz et al., 1994). In addition, agreement to transfer authority to the forest planning system further distances private forest owner management involvement. These types of one-time agreements are not designed for a long-term relationship, and interest shown by forest owners is in most cases simply for the present moment.

Awareness of principles of SFM and forest ecosystem as determiner for self-action and risk perception

Interviews with forest owners revealed that the risks of ecosystem hazards through even-aged coniferous monoculture approaches are much underestimated. Almost all forest owners favorized an economy-focused approach with the typical homogeneous plantation forest arguing that regular thinning alone would mitigate unsustainability risks. Some forest owners argued that environmental preservation of forest would be necessary but did not characterize species diversity as a factor of lower risk. This indicates that studies on risk perception of forest owners should distinguish the impact of different mono- and multi-species approaches.

7.4.7 External threats

Societal change

The population of Japan is expected to decrease by approximately twenty million until 2050. This decrease in population is likely going to affect domestic wood demand, unless the resource wood will find new and alternative ways of utilization. Overstock may become a problem of industrial forest in the future. A decreasing need for management that involves timber extraction may conflict with the need for management for conserving and maintaining these ecosystems. In addition, the forest owner population in Japan is ageing fast (Schindelbeck et al., 2008). An ageing forest owner population associates the problem of forest owners switching attitudes from active and passive management, with the latter being more interested in third party management, rather that self-determined management practices.

Wildlife threat

Wildlife damage is identified in the form of deer browsing. Although mitigation measures have been introduced to decimate deer population and to protect especially young trees from browsing damage, damage is still being reported. A focus group strengthened the need for introducing natural ways of dealing with browsing: “renewal thinning with followed natural rejuvenation can lead to increased food availability, and as a result reduce young tree damage by browsing.”

Climate change

Long-term increase in climatic heat and a change in precipitation patterns are often considered effects that can lead to a shift in site conditions which can change the growth characteristics and growth requirements of certain tree species. A mixing of tree species and introducing alternative tree species are considered ways to enhance forest stability and vitality, mitigating the unsustainability risk climate change may pass.

7.5 Discussion and Conclusion

The analysis presented in this paper identifies institutional factors that affect the ecosystem performance and forest owner behavior at five levels: Ecosystem level, Field operation level, Municipality level, Prefectural level, and National level in the study site Kochi Prefecture, Japan. The existing literature assumes that hierarchical structures can influence stakeholder behavior, as suggested by Rowlinson and Jia (2015) who found that institutional causal factors could interact with each other and do not necessarily translate through the path of the system hierarchy. This study supports findings that factors cascade down the hierarchies of stakeholders, and additionally identifies a vertical and horizontal relationship.

Due to Japan's systematic top-down forest management approach with the law in the top, vertical relationships cause direct and indirect negative horizontal relationships at each institutional level. A key issue identified in this analysis is the impact of unenforceable forest law at lower institutional levels, and the forest owner. This is particularly important in terms of dealing with decision-making processes that involve private forest owners and their motivation in engaging in management. Japanese forest law describes a vision, but it does not formulate nor implement strategies in the form of enforceable regulations. Ota (2010) claims in his study on Japanese forest law and policy that Japanese forest policy is mainly responsible for the current sustainability issues due to its limitation for effectively acting as a framework for implementation of SFM at the field operation level. Top-down planning is less successful than incorporating users of common-pool resources in system developments that match the ecological system on site, and the actions, norms and long-term welfare of its stakeholders (Ostrom, 2008).

Negative horizontal relationships have various effects on the forest owner: little alertness to on-site and off-site symptoms due to lack of awareness of SFM and ecosystem principles, management for profit maximization, and passive management through a system of transfer of ownership rights. These effects affect self-motivation and long-term commitment of the forest owner as they further distance forest owners from playing an active role in management decisions.

As observed in the analyses, the reason for lack of long-term participation is rarely due to lack of capital, but instead lack of available information on market opportunities, access to silvicultural technology, forest law development, and taxation support. Investments that could have been made by private forest owners themselves with proper advice and guidance, are lost with one-time management agreements (Enters et al., 2004). Increased awareness of the principles of forest ecosystems by forest owners through sustainability education, can act as an institutional driver for self-action and better risk perception, which may improve the status quo of not engaging management.

Participation and integration of forest owners is vital at all analyzed institutional levels. Readiness, as part of owner behavior, can be positively influenced by alteration of institutional drivers. The two factor theory of Herzberg (1967) is considered relevant in this issue as institutional drivers can increase satisfaction but also decrease dissatisfaction for SFM. Satisfier factors (e.g. advancement, sense of responsibility and recognition, personal growth) increase the individual's motivation to engage, while hygiene factors (e.g. policies and rules, relations, compensation, working conditions) decreases the individual's dissatisfaction to engage.

Therefore to mitigate vertical and horizontal effects on the sustainability of industrial forest, institutional adaptions must be performed to address a combination of satisfier and hygiene factors.

First, more SFM criteria and indicators of the Montreal Process (2015) need to be addressed in detail and implemented in the Japanese forest law.

Second, forest law must be enforced to allow managers at the prefectural, municipal and field operation level to gain unrestricted access to private forest, and to make clear the responsibility of private owners to be actively involved in management decisions. To foster integrity, forest owner involvement in management decisions should be encouraged by institutional drivers at the prefectural and municipal levels, such as access to market opportunities, and applicable financial support for management interventions that are in the public interest. Involvement of owners in decision-making processes can stimulate networking among owners, which is consistent with research conducted by Boon and Meilby (2007). Such networks initiate synergy effects which have the potential to spread knowledge and expertise, and which have an educational effect on individuals not directly involved in environment related issues.

Third, to improve coordination of stakeholder opinion, the implementation of a forester system into legal structures should be considered. As results show, local stakeholders, especially forest owners are the key to implementing sustainability related objectives. Policies and financial support systems need to incorporate local stakeholder communication to determine whether decisions are appropriate for the target environment (Paulson Priebe and Müller, 2013). Evidence exists that local communities are capable of governing local resources sustainably

(Ostrom, 2008). Findings indicate that the homogeneity of tree plantations and their potential negative effects on the production of natural and man-made capital must be reevaluated, and proper mediation between private and non-private stakeholders through a forester system can play an important role in this process, a result consistent with recent studies (Susaeta et al., 2014; Shigematsu and Sato, 2013).

Fourth, the financial support system of Kochi Prefecture needs to be redesigned. A subsidy scheme that encourages owners to transfer their management rights to a third party that is neither interested nor capable of assessing forest ecosystem condition, should not be considered a sustainable management strategy, as it further distances the public from active involvement in environment related issues. A new scheme should allow the establishment of multi-species forest to improve the production of ecosystem services. Subsidies with the aim of environmental development must not be restricted to forest age, to avoid excessive clear-cutting. Detailed description of subsidy objectives and subsidy schemes designed to meet the unique diverse characteristics of local forests will be vital in this approach. Research in Sweden has shown for instance that relative to spruce monocultures, mixed stands with broadleaf species performed better in terms of biodiversity, recreational and esthetic values, water quality, economic flexibility, and addressed risks associated with anthropogenic climate change (Felton et al., 2016).

It can finally be argued that under current conditions of non-enforceable forest policy, objectives and decisions regarding policy and management instruments made at the national level must integrate as they can influence agents vertically and horizontally. This requires effective and adaptive multi-level institutional governance by providing the resources and necessary freedom for assessment and application of site-specific management at the field operation level. The prefectural and municipal levels hereby need to ensure adequate coordination of these resources while providing institutional drivers in the form of education, market opportunities and stakeholder coordination to effectively steer and improve owner behavior in regards to engaging in sustainable management. In a system of unenforceable forest law, such stakeholder coordination would be impossible to realize under leadership with arbitration capability. Leadership through mediation by ecosystem experts at the prefectural and municipal levels may be an effective possibility to generate long-term decisions, as called for by previous researchers (Fuchigami et al., 2016).

The result of this study can help determinate causal factors to identify the accountability of stakeholders and opportunities to take action for the improvement of forest management.

Existing forest management research does not recognize the current forest management problem of Japan systematically, nor the institutional interrelationship of factors associated with it. This study collected data in Kochi Prefecture, Japan. The region-specific sample is a limitation of this study, however, the data could represent the situation of Japan as a whole, due to policy and subsidy systems being similar, leading to comparable perceptions of forest owners. This study also compares Japanese forest management with other European countries. In future research, studies about sustainable forest management in Japan should focus on cross-national comparison studies, specifically on the coordination and leadership aspect of private forest owners at the prefectural and municipality levels from a long-term forest ecosystem perspective.

Summary

Much research in recent years has analyzed the ecosystem service aspect of forest, while highlighting the need for sustainable forest. Forest management mechanisms at inter-institutional level in Japan have been identified to hinder the implementation of forest management that is focused on the equal production of ecosystem services. This study presents an institutional analysis of unsustainability risk causality in private industrial forest in Kochi Prefecture, Japan from an ecosystem perspective incorporating common ecosystem service hazards that affect the sustainability functions of forest. This was performed with the aim to offer a basis for a less complicated analysis of ecosystem service hazards in industrial forests, and to provide causal clarity at different institution levels. It was found that due to Japan's systematic top-down forest management approach with the law in the top, vertical relationships cause direct and indirect negative horizontal relationships at each institutional level. To mitigate vertical and horizontal effects, institutional adaptions must be performed to address a combination of satisfier and hygiene factors. Under current conditions of non-enforceable forest policy, objectives and decisions regarding policy and management instruments at the national level must integrate. This requires effective and adaptive multi-level institutional governance.

References

FAO. State of the World's Forests 2012. Rome, Italy 2012.

Sanjay, S. and Audun, R. (2003). On the path to sustainability: Integrating social dimensions into the research and practice of environmental management. Business Strategy and the Environment, 12, 2005-2014.

Chen, J. and Innes, J.L. (2013). The implications of new forest tenure reforms and forestry property markets for sustainable forest management and forest certification in China. Journal of Environmental Management, 129, 206-2015.

Day, K.J. and Pérez, D.M. (2013). Reducing uncertainty and risk through forest management planning in British Columbia, Forest Ecology and Management, 300, 117-124.

Sato, N., Marcel, P. and Fukawa, T. (2006). Attitudes of small-scale forest owners to their properties in an ageing society: Findings of survey in Yamaguchi prefecture, Japan. Small Scale Forestry, 5(1), 97-110.

Smith, W.B. (2002). Forest inventory and analysis: a national inventory and monitoring program. Environ. Pollut., 116, S233–S242.

Kirschbaum, M.U.F. (2000). Forest growth and species distribution in a changing climate. Tree Physiology, 20, 309-322.

Knauf, M. (2014). Is the sustainability revolution devouring its own children? Understanding sustainability as a travelling concept and the role played by two German discourses on sustainability. Forests, 5, 2647-2657.

Stupack, I., Lattimore, B., Titus, B.D. and Smith, T. (2011). Criteria and indicators for sustainable forest fuel production and harvesting: A review of current standards for sustainable forest management, Biomass and Bioenergy, 35(8), 3287-3308.

Totman, C. (1998). The Green Archipelago. Universiy of California Press. Rio de Janeiro.

Rist, L., Moen, J. (2013). Sustainability in forest management and a new role for resilience thinking. Forest Ecology and Management, 310, 416-427.

Cannell, M. G. (1999). Environmental impacts of forest monocultures: water use, acidification, wildlife conservation, and carbon storage. New Forests, 17, 239-262.

Kant, S., Alavalapati, J. (2014). Handbook of Forest Resource Economics, Routledge, New York, USA.

Anderson, S, Lundmark, R. (2016). Integrating empirical evidence on forest landowner behavior in forest sector models: a literature review and synthesis. Conference Paper. Lulea University of Technology.

Ota, I. (2007). A forest owners’ cooperative in Japan: obtaining benefits of certification for small-scale forests. (F. a. Nations, Hrsg.) Unasylva, 228(58).

Schmithüsen, F., Hirsch, F. (2010). Private forest ownership in Europe. Geneva timber and forest study paper 26. United Nations Economic Commission for Europe. Food and Agriculture Organization of the United Nations. Geneva, Switzerland.

The Montreal Process. (2015). Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests.

Japan Forest Agency. (2009). State of Japan's forests and forest management. Second country report of Japan to the Montreal Process.

Jacobson, G.M., Straka, T.J., Greene, J.L., Kilgore, M.A., Daniels, S.E. (2009). Promoting sustainable forestry in the northern region. North. J. Appl. For, 26(2), 61-67.

Gain, D., Watanabe, T. (2013). The contribution of forest regulations on the realization of sustainable forest management: a comparative law study of Japan and Germany. Internet Journal for Society for Social Management Systems, 3, SMS13-3086.

Schaaf, K.A., Broussard, S.R. (2006). Private forest policy tools: A national survey exploring the American public's perceptions and support. Forest Policy and Economics, 9(4), 316-334.

Sayer, J., Chokkalingam, U., Poulsen, J. (2004). The restoration of forest biodiversity and ecological values. Forest Ecology and Management, 201, 3-11.

Matsushita, K., Taguchi, K. (2011). The Kyoto Protocol and the private forest policy of local governments in Japan. Small-scale forestry, 10, 19-35.

Schotter, A. (1981). The Economic theory of Social Institutions. Cambridge University Press, Cambridge.

North, D.C. (1990). Institutions, Institutional Change and Economic Performance. Cambridge University Press, Cambridge.

Acemoglu, D., Robinson, J.A. (2008). Persistence of power, elites, and institutions. Am. Econ. Rev., 98 (1), 267-293.

Rodrik, D. (2003). Introduction: what do we learn from country narratives? In: Rodrik, D. (Ed.), In Search of Prosperity: Analytic Narratives on Economic Growth. Princeton University Press, Princeton, NJ, pp. 1–19.

Thornton, P.H., Ribeiro-Soriano, D., Urbano, D. (2011). Socio-cultural factors and entrepreneurial activity: an overview. Int. Small Bus. J., 29 (2), 105–118.

Aidis, R., Estrin, S., Mickiewicz, T. (2008). Institutions and entrepreneurship development in Russia: a comparative perspective. J. Bus. Ventur., 23 (6), 656–672.

Salimath, M.S., Cullen, J.B. (2010). Formal and informal institutional effects on entrepreneurship: a synthesis of nation-level research. Int. J. Organ. Anal., 18 (3), 358–385.

Urbano, D., Alvarez, C. (2014). Institutional dimensions and entrepreneurial activity: an international study. Small Bus. Econ., 42 (4), 703–716.

Rowlinson, S., Jia, Y. (2015). Construction accident causality: An institutional analysis of heat illness incidents on site. Safety Science, 78, 179-189.

Aoki, M., Rothwell, G. (2013). A comparative institutional analysis of the Fukushima nuclear disaster: Lessons and policy implications. Energy Policy 2013, 53, 240-247.

Franzén, F., Hammer, M., Balfors, B. (2015). Institutional development for stakeholder participation in local water management-An analysis of two Swedish catchments. Land Use Policy, 43, 217-227.

Primmer, E. (2011). Analysis of institutional adaptation: Integration of biodiversity conservation into forestry. Journal of Cleaner Production, 19, 1822-1832.

Gaballero, G. (2015). Community-based forest management institutions in the Galician communal forests: A new institutional approach. Forest Policy and Economics, 50, 347-356.

Ostrom, E. (2005). Understanding institutional diversity. Princeton University Press, NJ.

North, D.C. (2005). Understanding the process of institutional change. Princeton University Press, NJ.

Aoki, M. (2001). Toward a comparative institutional analysis. MIT Press, MA.

Fuchigami, Y., Hara, K., Uwasu, M., Kurimoto, S. (2016). Analysis of the mechanism hindering sustainable forestry operations: A case study of Japanese forest management. Forests, 7, 182.

FAO. (2005). Global forest resources assessment. Food and Agriculture Organization of the United Nations. Rome, Italy.

Hollingsworth, R.J. (2000). Doing institutional analysis: implications for the study of innovations. Review of International Political Economy, 7 (4), 595–644.

Glaser, B.G. (1978). Theoretical Sensitivity. Sociology Press, Mill Valley, Calif. 1978.

Strauss, A., Corbin, J. (1990). Basics of Qualitative Research: Grounded Theory Procedures and Techniques. Sage Publications, Newbury Park, Calif.

FAO. (1994). The state of food and agriculture. Food and Agriculture Organization of the United Nations. Rome, Italy.

Holland, A., Crabbe, P., Ryszkowski, L., Westra, L. (2000). Implementing ecological integrity : restoring regional and global enivronmental and human health. NATO science series. Kluwer Academic Publishers.

Mohammed, H.I., Guevara, D., Guevara, R. (2000). Sustainable forest management and global climate change: Selected case studies from the Americas. Edward Elgar Publishing.

Hernandez, C.A. (2009). Theoretical coding in grounded theory methodology. Grounded Theory Review, 3(8).

Holton, J.A. (2007). The coding process and its challenges. The Sage handbook of grounded theory. Thousand Oaks, CA, 2007.

Yamaba, A. & Nakagoshi, N. (2000). Community-based management of rural pine forests in a suburban village of Hiroshima Prefecture, western Japan. Journal of Forest Research, 5, 237-242.

Hasegawa, M., Pulhin, J. M., Inoue, M. (2013). Facing the challenge of social forestry in Japan: the case of reviving harmonious coexistence between forest and people in Okayama Prefecture. Small-scale Forestry, 12, 257-275.

UNEP. (2014). (United Nations Environment Programme). Integrated governance: A new model of governance for sustainability. A report by the asset management working group of the United Nations Environment Programme Finance Initiative.

Bull, G. Q., Bazett, M., Schwab, O., Nilsson, S., White, A., Maginnis, S. (2006). Industrial forest plantation subsidies: impacts and implications. Forest Policy and Economics, 9, 13-31.

Ota, I. (2010). Forest law and policy developments in Japan. Working Papers International Series Forest Policy and Forest Economics, pp. 3-11.

Lindsay, J. M., Christy, L. C., Di Leva, C. E., & Takoukam, P. T. (2007). Forest law and sustainable development - Addressing contemporary challenges through legal reform. Washington DC: The International Bank for Reconstruction and Development / The World Bank.

Fujisawa, H. (2004). The forest planning system in relation to the forest resource and forestry policies. Journal of Forest Research, 9 (1), 1-5.

Lutz, E., Pagiola, S., Carlos, R. (1994). The costs and benefits of soil conservation: the farmers' viewpoint. The World Bank Research Observer, 9(2), 273-295.

Schindelbeck, R.R., van Es, H.M., Abawi, G.S., Wolfe, D.W., Whitlow, T.L., Gugino, B.K., Idowu, O.J., Moebius-Clune, B.N. (2008). Comprehensive assessment of soil quality for landscape and urban management. Landsc. Urban Plan., 88, 73–80.

Ostrom, E. (2008). Institutions and the environment. Economic Affairs, 28, 24–31.

Enters, T., Durst, P. B., Brown, C., Carle, J., McKenzie, P. (2004). What does it take? The role of incentives in forest plantation development in Asia and the Pacific. Food and Agriculture Organization of the United States.

Herzberg, F., Mausner, B., Block Synderman, B. (1967). The motivation to work. Second Edition. Wiley, New York.

Boon, T. E.; Meilby, H. (2007). Describing management attitudes to guide forest policy implementation. Small-scale Forestry, 6, 79–92.

Paulson Priebe, M. E., Müller, J. G. (2013). Extant forest plantations as a potential bridge between social needs and ecological management: a comparative case study analysis. Journal of Environmental Management, 129, 608-614. doi:10.1016/j.jenvman.2013.08.031

Susaeta, A., Carter, D. R.; Adams, D. C. (2014). Sustainability of forest management under changing climatic conditions in the southern United States: Adaptation strategies, economic rents and carbon sequestration. J. Environ. Manage., 139, 80–87.

Shigematsu, A., Sato, N. (2013). Post forest reversal discussion: Restructuring public subsidy system for private forests under the differences of topographic conditions in Norway. Land use policy, 31, 249–258.

Felton A, Nilsson U, Sonesson J, et al. (2016). Replacing monocultures with mixed-species stands: Ecosystem service implications of two production forest alternatives in Sweden. Ambio, 45:124–139.

Chapter 8: Implications of Exploratory Research Findings

The findings of this piece of research so far are yet to be summarized to what was learned and how it can be practically applied at local level in Kochi Prefecture/Kami City today and in the future. Important results including new observations and insights will be discussed and will be linked relevant for realizing the SFM character in SWOT and Cause-State-Effect-Risk analyses.

8.1 Implications of Results

Summarizing discussions and conclusions of chapters 1 – 7, a number of implications can be made on findings regarding independent variables x_1 - x_4 of this research. These implications are following referred to as **Cause**. Statements are made from observations for objectives 1 – 4 for each of these independent variables, and for objectives 5 and 6 to derive risks and chances for SFM.

8.1.1 Implications of Results for Objective 1

- Perform a comparative simulation of annual height and volume growth of Japanese forest with German forest growth performance indices (PI) – **Investigation I**.

The initial problem posed for which this study was conducted was observed disparity of annual volume growth per hectare in natural and industrial forest in Kochi Prefecture, compared to the growth in Germany. Since Germany is known for successful implementation of SFM, an attempt was made to isolate the management factor of forest growth in both regions. This was performed in a simulation to (1) show possible unused growth potentials in Kochi Prefecture, and (2) to support Germany's strategy of managing all types of forest under sustainability principles.

Adding to the conclusions of this sub-study, the most important statements that can be made in terms of implementing local sustainability is probably the identified growth potential in Kochi Prefecture if management was carried out in a similar, sustainable way as in Germany. For economic efficiency, constant annual growth ensures continuous access to wood resources. This condition can be considered an important factor for the development of local forest industries. Therefore, a forest age structure with larger areas of rejuvenated stands may be a superior strategy to achieve constant annual growth. Therefore, it is suggested that Kochi Prefecture implements a forest building strategy capable of achieving an acceptable level of growth stability. This could be achieved by rethinking the duration of forest rotation and/or the introduction of alternative non-even aged forest approaches. Implementation and monitoring of these forest age redesign activities should be carried out by qualified experts in forest growth and forest building concepts. As discussed in "Implications for Objective 2", the implementation and monitoring of this forest building strategy could be made part of the SFM implementation plan for Kochi Prefecture. Due to large areas of industrial forest reforested after WWII, there was a gap of approximately 40 – 50 years in which management activities for these young forests were minor and not achieving much of a return on investment. The forest industry experienced a significant decline in especially this period. Now with these stands reaching a profitable age more management resources are needed than available. Failure to adjust the current forest age structure may lead to a repetition of this unsustainable growth condition.

8.1.2 Implications of Results for Objective 2

- Discuss general implementation issues of SFM in Japan and compare basic industry competitiveness between Japan and Austria – **Investigation II**

The initial problem that was posed for which this study was conducted was the various criticism for the inefficiency of Japan's forestry and the tangible evidence for spillover effects for which forest management could be made responsible. This study tried to put this criticism and visual effects in a logical order from the viewpoint of the concept of SFM.

Adding to the conclusions of this sub-study, the most important statements that can be made in terms of implementing local sustainability are probably the inefficient production of roundwood through <u>uncompetitive production cost</u>, and <u>insufficient stand monitoring</u>, necessary for ensuring a maximization of timber and soil quality during the growing stage. The price of timber, through increasing globalization, is no longer determined solely locally or regionally, but is largely influenced by global markets. Although cost efficient industrial forest in Kami was selected, the even-aged management approach of these forests is arguably not appropriate to minimize and prevent spillover effects as discussed earlier in Chapter 1. From the viewpoint of sustainable development, a strategy must be made that (1) prioritizes the adjustment of production cost to global price developments, and (2) that ensures the building and monitoring of stand structures that maximize economic value and environmental stability. For Kochi Prefecture/Kami City, stand condition monitoring which is in general public interest should be performed by the prefecture through qualified specialists and not be made the responsibility of private institutions. Works of Kami FOA and other potential private forestry business should be reduced to operative activities to further reduce production costs. Such a reallocation of administrative and operative functions among public and private institutions should be execute in the near future since the amount of works in the majority of sugi and hinoki stands, especially those where thinning is overdue, will become more dynamic. Now is a good time and chance for change.

8.1.3 Implications of Results for Objective 3

- Evaluate and discuss the appropriateness of the Kochi subsidy scheme for private forest in regards to achieving national sustainability goals. – **Investigation III**.

The initial problem posed for which this study was conducted was observed ineffectiveness of the Forest Basic Law to act as a framework for local implementation of the concept of SFM. MAFF promotes sustainable forestry, and this study tried to evaluate the appropriateness of the current subsidy scheme for private forest in Kochi Prefecture as a tool to implement national sustainability goals.

Adding to the conclusions of this sub-study, the most important statements that can be made in terms of implementing local sustainability are: (1) <u>Generalized subsidy scheme</u>, (2) a <u>resilience approach</u>, (3) <u>centralized works</u>, and (4) <u>forest owner exclusion</u> in management decisions.

(1) Subsidies can be argued to have the purpose to support a new way of thinking, a strategy, or generally an alternative way of doing things considered to be of higher benefit to society, until the new concept is implemented. In the case of the Kochi Prefecture subsidy scheme for private forest, such a supportive role of subsidies can not be justified. The subsidy scheme has been designed to revitalize the current condition of private industrial forest, however, based on FGD, the national sustainable forestry goals of the NBSJ are unlikely to be realized. A piece of additional research was conducted to investigate the annual usage of subsidies. As can be seen in Table 23, more thinning is performed if there is a higher market demand for roundwood. Figures for Kami City show that in the fiscal year of 2011/12 less than half subsidies were used compared to two years before and later. An interview with Kami FOA about the usage of subsidies

strengthened the conjecture. When asked about the imbalance in annual subsidy usage, officials replied that subsidies go in accordance with the current market situation and are influenced by market demands for roundwood, pulp, chip etc.

Table 23: Five-year history of financial support for private forest in Kami City

Type of subsidy / fiscal year[a]	2009/10	*2010/11*	*2011/12*	2012/13	2013/14
Subsidies for private forest under management planning systems	167,070	115,667	62,676	81,936	139,813
Subsidies for self-administered forest management of private forest	6,123	5,736	1,485	3,233	1,709
Subsidies for reforestation and protection from deer damage[b]	N/A	N/A	N/A	1,441	1,039

[a] figures x 1ooo Yen

[b] Subsidies for reforestation and protection from deer damage were first introduced in fiscal year 2012/13

However, despite the confirmation with officials at Kami FOA, and although much removal thinning is performed each year, the historical financial support data as in Table 20 cannot be taken as indisputable evidence that subsidies are indeed influenced by market demand. Besides removal thinning, funding for non-extraction thinning operations where all timber, even marketable timber, is left in the stand (*Kirisute kambatsu*) is included in the data. Detailed separation of financial support for extraction and non-extraction thinning operation over the five-year timeframe may serve as a stronger source of evidence in the discussion regarding market influenced subsidies.

From the viewpoint of business management, a market influenced subsidy development would be surely understandable, as forest works must be somehow financed. However, it can be questioned whether stands that need immediate management attention in order to avoid environmental damage, really receive adequate timely supervision and action.

Besides current revitalization through forest thinning, the introduction and implementation of financial support for alternative forest condition and biodiversity enhancing subsidies, as well as environmental supervision is suggested. Moreover, to implement national sustainability goals subsidies should be redesigned to at least provide the possibility for a forest owner to receive financial support for the restructuring of an even-aged monoculture to a more environmentally stable multilayered forest. Such forests may not deliver maximum return on investment, however, they can be considered an effective way to decrease the risk for degradation. As an example, a large area of red pine monocultures has been destroyed by insect infestation in Kami City. These forests will achieve little or no return on investment. Non-implementation of the national sustainability goals into the current subsidy scheme may repeat current environmental issues in the future.

(2) Resilience approach can be an important method to improve vitality and stability of forests. However, it should come in combination with a sustainability strategy. Industrial forest, especially in small-scale, is a man-made ecosystem that develops within natural dynamics. Surrounding ecosystems assimilate it which can create unforeseen environmental spillover effects in the process. External factors such as pollution and climate change further intervenes in this development. Such possible internal and external risks should be taken more seriously. Forests develop slowly but damage normally occurs comparatively fast which is why it is necessary to minimize these risks as much as possible. To do so, a sustainability strategy is needed. In Kochi Prefecture, this could be achieved by restructuring the current subsidy scheme for private forest and introducing specific forest building concepts that are more durable against the effects of pollution and climate change, and that are capable of increasing biodiversity.

A restructuring of the subsidy scheme could be accomplished with incorporation of silviculture experts in decision making processes, who are familiar with local forest conditions, and who act in accordance with the sustainability goals of MAFF. Forest owners must be properly educated and convinced to agree to measures that improve the stability and vitality of their forest. Should the current situation continue, the effects of climate change may further decrease stability of industrial forest in Kochi Prefecture/Kami City by making it more vulnerable to pest and other hazards. Similar to tree species, insects and fungi do not react to climate change uniformly but species-specifically. When vegetation periods become longer, more generations can emerge. Trees can profit from climate change, but also can insects and other varmint (Petercord et al., 2009).

(3) Although directly unrelated to subsidies, it was observed that forest works in Kochi Prefecture are largely performed by FOAs. Although strongly promoted in west Kochi, self-administered forest management (Jibatsu) or private forestry administered works are still comparatively low. This observation may suggest a development towards regional centralization of forest works with more or less oligopolistic structures in various regions in Kochi. Although often evaluated as a monopol due to FOAs administering most forest works, few competitors such as self-administered management and a small number of other private forestry businesses that stand in direct competition with FOAs are present. Regional centralization of forest works by FOAs

should be taken seriously. Besides subsidized works for the revitalization of forest, FOAs have access to public funding for various intern competitiveness enhancing activities such as subsidized labor, technology and education. For instance, part of the labor at Kami FOA, as well as machinery such as the MM-Forsttechnik Wanderfalke has been financially supported by the government. Access to funding that create production advantages over Jibatsu or other smaller private forestries generate regional power which can result into regional centralization of forest works.

In economic theory, prices for goods and services may stay the same for relatively long periods to avoid price wars among suppliers. These prices are strongly influenced and set by the market leaders. Although an advantage of an oligopolistic market structure is price stability (FOAs sell the service of forest works, not the actual product of roundwood unless the stand or the trees belong to the FOA), a disadvantage is the risk of cartel formations. (A detailed breakdown of production costs could not be retrieved from Kami FOA. When interviewing officials, the author had the impression that price calculations were performed based on past conduct). For the future, promotion of private investment for small forestry businesses that are able to compete alongside FOAs may have to be considered to lower the risk of regional centralization and the possible formation of FOA cartels.

(4) Although not directly related to subsidies, forest owner exclusion in management decisions could be observed. In various European countries, the forest owner is responsible for the management of his/her own forest. Being expected to have a motivation for being a forest owner, public foresters and forest agencies provide access to free information and guidance on how to implement personal goals regarding the management of forest that are still conform with public law. In the present system in Kochi Prefecture, contracts between private forest owners and FOAs authorize the management of forest on behalf of the forest owner. The owner is paid the profit of selling the wood on his/her land including financial support through subsidies. Forest owners themselves are normally excluded from management decisions regarding stand management, structure and design during a rotation period. Such a forest owner exclusion from management decisions can have the disadvantage of the owner losing interest in forest management and becoming focused on return on investment. Private investments may become insignificant as the connection between forest and owner weakens. Forest owners should be guided, made responsible for managing their land,

and should be effectively incorporated in all management decisions. Failure to do so may not improve management motivation of many forest owners.

8.1.4 Implications of Results for Objective 4

- Analyze and compare to what degree Japanese, German and Austrian forest law addresses and enforces criteria and indicators of SFM – **Investigation IV**.

The initial problem posed for which this study was conducted was observed criticism for the inefficiency of Japan's forest law which has been made responsible for forest management problems in Japan. This study tried to measure and compare the effectiveness of the Japan Forest Basic Act to three other forest laws in Austria and Germany, and to show which aspects of each law are insufficient from the viewpoint of the concept of SFM and its local implementation.

Adding to the conclusions of this sub-study, the most important statement that can be made in terms of implementing local sustainability is probably the non-addressing of all SFM Criteria and Indicators in the Japan Forest Basic Act. Forest laws are needed not only to provide general frameworks, but also to ensure successful sustainable local implementation. Given the current national legislation, Kochi Prefecture cannot formulate its own forest law. Therefore, it is suggested that the national law is changed to enable the enforceability of SFM at local level while incorporating and improving the addressing detail of SFM criteria and indicators. By increasing the detail of law statements regarding how forests are to be managed, and by introducing penalties in the events of severe law violation, regular assessment of stand quality would become a more necessary action to consider by both owners and local administrators to avoid punishment. In the case of Kami City, such quality assessment could be carried out by qualified public SFM experts in Kochi Prefecture. Since natural conditions in Kochi Prefecture is different to those in other prefectures it is suggested that Kochi Prefecture formulates an SFM implementation plan specific for its forests. Successful implementation of this plan could be controlled and monitored by the mentioned qualified public SFM experts, and after acknowledgement by MAFF, could be made an effective part of the Forest Planning System. Specific guidance that ensures successful implementation in private forest is communicated by these experts. This plan would ensure site specific management for Kochi Prefecture. Criticism for environmental and economic ineffectiveness may repeat itself should such legislative changes not be considered.

8.2 Sustainability Risk Management – an sSWOT Analysis

One important challenge of assessing sustainability risk is the identification of interrelationships of interdisciplinary issues. Other than deriving implications for each individual investigation, as it was performed in the beginning of Chapter 8, the processing of information of these implications in order to identify their interrelationships, shall be the next step in this research. For this task, a Sustainability SWOT (sSWOT) (Figure 26) Analysis is performed. sSWOT is a SWOT model that helps to make decisions in collaboration with stakeholders regarding environmental challenges that create risks and chances (Metzger et al., 2012). Unlike regular SWOT analyses, the sSWOT analysis has shown that with a specific sustainability focus, stakeholders could identify new risks and chances that could not be identified with regular SWOT. In addition, the communication of complex issues among stakeholders could be improved (Pesonen and Horn, 2013).

Source: Metzger et al., 2012

Figure 26: Sustainability SWOT

While chances bring potential positive outcomes, risks on the other hand are potentials of loss or reduction of sustainability brought by one or more effects. Risks can worsen current management from the viewpoint of the pillars of sustainability and are the foundation of changing causes and states. The possibility of a risk occurrence and impact may change and become lower or higher over time depending on the characteristics and the impact strength of the effect. Risks and their impacts can be difficult to assess under highly uncertain conditions. Risks can be perceived differently by personal experience, evaluative capability and knowledge. Risk assessment quality can be increased through assessment that incorporates evaluation from experts in various relevant disciplines. To ensure future sustainability, risks and their potential occurrence and impact should be kept minimized.

Definition of risk

In ISO 31000:2009, risk is defined as the effect of uncertainty on objectives.

- An effect is a deviation from the expected - positive and/or negative.
- Objectives can have different aspects (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process).
- Risk is regularly characterized by reference to possible events and consequences, or a combination of both.
- Risk is usually expressed as a combination of the consequences of an event (including changes in circumstances) and the likelihood of its occurrence.
- Uncertainty is the state of deficiency of information related to, understanding or knowledge of an event, its consequences or its likelihood of occurance.

Source: ISO 31000:2009, 2.1

sSWOT Analysis

AS defined by ISO 31000:2009, risk is the effect of uncertainty on objectives. In sSWOT, uncertainty can be classified as the opportunities and threats of reaching the objective, which in the case of this study is therealization of SFM as defined by Montreal Process

The factors of internal origin (Strengths) are various. Kami FOA has access to state of the art forestry technology which is helpful to increase production efficiency. The companies' healthy finance situation, strong national reputation, and its skilled operational workforce provide an excellent framework for the implementation of SFM. The excellent forest location provides wide access to forestland. The climatic conditions are beneficial for efficient tree growth. Factors of external origin (Opportunities) that have the potential to be helpful regarding the implementation of SFM are present. Markets for broadleaf timber are starting to emerge through the growth of local markets for renewable energy. MAFF is promoting the production of roundwood to enhance domestic self-sufficiency. The area of internationally recognized certified forest is still comparatively low. An increase of certified forest has the opportunity to compete internationally in terms of reaching quality standards for the market of certified wood.

Positive and negative capacity to reach target objective: SFM

Factors that are harmful for the realization of SFM were identified. The factors of internal origin (Weaknesses) are various. Forest building and monitoring resources, specifically those aiming the management of stable mixed forests are insufficiently available. Education resources for local implementation of SFM are yet limited. Difficulty in the management of forest owners and lack of financial resources have led to late thinning in various stands. Due to late thinning timber quality has become inconsistent. Complex topography and a yet weak road infrastructure make the utilization of large-scale cost efficient transportation of roundwood away from the site of felling impossible, relying on non-value added economic activities. These activities contribute to comparatively high roundwood production costs. Management strategies specifically aiming SFM are also not yet present. For Kochi Pref. low local competition for Kami FOA may be a weakness. Market theory suggests that competition can have a positive effect on price development and stability.

Positive and negative uncertainty (risk) to reach target objective: SFM

Factors of external origin (Threats) that have the potential to be harmful regarding the implementation of SFM are also present. Due to increasing global competitiveness, also because of high production costs in Kami, production is highly dependent on subsidies. How much longer these subsidies will be available is unclear. Access to forestland is limited in various stands in which owners cannot be identified and contacted due to privacy protection law. The forest age structure for both natural and industrial forest can be considered unbalanced which may result in future timber shortage, and forest degradation should no thinning be practices. An increasing deer population may further intensify browsing damage. Strategies should be formulated to address the potentially harmful factors weaknesses and threats of Kochi Pref. and Kami FOA.

A way to consume forest services and goods without limiting forest ability to provide them shall be examined for the development of an SFM approach. For the development of such an approach, the strengths, weaknesses, opportunities and threats of Kochi Prefecture public administration and Kami FOA are organized in a SWOT analysis in Table 24.

Table 24: sSWOT analysis for Kochi Prefecture and Kami FOA

Positive and negative capacity to reach target objective: SFM	
Strengths (Positive capacity)	Weaknesses (Negative capacity)
Economic strengths - Access to modern forestry technology - Healthy financing (Kami FOA) - Strong reputation in Japan - Skilled operational workforce - Low competition (Kami FOA) Environmental strengths - Productive forest location in Japan Social strengths - Increasing public interest in forest management	Economic weaknesses - Inconsistent timber quality - High roundwood thinning cost - Low regional competition (Kochi Pref.) Environmental weaknesses - Complex topography - Weak forest road infrastructure Social weaknesses - No specific SFM objective - Limited access to alternative forest building and monitoring concepts - Limited access to specialized SFM education for workforce
Positive and negative uncertainty (risk) to reach target objective: SFM	
Opportunities (Positive uncertainty)	**Threats (Negative uncertainty)**
- New market for broadleaf timber - Growth of local market for renewable energy - Promotion of growth of domestic self-sufficiency - Quality increase through forest certification - Joint-venture with Monobe FOA to gain large access to national forest	- Subsidies may stop - Increase of worldwide competitiveness - Lower access to forestland - Diverse forest may never be promoted - Shrinking local population - Biological diversity may further decline - Browsing through increasing deer population
Total effects of uncertainties (positive and negative uncertainties) on objective: SFM	
- R1 Discontinuity - R2 Environmental degradation - R3 Market inefficiency - R4 Resource maldistribution	

Source: Author

Total effects of uncertainties (positive and negative uncertainties) on objective: SF8.2.1

Prioritize: Cause – State – Effect

When determining actions for mitigation, it is useful to know what insights will influence them. Table 25 shows identified relationships of field operations, subsidy and law. It can be seen that the conditions of low SFM responsibility, low FCS certification and uncompetitive cost have their origin in the law.

Table 25: Conditions – Field Operation – Subsidy – Law

Conditions	Field Operation	Subsidy	Law
Low SFM responsibility	Limited forest access Little participation	Owner buyout	No clear land ownership information
Low FSC certification	No environmental assessment Little involvement by Kochi Prefecture Administration	No integrative mgt. No support for diversity Works determined by area No natural alternative for wildlife damage protection	No description of biological diversity No description of recreation No enforcement Basic Act shows characteristics of policy
Uncompetitive cost	Non Value Added activities Dependency on subsidies	Little involvement by Kochi prefecture Increased forest access by subsidies	No enforcement of forest access Privacy law

Source: Author

Risk deriviation

Table 26: Objective – Threat – Uncertainty - Risk

Objective	Threat	Uncertainty	Risk
SFM mgt. (Owner responsibility)	Subsidies may stop Forest access may further decrease	Impact of threat on mgt. area	R1: Discontinuity Access forest area decreases
Production of ecosystem services	Biological diversity may further decline Diverse forest may never be promoted Climate change	Impact of threat on the production of ecosystem services	R2: Environmental degradation Production of ecosystem services worses
Value added activities	Subsidies may stop	Impact of threat on value added activities	R3: Market inefficiency Value added smaller than production cost
Efficient utilization of financial resources	Subsidies may increase despite monoculture mgt.	Financed mgt. may no longer help to enhance ecosystem services	R4: Resource maldistribution

Source: Author

Table 26 shows the deriviation of four sustainability risks. Risk is defined as the effect of uncertainty on the objective.

The Cause

Defines: “Sources of current effects”

Forest management conditions have an origin, a basic foundation in various small decision making processes that were will be made to serve specific management aspects. These “smaller” decisions are made to achieve or improve a certain management aspect in short, mid, or long-term timeframes (e.g. enhancement of roundwood production or profitability, modernization of harvesting techniques or forest road infrastructure, improvement of work safety or owner relationship, development of forest legislation, enlargement and improvement of specific bird and other wildlife habitats etc.). A cause is the smallest piece of a management construct or condition. A current condition is the final result of various “smaller” causes. Each decision brought cause and their interrelationships influence sustainability and the states, the sub-formations of the current management condition. States are intentional or unintentional results of causes, however, may also come first. In this case causes become the tools or the results to establish or maintain a desired state. A change, addition or elimination of one or more interrelated causes can directly affect the character of a state, or the entire nature of it. Identification and organization of interrelated causes is crucial for state management. For instance, a change of a single cause may change the character of a wanted state although other causes are left unchanged.

The State

Defines: “Conditions of current effects”

Management States are formations or chunks that are the reason or have become the result of management causes. A state describes a condition. It is the logical consequence of the interrelationship of two or more causes of intra- or interdisciplines (e.g. The decisions to reduce production costs of a product and to outsource parts of production, and to replace the core workforce with less expensive part time workers results into the condition of corporate competitiveness, from the microeconomic viewpoint of the producing business.). States being formations of causes, intended changes also require changes, adding or elimination of current causes. States are management constructs among causes and effects that show the interrelationship or the disciplinary belonging of a cause. States can be either wanted or unwanted and can bring positive and/or negative sustainability effects. States may be unintentionally neglected if they are not seen or not noticed. In this case a wanted state may be transformed into an unwanted one if one or more if its causes are altered.

The Effect

Defines: "Results of current causes and states"

Effects can be of various interdisciplinary origin (economical, environmental, social etc.) and can be either positive or negative. They are the full or partial causal result of one or more management states and their causes, and describe a consequence or what happens given the cause-state situation. Effects can be wanted or unwanted but in either case always affect human beings either directly or indirectly (e.g. the release of toxic contaminants in a production process is in most cases an unwanted process that directly affects human health. Or, innovative technology and lean management results into a five-year consecutive annual turnover increase. Shareholders may indirectly experience an increase of shares). A desired improvement, alteration or elimination of an effect is paired with changes in causes and states.

Cause – State – Effect

Causality or cause and effect is in science the foundation of connecting processes with one another. Cause and Effect is often graphically organized in fishbone charts to show location and character of the causes. Causes can be ranked and summarized into larger causes in their respective categories. However, interdisciplinary conditions (states) are not part of the Cause and Effect theory. Although a cause – cause relationship can be displayed in fishbone charts, interdisciplinary relationships of causes between categories, and the conditions that they create or maintain cannot be displayed satisfactorily, or in other words, cannot effectively show the condition (state) of interdisciplinary cause formations. The management concept of SFM deals with exactly these interdisciplinary interrelationships of causes and their conditions. Therefore, Cause – State – Effect – Risk is leaned on an alternative theory, one which includes conditions (states) as a part of a cause – effect relationship.

In Buddhist teachings, there is an alternative approach to the law of cause and effect which includes conditions. Other than the conventional cause and effect theory, in Buddhist teachings a cause cannot have an effect without a condition. A condition cannot have an effect without a cause. An effect consists always of a cause and a condition. Other than causes, conditions are non-physical (e.g. a falling apple where the apple is the physical cause of the object falling. Gravity, that makes the apple fall is the non-physical condition. The resulting effect of this cause – condition relationship is falling). However, gravitational effects do not come out of nowhere. Nowadays, with a more scientific understanding of what gravity is and how it is created, it can be agreed upon that the condition of gravity is in fact also a result of physical causes. (Physical objects that possess a mass and a distance between these objects) that interact with each other.

Causes and conditions

Similar to the cause – condition – effect law in Buddhism, Cause – State –Effect – Risk also attempts to describe effects that do not only occur with causes but also conditions (State). What is different is, however, that in Cause – State – Effect – Risk effects can be created under given conditions without additional (single or multiple) causes. In other words, Cause – State relationships create an effect without additional, initializing causes. This is explained by States always exerting a force to the surrounding. (Gravity for instance also exerts a constant force to surrounding masses). Under this explanation, therefore, there should be two kinds of effects, dynamic and non-dynamic effects. For instance, a falling apple is a dynamic effect where gravity changes the apple's location from one place to another to balance the gravitational energy between them. On the other hand, a non-dynamic effect is the motionless apple that has fallen down, but where gravitational attraction remains motionless due to masses pressing against each other. Although not visible, gravitational force remains.

There may be a way to extend Cause – State – Effect – Risk to include those additional causes that initialize dynamic effects.

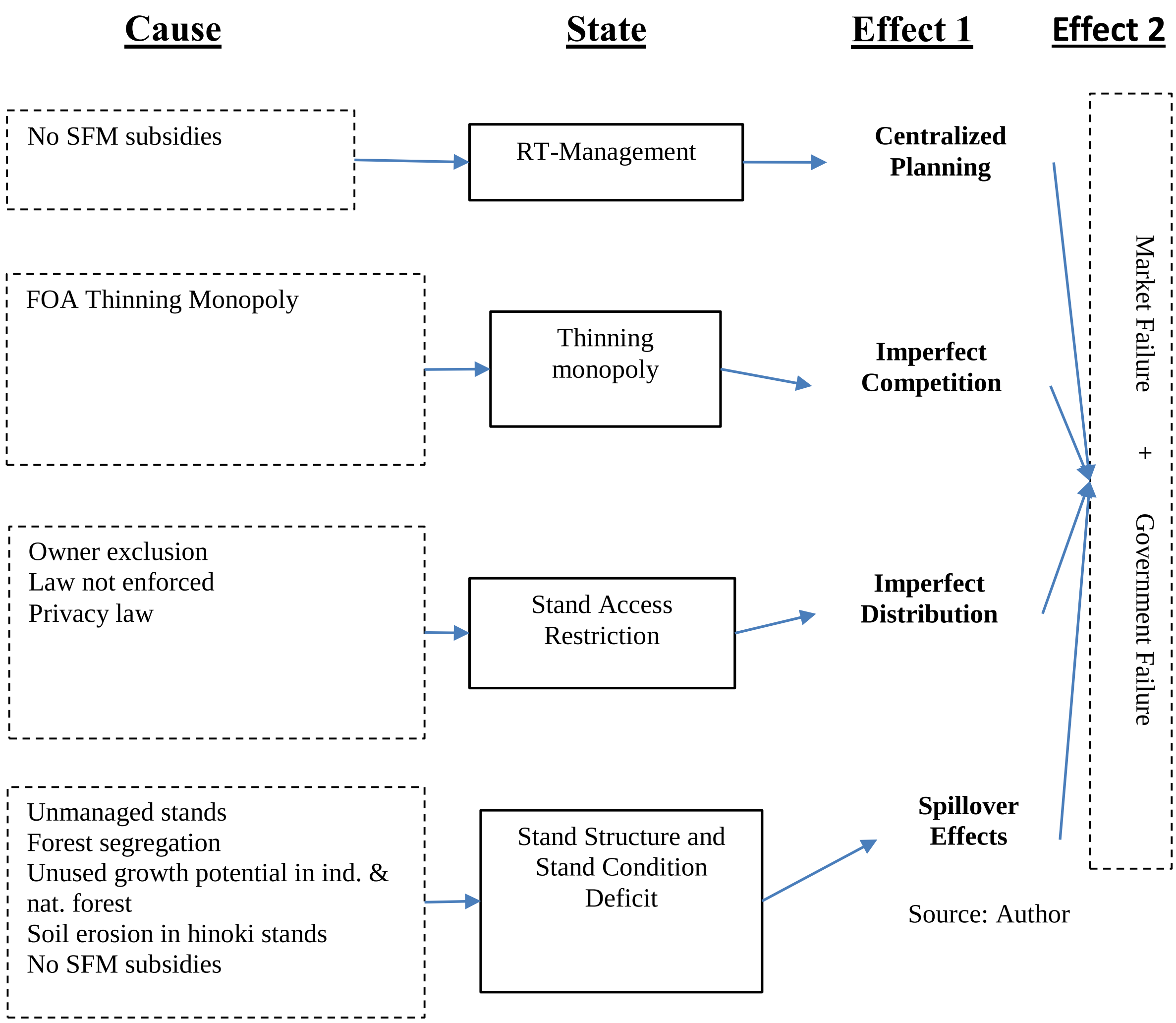


Figure 27: Cause – State – Effect relationship

8.2.2 RT-Management

In Kochi prefecture rotation forest management (RT-Management) is the main forestry approach in industrial forest. Two causes were observed that show strong indication for this approach: market influenced subsidies and resilience approach. The resilience approach has the potential to revitalize current even-aged monocultures while market influenced subsidies may lay a focus on the economic production of roundwood. For such a strategy, the RT-approach may be ideal being the most efficient regarding return on investment. The influence of this cause – state relationship may contribute to the market effect of centralized planning, which is also supported by the revitalization objectives by the Japan Forest Planning System. Central planning is the idea and market intervention of a government to overcome market failure and to achieve a balanced distribution of resources. This claim of a centralized planning state supported by the causes of market influenced subsidies and a resilience approach shall be discussed. The Kochi subsidies for private forest have the purpose to improve the condition of coniferous monocultures. A coniferous monoculture (assuming there is no damage during the rotation cycle) is considered the ideal forest management approach for production cost minimization and profit maximization. Kochi Prefecture sets annual goals regarding the production volume of coniferous roundwood. Subsidies are available to financially support these annual production goals. These subsidies also aim to improve the current health of coniferous forest, not their sustainability aspect. Revitalization of current monocultures to improve timber quality and value, and market influenced subsidies used to ensure annual production goals, are two supporting factors for an RT-approach and centralized planning. However, centralized planning is considered to have important sustainability disadvantages:

1. There is lack of incentives when governmental support is guaranteed.
2. Future trends are often noticed late.
3. Moreover, the most important statement that can be made is inflexibility of the forest management approach and the subsidy scheme to apply adequate countermeasures other than thinning in cases immediate care of forest becomes necessary. For the time being, financial support is strongly limited to thinning works. Thinning alone, especially in coniferous monocultures, however, is not stand specific management and may not sufficiently improve its sustainability aspect. Additional stand specific works alongside density reduction may be necessary such as species mixing, improvement of underplanting, fertilization, insect control etc. Management today does not offer the flexibility to apply necessary stand specific management works. Especially long planning terms create uncertainty which makes management flexibility in regards to new or alternative options an asset to improve forests. A combination of thinning and stand specific management reduces the need of frequent management requirements. Greater flexibility may reduce volume production productivity and increase management costs, but the greater ability to effectively respond to market changes, natural climate and new management objectives may be more beneficial, and in the long run more important for forest owners (Wilson & Baker, 2000).
4. For local implementation of SFM in Kochi Prefecture these may be the most important statements. Forests are dynamic ecosystems. The management of man-made forest must be flexible enough that risks and spillover effects can be mitigated.

8.2.3 Production Oligopoly

Two possible causes that may show strong influence for state of a production oligopoly were observed: centralized works and uncompetitive production costs. The majority of forest works in Kami City are administered by Kami FOA making it the strongest provider of forest works in the region. This is supported by Kami FOA having access to state of the art forestry technology and expertise. As suggested in market theory, a production oligopoly has the potential to drive firms to abnormal profits. In the case of Kochi Prefecture, no claim is made that this may apply to Kami FOA, however, as observed by the author in several interviews, production costs are seemingly not efficiently broken down. A derivation of how production costs are calculated could not be provided on all occasions. This may suggest that production costs could be fixed amounts. The influence of this cause – state relationship may contribute to the market effect of Imperfect Competition. In this market form, perfect competitive markets are not satisfied, meaning that no company in the market can influence the market price (Again, the product that is meant here is the service of forest works such as thinning, extraction, moving etc. with which forestry business compete). Suppliers provide a homogeneous good (In the present case the suppliers are private forest owners and the homogeneous good is coniferous roundwood). Such a production oligopoly may have important sustainability deficits:

1. Market entry barrier.
2. Customers (private forest owners) have little to no choice of product selection.
3. However, the probably most important statement that can be made is the possible risk of future market inefficiency. In the case of forestry, there is one crucial exception for customers (forest owners), a time will come where purchase forest works becomes necessary because a thinning or selection cut must be performed in order to avoid forest damage. Therefore, a forest owner cannot simply refuse to buy. This is a condition that firms in an oligopoly can use to their advantage and perform insufficient effort to adjust to (global) market and price dynamics.

8.2.4 Stand Access Restriction

Two possible causes that may show evidence for state of Stand Access Restriction was observed: Owner exclusion and low addressing of SFM Criteria and Indicators in forest legislation. The influence of this cause – state relationship may create the market effect of imperfect distribution of income and wealth. From the viewpoint of sustainable development, an exclusion of forest owners in management decisions is a condition that fails to treat forest owners as active producers of the public goods that they produce: roundwood, wood for bioenergy etc., and all the managerial factors associated during the production process. In Kochi Prefecture, public wealth in the form of subsidies has been, and is being utilized for supporting the production of these private goods. Insufficient addressing of SFM Criteria and Indicators and lack of enforceability provides little to the establishment of stable forest that produce man-made and natural capital. The most important risk that the state of imperfect distribution in the current case can bring is the risk of temporary or permanent discontinuity of any forest management activity by forest owners, and the risk of resource maldistribution.

Discontinuity can occur in several private sector or governmental sector induced occasions.

1. Forest owners are no longer interested in forest management due to lack of prospect and involvement. Lack of prospects are for instance little access to markets and opportunities. Markets include for instance those current markets for domestic and international coniferous and broadleaf roundwood, pulp, chip and bioenergy. Other prospects are access to alternative stand management approaches other than coniferous rotation management and conversion to natural forest, but approaches such as CCF, close to nature forestry, water management or simply forestry for recreative purposes. Forest management education is another lack of prospect, or lack of prospect opportunity. What reasons, other than profit are there to be or become a forest owner? What benefits, other than personal financial development are there that make it worth to be or to become a forest owner. How can a forest owner be actively involved? Access to forest management education that addresses these questions and that addresses alternative management opportunities may greatly increase reasons for forest owners to be actively involved in forest management.

2. Discontinuity may also occur when government decides to decrease or abolish funding for forest works. Momentarily, subsidies are used as compensation for roundwood price and production cost. A decrease or complete abolition of compensation funding would lead to less incentives to harvest roundwood and to conduct any type of extraction works.

Resource maldistribution is false or inefficient distribution of tangible or intangible forest management related resources during the process of roundwood production and stand development. It can occur in governmental interventions and may include financial, biotic and abiotic resources. It may also occur in

1. Financial resources. Public funding of forest works is a way to initialize action to improve the condition of forests. Governments have the responsibility to use public funds in the best possible interest of the general society. This would be to support sustainable forest management strategies that improve an unbiased, sustainable development of all, private, public, industrial and natural forest areas. A management focus on one type of forest area or one specific type of owners misses the chance to improve forest conditions from a long-term perspective, and the production of their resources uniformly. For instance, the revitalization of even-aged industrial forest is an approach to improve financial value, but not an approach that improves all aspects of environmental value such as biotic and abiotic resources.

2. Biotic and abiotic resources. Forests do not only consist of trees. They are ecosystems of various other plant life and serve as habitats for a great diversity of lifeforms. In balanced coexistence, biotic resources such as wood, mushrooms, wild animals, fish in lakes and rivers etc., and abiotic resources such as oxygen, clean water, fertile land etc. can be produced. An interference of this fauna-flora coexistence due to human action or non-action can cause maldistribution of these resources. Human action induced resources maldistribution of biotic and abiotic resources in forests may be linked to environmental spillover effects as discussed in Introduction. Human non-action induced resource maldistribution includes lack of forest access.

3. Forest access. Temporarily or permanently disturbed forest access can cause resource maldistribution. For instance, a still underdeveloped forest road and forest vehicle infrastructure causes temporary resource maldistribution as forest resources cannot be extracted or maintained when necessary. Private stands that are not self-managed or managed through a third party may cause permanent resource maldistribution. Under current forest law, forest ownership does not require active forest management.

An improvement of the distribution of forest resources can only be achieved under a framework of sustainable development and ownership responsibility. Such a framework can be created with an approach of support, incentives and education. Access to forestland is essential to apply works, especially when immediate action is required. A change of the law that enables the establishment of contact with forest owners by public governments to communicate management strategies can be a first step towards such a framework. With establishing contact, the risk for areas of private forest currently not receiving management to degrade may decrease significantly. Given current legislative conditions, management in those areas of forestland may even be discontinued until contact with the owner can be reestablished. The exclusion of forest owners in management decisions may further create distance and loss of interest in forest management. Already, the majority of private forest owners is not interested in forest management as suggested by the national forest management survey conducted by MAFF, 2010. Once access to forest has been established, the next step would be to communicate the need for a broadening of the view how forest resources are assessed. Biotic and abiotic resources need to be seen as equally important to financial and wood resources. Such a change of thinking will be the foundation for all future decisions regarding the management of forests, and will generate a common need for stakeholder collaboration.

8.2.5 Stand Structure and Condition Deficit

Two causes were observed that show evidence for a state of <u>Stand Structure and Stand Condition Deficit</u>: <u>growth potential</u> and <u>unmanaged stands</u>. A growth potential of Kochi's industrial forest under similar silvicultural and site specific management conditions as in Germany was estimated. In addition, as observed in Kahoku Town/Kami City, areas of unmanaged private sugi and hinoki stands with high density and with little or no underplanting are evident. Causes for these unmanaged stands are of various legislative, market and forest infrastructural, forest conditional and classificational nature.

1. Forest legislation does not enforce any type of forest management. Given current forest legislature, ownership of forest does not require active management, for instance, to improve environmental conditions or to produce forest resources. A man-made forest may be left for natural conversion into natural forest, regardless the environmental risks that may occur in the process. As forest management is costly with financial returns often within large timeframes, it is understandable that private owners manage forest only with satisfactory return on investment. As an incentive for active forest management, thinning subsidies are available to forest owners with forest areas larger than 0.1ha with the intention of environmental stand enhancement and roundwood extraction to compensate for unsatisfactory returns under current market conditions. (To enable eligibility of subsidies to owners with very small forest areas of under 0.1ha, unification of forest has been a recent strategy by Kami FOA to reduce areas of

unmanaged stands.) Private industrial forest management (besides the aspect of clear cuts) is an incentive driven, not legislature driven (or both) approach in Kochi Prefecture. Unmanaged stands may occur due to this legislative limitation.

Affected by this law limitation are not only current owners but also owners that have inherited forest. These type of forest owners that have come into possession of a forest through inheritance have not seldom another, less connected, relationship to the forest, despite the investment opportunities it may offer. Relocation and timely preoccupancy of the owner are often additional conclusive factors against management. In some cases, individuals have yet to become aware of their forest inheritance. First establishment of communication with this type of inherited forest owners to discuss management approaches and incentives is further impeded by Japanese privacy laws. Stands of owners that have yet to contacted are currently left unmanaged until contact has been established and management actions of the owner have been made. Management by government or third parties is currently not possible without owner permission.

Management of stands is also influenced by regulations that limit the application of forest works immediately after a thinning that was financially supported by subsidies. For instance, recently subsidized thinned stands must not receive another thinning or be clear cut over a given timeframe of several years. As a thinning is conducted to enhance future annual radial growth of remaining tress for increasing wood mass, as well as the overall environmental and sustainable condition of the stand, this regulation is meant to avoid misconduct of public funding. This regulation also transfers in cases ownership of subsidized stands changes. Violation may lead to a return of all public funding received. Owners who are interested in clear-cutting their forest in the early future (normally stands close to reaching maturity and that will give a higher instant return over a thinning) refrain from publicly financially supported thinning and leave their stand unmanaged, sometimes for an entire rotation period, until a clear-cut decision is made.

2. Market infrastructure can influence forest management decisions. Forest management includes in many cases the planting of seedlings and the removal of roundwood. Markets that do not offer a satisfactory financial and logistical incentive for removing roundwood can lead to decisions for leaving stands unmanaged. When market prices for domestic roundwood reach a certain low point (prices for hinoki and sugi have been slightly recovering in the past three years) owners tend to postpone forest management,

leaving stands unmanaged with the hope of prices to increase again. In Kochi, such a scenario happened over approximately the past twenty years. However, it must be noted that twenty years ago the area of forest where a thinning became necessary was lower. Nevertheless, continuing falling market prices resulted into unmanaged and late thinned stands.

Forest infrastructure, especially forest road infrastructure is another aspect that influences the management of forest and that may lead to unmanaged forest. Areas of forest that qualify for thinning or even a clear-cut can be left unmanaged when there is no direct access to a forest road. Despite topographical challenges, compared to other forest management performing nations such as Germany, Austria and Switzerland the forest road network in Kochi is still underdeveloped in terms of road width and road length per hectare. To enable management in stands without forest road, at least for environmental enhancement, financial support for thinning without roundwood extraction have been made available (kirisutekanbatsu).

3. Forest condition can influence owner decisions regarding forest management. Roundwood for sawn wood is more valuable than roundwood for pulp and chip. For roundwood to qualify for sawn wood (for instance for boards and beams) it needs to be straight and reach certain radial dimensions. While the first condition is normally easily fulfilled with coniferous wood, radial growth can be significantly slowed in stands with high density. When wood prices are low, a thinning, a late thinning, or even a clear-cut in a stand with low volume and/or low quality timber may not be lucrative enough, or lucrative at all, to conduct management. Under such forest conditions forest can be left unmanaged until financial incentives for the owner have improved.

4. The final possible cause for unmanaged stands can be said is the classification of forest. Management of forest is not to be compared with agriculture. Agriculture is the management of land and its soil to grow a crop or rear animals with relatively short rotation periods, usually for food and other products with the objective to achieve a financial profit. Given the diverse and complex ecosystem aspect of forest, its management is a decision to take natural responsibility for its conservation with the prospect of a financial profit through the production of roundwood, for instance for building material and energy. Currently, the natural conservation aspect of forest is not yet made an enforced requirement for forest owners in Kochi. Types of forest owners and their objectives regarding forest management are diverse, some focus on return,

> others on conservation, protection and recreation. Although there are forest owners that not only focus of financial return in Kochi, their decision to conserve their forest by using some private funding to improve its natural condition, even in times when wood prices are low, is voluntary, not a requirement. Education of society for taking this responsibility for natural conservation may improve owner commitment to management and reduce areas of unmanaged forest. However, even with improved commitment to management, ample access to market opportunities will also be needed to improve forest management.

The influence of this cause (<u>growth potential</u> and <u>unmanaged stands)</u> – state (<u>Stand Structure and Stand Condition Deficit)</u> relationship may contribute to the market effect of <u>Spillover Effects</u>. Although the issue of unmanaged stands is commonly associated with stand access restriction, a number of environmental and economic spillover effects such as stand degradation, loss of biodiversity, and a slowing down of radial stem growth could be witnessed. This condition poses the risk of <u>environmental degradation</u> in these affected private stands in the form of temporary natural habitat loss with need for either artificial or natural recovery, as well as temporary habitat loss in surrounding aquatic and non-aquatic ecosystems through the risk of spread of biotic disease and sudden uncontrolled wildlife population increase. A strategy for the correction of stand structure and condition capable of reducing such spillover effects and the risk of environmental degradation is suggested. This shall be achieved by establishing a legislative framework that requires forest owners to become responsible for stand condition and allow access to forest for the application of mitigation strategies if necessary. Such a framework should be supported by constant expert supervision of stand condition. Failure to do so may continue, repeat and create new spillover effects.

8.2.6 Market and government failure

Market failure

Market failure is a situation where the allocation of resources, goods and/or services in a free market is not efficient. There are varieties of reasons that can bring market failure. These are productive and allocative inefficiency (imperfect distribution), abuse of monopoly power (imperfect competition), lack of public goods, missing and incomplete markets (centralized planning), negative externalities (spillover effects) and other market imbalance bringing factors. Table 27 provides a classification and production efficiency of tangible and non-tangible forest goods and services in current industrial forest in Kochi Prefecture. It lists the major goods and services produced and provided by an industrial forest in Kami, separated in consumption rivalry and consumption excludability (These goods and services are usually the same in all types of forest with roundwood extraction).

Table 27: Type & production efficiency of industrial forest goods and services

Rivalry/Excludability	**Exclusion easy**	**Exclusion difficult or costly**
Rivalrous in consumption (subtractable)	*Private goods* **Roundwood** low efficiency **Wood for fuel and energy** low efficiency	*Common-pool goods* **Forest** moderate efficiency **Protection** moderate efficiency
Non-rivalrous in consumption (non-subtractable)	*Club goods* **Recreation** low efficiency **Traditional resources** **Sugi for temple maintenance** low efficiency	*Public goods* **Air purification** low efficiency **Pollination** high efficiency **Biodiversity conservation** low efficiency **Carbon storage** high efficiency **Soil conservation** low efficiency **Wildlife habitat maintenance** low efficiency

Source: Author

Consumption rivalry is a condition where the availability or accessibility of goods and/or services is characterized in its scarcity. Excludability is a condition where consumers can or cannot be excluded from goods and services. Full private goods are rivalrous goods protected by property rights which make exclusion of consumers from these goods easy. Club goods are non-rivalrous goods as these goods are not scarce but consumers can easily be excluded. Common-pool goods are rivalrous in consumption but consumer exclusion is difficult or costly. Full public goods are non-rivalrous in consumption and exclusion of consumers is difficult or costly.

Why can we imply market failure?

(1) Productive and allocative inefficiency

A market is a place where supply and demand operate and where buyers and seller interact to trade goods and services. In Kami, the production of wood in industrial forest is supported with public funding to compensate for extraction costs. The production of the service recreation can be considered low, as monocultures do not offer sufficient aesthetic incentives to be visited. In addition, access to private industrial forest is not public in Kochi. In comparison, in many European nations recreation is a free accessible, non-rivalrous public good and not a club good as in Kochi. Due to the even-aged, monoculture structure of industrial forest, the production of most public goods can be considered as low. Timber storage can be considered as very high (Chapter 1, Figure 7), however, undynamic due to even-aged forestry approach.

(2) Oligopoly power

In Kami, most forest works are conducted and most public funding for forest works are received by Kami FOA. A relatively small part of works is conducted by self-administered management. This centralized, close to monopoly power condition allows Kami FOA to enhance price efficiency for forest works relatively effortlessly. The market fails to control this oligopoly power.

(3) Missing markets

Markets for broadleaf timber are undeveloped in Kochi. Works that involve broadleaf timber extraction can insufficiently be compensated by the sale of broadleaf wood. Markets for broadleaf timber fail to form.

(4) Incomplete market

Although efforts to increase access and improve forest pedagogy in Kochi Prefecture have been high (Kochi Forestry School, school excursions, thinning practice, symposia etc.), access to education, specifically for SFM remains scarce.

Producers of roundwood in Kochi manage forest as economically efficient even-aged coniferous monocultures. However, producers fail to take into consideration the negative effects of this forest management approach on third-parties and the environment that are indirectly suffering as a result. Many public goods of forests are produced inefficiently (lack of public goods) and may cause environmental damage and unbalance as spillover effects. The market fails to prevent these spillover effects.

(5) Treating forestry like agriculture

In economics types of market failure often include agriculture in general due to externalities and price control. Kochi's segregative forestry approach of separating forest into industrial and natural forest may indicate the treatment of industrial forest similar to agriculture. As in agriculture, industrial forest in Kochi is managed as a rotation even-aged monoculture, planted and fully harvested after one rotation period. The market fails by treating industrial forest like agriculture.

(6) Information failure

Forest owners have no access to alternative management approaches such as mixed-species and multi-layer approaches. Information about these approaches that would treat forests like an environmental habitat and not simply like areas with trees as crop are not accessible. As discussed in Chapter 5, forest owners do not seem to be interested in more sustainable multi-species and multi-layer approaches. Access to specific SFM education, risk mitigation leadership, market opportunities and government policy and support to convince forest owners about the higher social benefits and lower social cost of SFM are currently not available. The market fails to provide information and their channels to make sustainable decisions.

In market theory, market failure is commonly mitigated through the correction of imperfect distribution, imperfect competition, centralized planning, spillover effects, and by the adding of improvement of human capital.

Why can we imply government failure?

The definition of government failure is when governments fail to correct or deepen the effects of a market failure. In the present case, meaningful government intervention would therefore target the factors that cause market failure. These factors include as the misdistribution of financial resources for the production of common-pool goods, the imperfect competition of FOA, the centralized planning of the Kochi subsidy scheme, and the natural spillover effects caused by current forest management. A common way to overcome market failure by government intervention is the use of price mechanisms by implementing policies that change consumer and/or producer behavior to correct the above mentioned factors of market failure. However, current price mechanisms and policies do not target a long-term improvement of market issues. Instead, they address a quick fix to the problems. This phenomenon of governments trying to provide quick measures to fix market failure is often referred to as Policy Myopia. Three common consequences can be observed:

- Policies create more losers than winners

In the present case, the public is the clear loser of current forest policies. The common-pool goods (ecosystem goods and services) the public is interested in are insufficiently and unsustainably produced.

- Policies are ineffective

Policies are unable to provide unrestricted access to private industrial forest. Moreover, decisions are not made with a long-term perspective.

- Policies have damaging long-term consequences

Policies are unable to integrate the forest owner in management related decisions. As reported, the number of forest owners becoming less interested in forest management is increasing. It will be difficult in the future to negotiate any sustainability related decisions in cooperation with these forest owners.

8.3 Risk mitigation

Table 28 shows a risk mitigation plan for the identified four unsustainability risks. A number of risk mitigation factors shall be discussed.

Table 28: Risk mitigation plan for Kochi Prefecture/Kami City sustainability risks

Type of risk	Risk mitigation factors
Environmental Degradation	Expert assessment and monitoring of stand condition including biotic balance. Introduction of alternative mixed-forest strategies and continuous cover approaches. Public forest monitoring through local integrative networking.
Discontinuity	Adaptation of legal framework for unrestricted stand access. Involvement and support of forest owners in management decisions. Guidance through expert communication.
Resource Maldistribution	Expert assessment and monitoring of stand condition to maximize timber value. Adaptation of legal framework for unrestricted stand access. Detailed inclusion of SFM C/I in law and policy for the enhancement of timber quality.
Market Inefficiency	Promotion of market entry for private forestry businesses. Long-term focus on strategies for the reduction of production costs. Focus on operative functions of FOA.

Source: Author

8.3.1 Mixed-forests as alternatives to even-aged monoculture strategies

Monoculture plantations, if viewed from economic perspective, can be considered an effective return on investment, they are reported to be coupled with powerful long-term environmental risks affecting natural capital (Rist and Moen, 2013). Plantations, especially even-aged monocultures, reportedly sustain insufficient wildlife diversity acting as ideal habitats for rapid and difficult to control population increase of certain creatures, due to missing natural predators

(Cannell, 1999). The main species in Kami City, hinoki and sugi, are considered shade tree species that, other than many broadleaf species, in unitary cultivation block the majority of sunlight to reach the forest floor when canopy becomes dense, increasing the risk of soil erosion. Rainfall may then become responsible for transporting eroded soil into nearby aquatic habitats, affecting environmental balance there. In Kami City, such erosion is currently suspected in certain regions of near Monobe River. Although enhancement of natural capital can be achieved through thinning, the direct promotion of even-aged monocultures can, however, bring long-term habitat damage.

Addition of mixed forests strategy into current subsidy scheme

Subsidies must include detailed performance directives such as density, tree species distribution, forest vitality, growth and development. For forestry subsidy schemes to become effective local implementation tools for achieving national sustainability goals, a detailed description and implementation outline for each subsidy is inevitable. Lack of description detail of subsidy schemes runs two fundamental local implementation problems. (1) Unintentional misinterpretation by local forest managers during the implementation of these subsidies can lead to results that may be different to national objectives. For instance, such misinterpretation may already have occurred in the selection of tree species for reforestation at the study site. For a transformation of coniferous monocultures to mixed forest, a detailed instruction for applicable deciduous species utilizable for each particular stand will eliminate the risk of forest managers to select identical or other coniferous species that create a less or lower environmental and economic benefit. The second problem is (2) deliberate negligence of the implementation of environmental objectives by forest managers to avoid complication of management practices and an increase of management costs. For instance, compared to mixed cultures, management of coniferous plantations is considered less complicated and less cost intensive. These two conditions increase the likelihood of earlier and higher financial benefit. Imprecise description of subsidy objectives increases the risk of forest managers to exploit “loopholes” which may result counter-productive. Reforestation and afforestation subsidies must be designed to avoid the possibility of misapplication that could lead to a publicly financed creation, recreation or even expansion of plantations.

8.3.2 Local leadership and forest owner involvement

Yamaba and Nakagoshi (2000) observed that large dynamics in Japanese domestic wood markets and policy development would make extended multi-stakeholder participation inevitable. The authors point out a serious problem in Japan: the increasing loss of interest of private forest owners in active involvement in forest management. Even higher subsidies do not seem to be enough of an incentive for active participation anymore (Hasegawa et al., 2013; Matsushita and Taguchi, 2011). Therefore, introducing financial incentives for public forest management projects, as frequently executed by the Japanese forest planning system, bring about the elemental risk of merely "purchasing" forest owner participation (Lutz et al., 1994). In addition, agreement to transfer authority to the forest planning system further distances private forest owner management involvement. These types of one-time agreements are not designed for a long-term relationship, and interest shown by forest owners is in most cases simply for the present moment. Forest management requires active long-term participation of private forest owners to strengthen general public involvement and to avoid a further disinterest in environmental issues. The reason for lack of active long-term participation is in the least cases lack of capital, but instead lack of available information on available market chances, access to silvicultural technology, forest law development, and taxation support. Investments that would have been made by private forest owners themselves with proper advice and guidance are lost with one-time management agreements (Enters et al., 2004). Therefore, policies and financial support systems need to incorporate local stakeholder communication to determine whether response decisions are really appropriate for the target environment (Paulson Priebe and Müller, 2013). The homogeneity of tree plantations and their potential negative effects on the production of natural and even man-made capital must be reevaluated, and proper mediation between private and non-private stakeholders will play an important role in this process (Susaeta et al., 2014; Shigematsu and Sato, 2013).

A subsidy scheme that enables private forest owners to transfer authority of management should not be considered a sustainable management strategy as it further distances the public from active involvement in environmental management. Forest owners should be involved in decision making processes to maintain a dynamic and diverse management network (Boon and Meilby, 2007). Such a management network initiates synergy effects among private forest owners which have the potential to spread knowledge and expertise, and which have an educational effect on individuals not directly involved in environmental management issues.

8.3.3 Monitoring through local integrative networking

Local forest conditions are too diverse to be effectively addressed by national policy. For financial support systems to effectively enhance man-made and natural capital, policy makers and local managers are responsible for weighing out all potential risks before final management decisions are made (FAO, 2010). Active involvement by forest owners and implementation of a silvicultural knowledge party that acts as a mediator and adviser for personal investment through market opportunities, as well as applicable financial support for management interventions that are in the interest of the general public, to facilitate effective decision making processes and to lower environmental uncertainty are necessary. Subsidies with the aim of environmental development must not be restricted to forest age to avoid the probability of clear-cutting. Detailed formulation of policy, to avoid misinterpretation at local implementation, as well as schemes designed to meet the unique characteristics of local forests will be vital in this approach. For instance, the Bavarian subsidy scheme for private and corporate forest of 2014 directly aims at the conversion to environmentally vital and climate resistant mixed cultures, while indicating in detail the exact tree species and their minimum planting density that is necessary to qualify for financial support, making pure rotation-management type forestry completely excluded from financial support.

Summary

Chapter 8 summarized findings of the exploratory research and identified possible implications of what was learned and how it can be practically applied at local level. By summarizing the results for objectives 1 – 6, a Cause – State – Effect – Risk relationship model was build based on the theories of macroeconomics and sustainable development. It was discussed that the current forestry system in Kochi Prefecture shows probable signs for a being organized as a planned economy with imperfect competition, imperfect distribution of income and economic and natural wealth, and which shows signs of economic and environmental spillover effects. The indications of this type of organization were explained and discussed as the macroeconomic condition of market and governmental failure. From the viewpoint of sustainable development, the unsustainability risks: environmental degradation, discontinuity, resource maldistribution, and future market inefficiency were derived. A mitigation plan was suggested. Action strategies of this risk mitigation plan were discussed. The role of local leadership, mixed-forest approaches and local integrative networking as mitigation strategies were discoursed.

References

Boon, T. E., Meilby, H. (2007). Describing management attitudes to guide forest policy implementation. Small-scale Forestry 6, 79-92. doi:10.1007/s11842-007-9006-2

Cannell, M. G. (1999). Environmental impacts of forest monocultures: water use, acidification, wildlife conservation, and carbon storage. New Forests 17, 239-262.

Enters, T., Durst, P. B., Brown, C., Carle, J., McKenzie, P. (2004). What does it take? The role of incentives in forest plantation development in Asia and the Pacific. Food and Agriculture Organization of the United States.

FAO. (2010). Developing effective forest policy - A guide. Rome, Italy: Electronic Publishing Policy and Support Branch. Available from: http://www.fao.org/docrep/013/i1679e/i1679e00.htm (accessed 22.10.14)

Hasegawa, M., Pulhin, J. M., Inoue, M. (2013). Facing the challenge of social forestry in Japan: the case of reviving harmonious coexistence between forest and people in Okayama Prefecture. Small-scale Forestry 12, 257-275.

Lutz, E., Pagiola, S., Carlos, R. (1994). The costs and benefits of soil conservation : the farmers' viewpoint. The World Bank Research Observer 9 (2), 273-295.

Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF). (2010). Opinion survey of forest management. http://www.maff.go.jp/e/japan_food/ (accessed on 15 October, 2015).

Matsushita, K., Taguchi, K. (2011). The Kyoto Protocol and the private forest policy of local governments in Japan. Small-scale forestry 10, 19-35. doi:10.1007/s11842-010-9128-9

Metzger, E., Putt Del Pino, S., Prowitt, S., Goodward, J., Perera, A. (2012). sSWOT – a sustainability SWOT. World Resources Institute. Washington, USA.

Paulson Priebe, M. E., Müller, J. G. (2013). Extant forest plantations as a potential bridge between social needs and ecological management: a comparative case study analysis. Journal of Environmental Management 129, 608-614. doi:10.1016/j.jenvman.2013.08.031

Pesonen, H., Horn. S. (2013). Evaluating the sustainability SWOT as a streamlined tool for life cycle sustainability assessment. International Journal of life-Cycle assessment.

Petercord, R., Leonhard, S., Muck, M., Lemme, H., Lobinger, G., Immler, T., Konnert, M. (2009). Klimaänderung und Forstschädlinge: Waldschutz-Klimaprojekt rüstet die Waldwirtschaft für die anstehenden Aufgaben. Bayerische Landesanstalt für Wald und Forstwirtschaft aktuell 72.

Rist, L., Moen, J. (2013). Sustainability in forest management and a new role for resilience thinking. Forest Ecology and Management 310, 416-427. doi:10.1016/j.foreco.2013.08.033

Shigematsu, A., Sato, N. (2013). Post forest reversal discussion: restructuring public subsidy system for private forests under the differences of topographic conditions in Norway. Land Use Policy 31, 249-258. doi:10.1016/j.landusepol.2012.07.002

Susaeta, A., Carter, D. R., & Adams, D. C. (2014). Sustainability of forest management under changing climatic conditions in the southern United States: adaptation strategies, economic rents and carbon sequestration. Journal of Environmental Management 139, 80-87. doi:10.1016/j.jenvman.2014.02.033

Wilson, J.S., Baker, P.J. (2000). Flexibility in forest management: managing uncertainty in Douglas fir forests in the Pacific Northwest. Forest Ecology and Management 145, 2019 – 227

Yamaba, A., Nakagoshi, N. (2000). Community-based management of rural pine forests in a suburban village of Hiroshima Prefecture, western Japan. Journal of Forest Research 5, 237-242.

Chapter 9: Model development, verification and application

The purpose of Chapter 9 is to develop, verify and apply an alternative forest management model for Kochi Prefecture, one that is capable of mitigating the sustainability risks identified in earlier exploratory and explanatory research, and that creates the foundation for successful implementation of integrative forestry at local level. The new model shall be leaned on the concept of Multi-Party Risk and Uncertainty Management Process for Local Environmental Management (MRUMP) but is additionally organized as an inter-functional forestry concept with an external and internal management cycle. The external cycle is meant to have a supportive function for strategy development at national level and shall be referred hereinafter as Development-Application-Communication-Adaptation (DACA). This DACA cycle is important to ensure (1) successful implementation of local integrative management in the internal cycle by applying appropriate strategies developed in the external cycle, and (2) to enable the possibility of inter-adjustment of internal and external dynamics induced by changes in, for instance, demographics, market, climate, and other uncertain factors. The internal cycle is a local management model for the integration of stake of local stakeholders for the realization of multifunctionality. This integration shall be performed through multi-party risk management by expert risk mediation which shall be explained in more detail later. The internal cycle is hereinafter referred to as Local Expert Risk Mediation (LERM).

9.1 DACA – Model derivation

The external management cycle is organized as a “learning” cycle for strategy and policy development on national level based on local wants and needs. The external cycle is built upon four management components for strategic management: (1) Development, (2) Application, (3) Communication and (4) Adaption (DACA). Other than the currently practiced top-down approach, this method suggests an additional bottom-up approach which communicates local infrastructure and environmental aspects, gained from local multi-stakeholder management processes, to national forestry administration. By adding bottom-up communication to the current system, a learning process is introduced providing additional information to national-level authorities about local management developments, allowing adaptation of strategies and policy to local processes on an ongoing basis. The concept of DACA is shown in Figure 28.

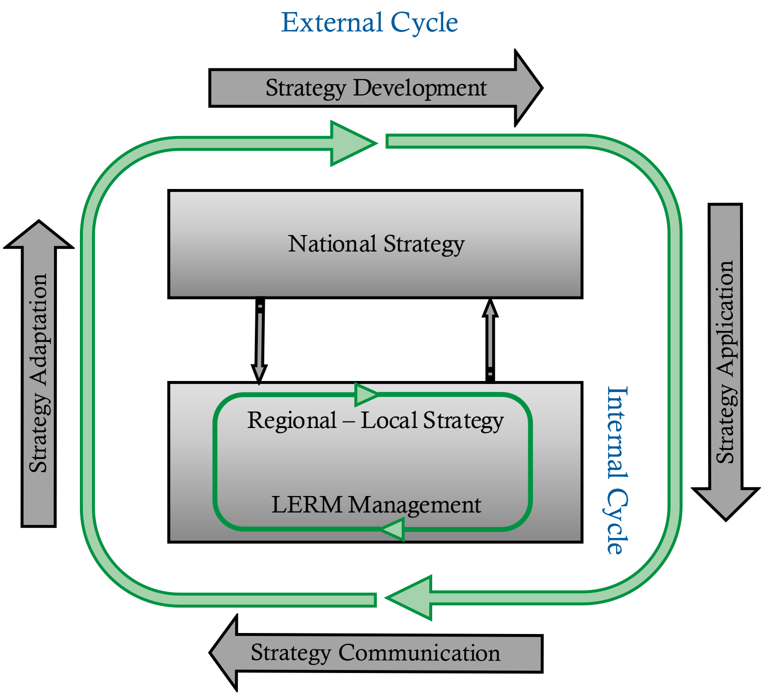


Figure 28: Concept of Internal and External Cycles of Strategy Management

Application and derivation

Through the Forest Planning System national, regional and local forestry strategies are planned and implemented in industrial forest. This plan is updated every five to fifteen years. Main focus is set on logging and revitalization activities in industrial forest. Specific local infrastructure and environmental conditions and their development vital for ensuring long-term sustainability are yet to be made part of this system. The idea of the external DACA cycle is ongoing national strategy and policy development through communication with local authorities and private management bodies, based on local stakeholder wants and needs. Based on this communication, strategies shall be developed in the forest planning system that are adapted and developed based on information gained through expert mediation within the internal management cycle – LERM. The functions of DACA briefly summarized:

Application: Local implementation of national policy

Communication: Learning process of local stakeholder wants and needs, market development and forest ecosystem condition

Adaptation: Adaptation of current policy to adjust to threats concerning the multifunctional role of forest.

Development: Development of alternative measures for local implementation

The concept of DACA over current top-down communication structures are described in the following four examples:

- opportunity to learn from local conditions and to develop national strategies for successful mitigation of local management issues, as well as the improvement of forest conditions to enhance their multifunctional role

For instance: Browsing has become a serious issue in many forest areas in Kochi Prefecture. The number of hunters is who would be capable of reducing the ever increasing deer population is decreasing rapidly. Many of these hunters are ageing and hunting work is freelance and losing popularity. Although efforts are being made by local authorities to get browsing damage under control such as awarding financial support for each deer shot, a solution that not only targets the reduction of the deer population but that also addresses wildlife as an equal contributor to natural balance is yet far away. Hunting is a licensed occupation that goes hand-in-hand with forest management in many nations in the world. Learning from the current situation in Kochi should be encouragement of national policy makers to rethink the role and occupation of hunters. Efficient control of browsing damage through wildlife population management would positively mitigate the sustainability risks of Environmental degradation through browsing damage.

- chance for efficient consideration and integration of local research not only into local but into national policy development

For instance: The investigation of forestry subsidies in Kochi in Chapter 5 has shown that multifunctional forests, as promoted by the NBSJ, are unlikely achieved with current even-aged coniferous forest structures. Moreover, as found in Chapter 6, the legal, institutional and economic framework for forest conservation and sustainable management is insufficiently addressed in national forest policy. Although economic incentives are provided to forest owners for active forest management, specific taxation and economic strategies to support especially SFM are not yet present. Research targeting possibilities for local restructuring of forest and their practical application could be used as a support to not only improve national policy but also to improve national support schemes based on local needs. The development of national policy to enhance local conditions, especially regarding alternatives for forest restructuring and support schemes, is a vital effort to mitigate the risks of:

Environmental degradation: increase of forest stability and vitality through site specific management,

Discontinuity: long-term support schemes and incentives, and

Resource maldistribution: financial support to enhance sustainability and to avoid possible harmful effects of predetermined management that is not intended to be site-specific.

- Consideration of local, non “ringyou” stakeholder experience, expertise and opinion

For instance: Besides forestry practitioners, the general public is an active consumer of forest services and goods. Therefore, consideration of public opinion regarding structure and management of forest is an important aspect of stakeholder integration. Successful integration of public opinion has shown in other countries to enhance human interaction with forest. Effective human-forest interaction is important to develop public interest in forest related matters such as forest ownership, employment, industry, natural issues, and forest resources. An understanding of the needs and wants of local communities can be used to further improve national forest policy for a better human-forest interrelationship, which will positively influence the mitigation of the risks of Discontinuity and Market inefficiency.

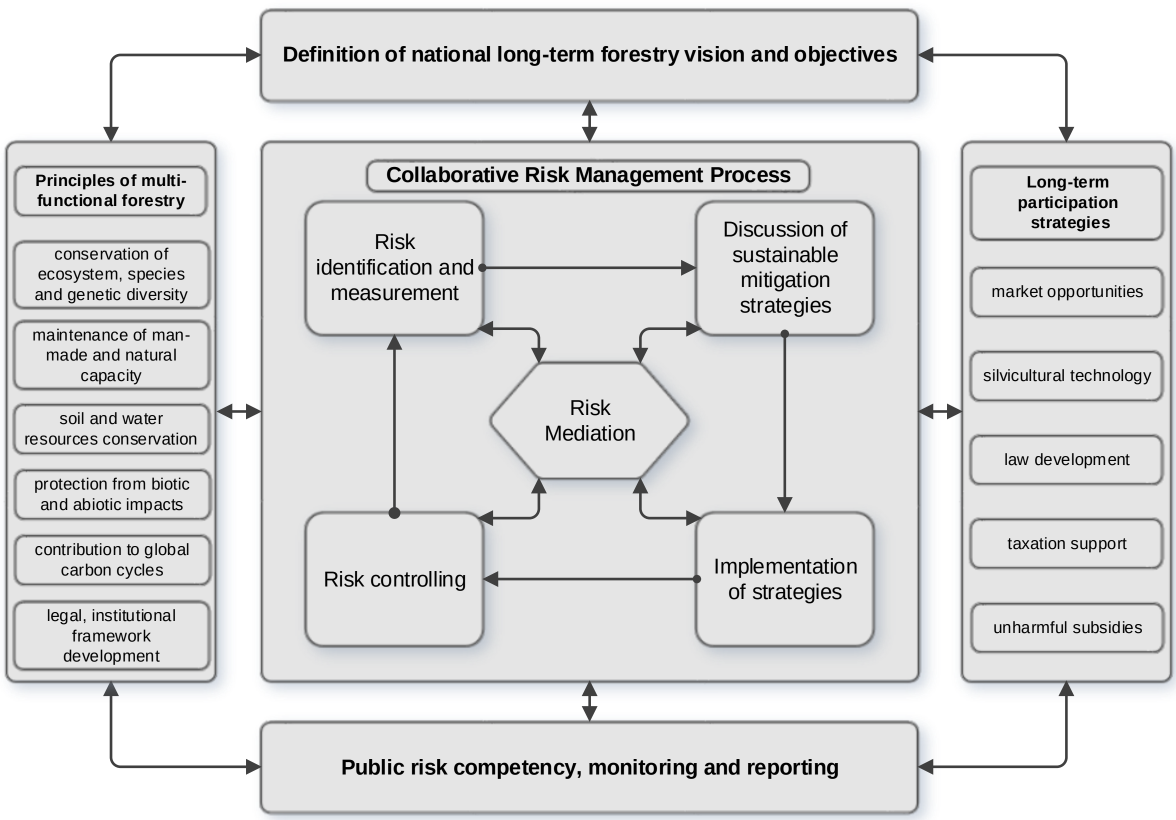
- Support for local managers to implement the multifunctional forestry concept and to develop yet unpracticed, more suitable approaches in regards to forest structure, such as close-to-nature and site-specific management concepts

For instance: In order to enable more complex, alternative site-specific forest management concepts, access to qualified forest experts with sufficient silvicultural expertise and knowledge of local forest conditions will need to be introduced. Top-down-bottom-up communication within the DACA cycle enables ongoing communication between local silviculture experts who report on the development of local forest structures and national policy makers for maintaining a policy framework which is capable of best ensuring the multifunctional role of forests from a local management perspective. Becoming more flexible regarding alternative forest structure management allows appropriate and timely adjustment to local dynamics affecting forest condition such as biotic impacts, changes in local market structures, climate threats and general local demands regarding forest structure and health. Forest structure management flexibility will positively influence the mitigation of all four identified sustainability risks.

9.2 LERM – Model derivation

The internal management cycle LERM is the local management component within DACA which is responsible for the implementation of national forest strategy and policy through (1) applying site-specific forest structure management for the maximization of the production of forest products and services while preserving the forest as a natural wildlife habitat, and (2) to conduct stakeholder integration management by applying expert risk mediation leadership to improve the quality of forest structure and sustainability related decisions for the minimization of sustainability risks. For successful governance of stakeholder integration including local corporations and forest owners, the development of LERM shall be leaned on the value creation principles of the Integrated Governance Framework of the United Nations Environment Programme who promote durable sustainability.

The general concept of LERM consists of one main (Collaborative Risk Management Process) and four supportive management components which directly influence the direction of stakeholder communication within the collaborative risk management process (Figure 29).



Source: Author

Figure 29: Local Expert Risk Mediation (LERM) – General Concept

Table 29 shows the model derivation of the internal cycle LERM. It is shown how the five components of LERM: (1) Collaborative Risk Management Process, (2) Definition of long term forestry vision and objectives, (3) Principles of multifunctional forestry, (4) Long term participation strategies, and (5) Public risk competency, monitoring and reporting, positively influence the previously in Chapter 8 identified four sustainability risks: (i) Environmental degradation, (ii) Discontinuity, (iii) Resource maldistribution, and (iv) Market inefficiency. The five components of LERM can be separated into one sustainability process management component (1) and four management components (2-5). The role of each component in the mitigation of sustainability risks shall be discussed hereinafter.

Collaborative Risk Management Process

The Collaborative Risk Management Process (CRMP) is the core component of LERM responsible for the mitigation of sustainability risks. It comes into practice in events when stakeholder leadership is required in order to enhance forest structure management related decisions. CRMP of LERM is responsible for communicating the context of the four other management components with key stakeholders to support stakeholder opinion integration and to make sustainable decisions regarding the management of private industrial forest and its practical application. A cost-benefit analysis (described in 8.6) is prepared and used as supportive material to facilitate and enhance the quality of decisions. Leadership in this device is conducted by one or more qualified prefectural forestry officials who mediate national and regional forestry strategies while stressing the importance of maintaining and developing the four LERM management components among key stakeholders, while putting effort into the maximization of stakeholder wants and needs. The four supportive management components built around CRMP have the function to act as sources of information and strategy, used by leadership to reduce uncertainty and to strengthen comprehension and transparency of the forest management related decision making process. Leadership by mediation regarding the type of forest management shall incorporate tangible evidence about the current quality of the target forest stand, such as data obtained through on-site assessments or relevant supportive data. In events decisions should be made not in favor of the forest owner, which are expected to bring forth a financial disadvantage, adequate compensation shall be provided. Consultation of the risk mediator regarding management practices and national forestry goals shall be free of charge. The implementation of forest management including works becomes matter of the forest owner and shall be executed by approved forestry businesses in the case the forest owner is incapable of self-management. The selection of these businesses is to be under the responsibility of the forest owner. Recommendations by the risk mediator can be made in cases the forest owner requires assistance for choosing an appropriate forestry business. Stand condition is monitored by the risk mediator in an adequate timeframe and shall be in consent with the forest owner. The stages of CRMP for the mitigation of sustainability risks are described as follows:

<u>Risk identification and measurement; Risk mediation:</u>

Risks identified by the risk mediator are measured and/or estimated based on preexisting site data (e.g. inventory data collected by Kami FOA), site assessments and/or supplemental macro data (e.g. trends in climate change, wildlife population changes, infestation spread). This data shall be organized in a cost-benefit analysis (CBA) and used to support consensus building for the building of mitigation strategy during stakeholder communication.

<u>Discussion of sustainable mitigation strategies:</u>

Strategies for the mitigation of the identified risks are discussed and made internally within the forestry agency or, in cases consensus could not be made with one or more key-stakeholders, communicated in a LERM meeting with these key stakeholders.

<u>Implementation of strategies:</u>

Strategies (including practical measures involving alteration of forest structure) are implemented by a qualified forestry business, the forest owner, or other qualified third-party.

<u>Risk controlling:</u>

Risk controlling is performed through regular site condition monitoring by the risk mediator and/or the responsible public forest agency.

Definition of national long-term vision and objectives.

As stated in forest legislation in Japan, the national government promotes the establishment of multifunctional forests (Japan Forest and Forestry Basic Act, 1964). In order to achieve multifunctional forestry, the integration of forest functions is necessary in forest management related decisions. The necessity of decision making that goes in accordance with national law is to be communicated during the CRMP. Japan’s long-term vision and objectives promote multifunctional forests and therefore positively influences the mitigation of sustainability risks.

Principles of multifunctional forestry

The principles of multifunctional forestry, as adopted by FAO and by the SFM criteria and indicators of the Montreal Process, are the fundamental component in the mitigation process of sustainability risks. These principles shall be the groundwork in decision making to ensure and effective local implementation of SFM (The Montreal Process, 2015). The principles of multifunctional forestry bring a positive effect in the mitigation of the following sustainability risks:

<u>Conservation of ecosystem, species and genetic diversity:</u>

- Environmental degradation (The Montreal Process, 2015).

<u>Maintenance of man-made and natural capacity:</u>

- Environmental degradation (The Montreal Process, 2015)
- Resource maldistribution (by ensuring equal balanced and maximized production of both man-made and natural forest products and services) (as in the FAO definition of sustainable forest management, FAO, 2000).

<u>Soil and water resources conservation:</u>

- Environmental degradation (Environmental degradation will directly affect soil erosion and available water through impacts on ground and surface water (Nellmann et al., 2009).

<u>Protection from biotic and abiotic impacts:</u>

- Environmental degradation (The Montreal Process, 2015).
- Resource maldistribution (e.g. the intentional introduction of a specific alternative species in a forest ecosystem has been observed to negatively influence structure and species composition (Woziwoda et al., 2014).

Long-term participation strategies

Long-term participation strategies ensure maintenance of key-stakeholder relationships and their active involvement in management matters. Urban forest practitioners and managers play an important role in stakeholder engagement and can provide various types of opportunities for stakeholders to become involved in tree planting and forest stewardship (Moskell et al., 2010). Providing these opportunities to get stakeholders actively involved in urban forest management may improve long-term engagement and may lead to sustainably managed urban forests (Clark et al. 1997). The risk mediator informs key stakeholders about opportunities which are capable to enhance economic, ecological efficiency and the social wellbeing by forest management, such as market opportunities, new technology, law developments, taxation support, and access to financial support. These opportunities shall be incorporated and communicated during the collaborative risk mediation process. Access of these opportunities shall be provided free of charge. The long-term participation strategies bring a positive effect in the mitigation of the following sustainability risks:

<u>Market opportunities:</u>

- Discontinuity; market inefficiency (Community dependency on forest resources depends on the condition of the forest, access rights, demand, income-earning opportunities and market opportunities (Lele et al., 2000, p. 14).

<u>Silvicultural technology:</u>

- Environmental degradation (Urban forestry programs are a long-term participation strategy that offer educational opportunities for stakeholders who want to improve their skills and knowledge regarding tree planting and forest conservation (Moskell et al., 2010).

<u>Law development:</u>

- Externally made reforms without domestic commitment tend not to be sustainable. A long-term political-economy approach that is based on training domestic ownership reforms is needed (Lele et al., 2000, p. 54).

<u>Taxation support:</u>

- Discontinuity (Private forest owners can be encouraged or discouraged to invest in SFM practices through economic mechanisms such as property tax (Arborgast, 2015).

<u>Unharmful subsidies:</u>

- Environmental degradation; Discontinuity

  (Most consumption and production activities have an impact on the environment mitigated by government policy. A subsidy is considered harmful to the environment if it encourages more environmental damage than without the subsidy. Subsidies are costly, often inefficient, and often without a long-term strategic vision for economic and social purposes (Barde & Honkatukia, 2003).
- Discontinuity; Market inefficiency

  (Main challenge is to effectively integrate ecological and traditional knowledge, technical capacities, and the role of issues of society in restauration programs that engage active long-term participation of landowners, and increases governmental support. Many programs encourage participation only through economic incentives, without considering the importance of nonfinancial interest (Sarukhan et al., 2014).

Public risk competency, monitoring, and reporting

The local forestry agency shall inform the general public about local sustainability developments (In the case of Kami City this could be achieved through the monthly issue of the local magazine “KAMI” or other public information channels) to build-up a level of competency to self-evaluate forest condition. This competency shall be educated by the risk mediator as part of the local school curriculum, relevant NGO, and other applicable public events. Opinion surveys shall be conducted. Monitoring and reporting of forest condition (illegal waste deposit, logging, hunting, etc.) by the local public shall be encouraged and rewarded in severe cases. In the case of Kami City, monitoring and reporting could be implemented as part of the local district administration (HAN). Public competency as well as developments in regards to public monitoring and reporting shall be incorporated in the CRMP on behalf of the general public.

New approaches for increasing public risk competency, monitoring and reporting (public participation) can positively influence the mitigation of Environmental degradation and Discontinuity:

- Participation by private forest owners is essential for balanced development of forest policy, programs and legislation (MCPFE, 2002).
- Public participation increases mutual understanding of community interest and forest values, to avoid conflicts in the use of forests and their resources. Effective SFM participation enhances the awareness of its benefits. There is a need for forest authorities and managers to develop opportunities for SFM involvement (MCPFE, 2002).
- Public participation was encouraged in Agenda 21. Informed consent is regarded a means for local communities to shape the direction and outcomes of forest management including REDD+ (Reducing emissions from deforestation and forest degradation and enhancing conservation, the sustainable management of forests and forest carbon stocks) (Sun Park & Lee, 2016).
- A need for new approaches for public participation management becomes evident (Buchy & Hoverman, 2000).

Table 29: LERM-Model Derivation

		Environmental degradation	Discontinuity	Resource maldistribution	Market inefficiency
Collaborative Risk Management Process	Risk identification and measurement	RMP[1]	RMP	RMP	RMP
	Discussion of sustainable mitigation strategies	RMP	RMP	RMP	RMP
	Implementation of strategies	RMP	RMP	RMP	RMP
	Risk controlling	RMP	RMP	RMP	RMP
	Risk mediation	RMP	RMP	RMP	RMP
Definition of long term forestry vision and objectives	N/A	○	○	○	○
Principles of multifunctional forestry	Conservation of ecosystem, species and genetic diversity	○			
	Maintenance of man-made and natural capacity	○		○	
	Soil and water resources conservation	○			
	Protection from biotic and abiotic impacts	○		○	
	Contribution to global carbon cycles	○			
	Legal, institutional framework development	○	○	○	○

[1]RMP: Risk Management Process

Table 29 cont.

		Environmental degradation	Discontinuity	Resource maldistribution	Market inefficiency
Long term participation strategies	Market opportunities		○		○
	Silvicultural technology	○			
	Law development	○	○	○	○
	Taxation support		○		
	Unharmful subsidies	○	○		○
Public risk competency, monitoring and reporting	N/A	○	○		

Risk mitigation effects of DACA-LERM at legislative, administrative and operative level

Figure 30 briefly visualizes the combined sustainability risk mitigation effects of a DACA-LERM on legislative (policy making), administrative (strategy making and management), and operative (strategy implementation) levels.

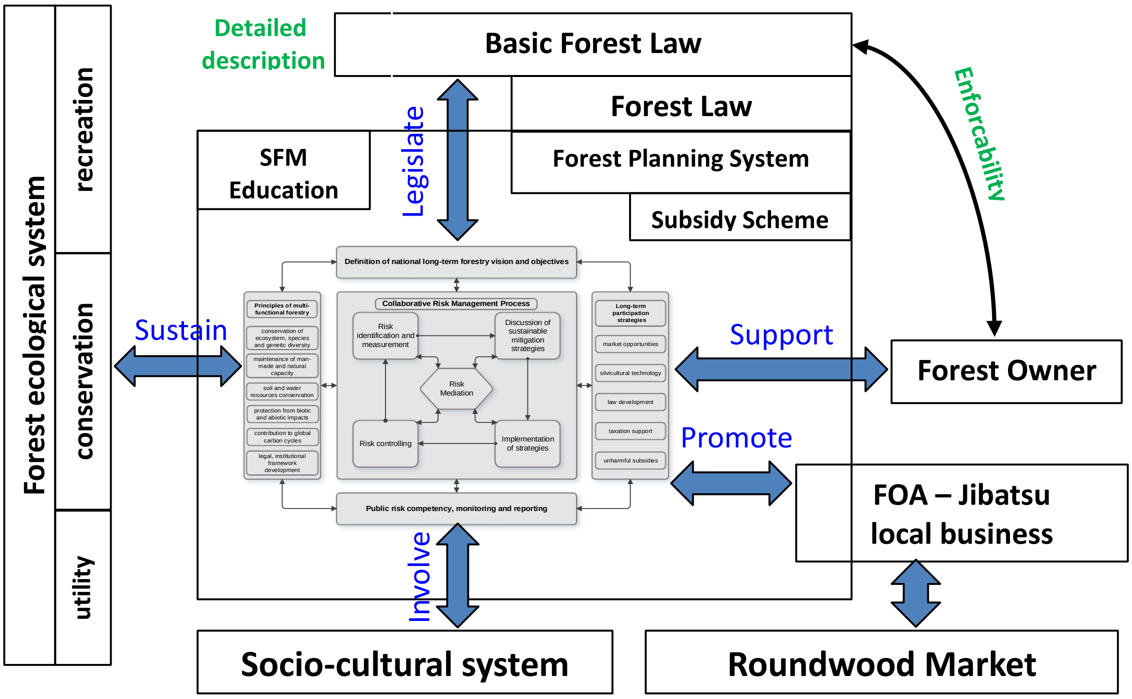


Figure 30: Sustainability risk mitigation effects of DACA-LERM on legislative, administrative and operative level

Sustain: Decisions made in the internal cycle should be capable to sustain the forest ecological system based on the concept of SFM promoted by the working group Montreal Process.

Support: Forest owners should receive hands-on supported to be become active members of forest management. Decisions made in the internal cycle should be made multi-stakeholder conform through expert mediation.

Legislate: Local and regional characteristics of environment, socio-demographics, industry, etc. should be communicated with MAFF to further develop policy and its enforceability.

Involve: The internal cycle should design activities and provide opportunities to further involve society in forestry and environment related topics.

Promote: Local industry development should be promoted through long-term participation strategies prepared and offered from management within the internal cycle.

9.3 LERM leadership

As previously discussed in Chapter 8 (8.3.2), local leadership and stakeholder integration is considered to facilitate communication and consensus building for practices that lead to sustainably managed forests. The aspect and kind of applicability of local leadership in Kami City/Kochi Prefecture shall be further discussed herein.

Many situations where the qualities of leadership become important are when interests and opinions collide. Effective leadership builds consensus among the different stakeholder interests to make the right decisions (Lax & Sebenius, 1986). Here, a separation between the common leadership styles arbitration and mediation shall be made to comprehend their main differences in the present case. Unlike leadership through arbitration where the leader has the authority to force decisions, leadership through mediation doesn't. This change of authority is probably the key difference of leadership in Kami/Kochi compared to the leadership in German or Austrian forest management, where final decisions can and are made by foresters with arbitration authority. A mediator on the other hand assists and guides parties with conflicting interests to reach an agreement, in most cases completely voluntarily (Pruitt and Rubin, 1986). Currently, the forest law in Japan can only insufficiently enforce the sustainability goals of the national government (Gain and Watanabe, 2013). These goals cannot be enforced through arbitration, so their implementation can only be negotiated through an alternative, non-enforceable approach. For this approach, the better applicable, but at the same time more difficult and challenging mediation approach seems appropriate.

Mediation over arbitration in local forest management processes in Kochi does not need to be disadvantageous. Research has shown that parties are usually more strategic in situations where leadership is conducted with an arbitrator who retains the right to make final decisions (Bowles, 2005). These parties normally tend to be more self-protective and try to maximize their personal outcome during this arbitration process being less open for settling disagreements by making mutual concessions. On the other hand, in mediation led leadership, parties keep a sense of control over the final decision, which preserves a feeling of comfort and personal safety. Brett and Goldberg (1983) observed in a field experiment that the more control stakeholders were given, the process and the outcome were judged to be fairer in comparison to arbitration. Moreover, information can be shared freely in the negotiation process among stakeholders for solving problems as a team. As a result, mediation can present fairly high consensus success rates of 60 – 80 percent, as various other research has shown (Bowles, 2005). In environmental research up to 78% success has been observed in several cases (Gail, 1986). Given this high success rate by mediation, a change of the forest law to enforce sustainability decisions may not even be necessary in Kochi.

In Kochi, the question remains what professional qualities such a mediator should possess. Arguably, a prerequisite of such a mediator would be adequate interpersonal and interdisciplinary scientific qualities ranging from technological soundness to management skills. The mediator must appear as a leader representing every party's interest while communicating the sustainability goals of the national government and the local characteristics of the target forestland to be managed. As an opinion representing body, the mediator must also be seen and respected as such. A gathering of sufficient knowledge of local key stakeholder motives with an effective establishment of relationships will be important for successful consensus making within the mediation process. Then the mediators become the leaders of the leaders.

Given the integrative aspect of LERM, NGO, research and other interest groups with a stake regarding the condition and structure of forest are given a greater chance to be heard and to present opinions and suggestions, generating greater networking. This access to alternative knowledge and expertise provides a chance to improve the condition of forest from an even wider perspective. This chance to lower sustainability risks should not be wasted. However, this integration of third-party opinion would also bring an expected increase in corporate responsibility from these interest groups. Opinions and suggestions must be prepared soundly to offer an effective foundation for discussion.

Besides the many advantages to improve the sustainability aspect of forest through stakeholder integration in Kochi, it may, however, bring some organizational disadvantages, especially for the private forest owner. Investing free time to attend LERM meetings may not be favored. Commuting to these meetings may prove to be a stumbling block in ensuring participation. A large portion of encouragement to establish meaningful participation in these meetings will be needed. In the long-term, the goal is to establish these meetings as a matter of course. Another disadvantage is that in certain disputes decisions made by mediation may not really be good sustainable decisions. Without a legal framework where one can fight legally for improvement, the system remains still vulnerable (Kahn, 1994).

Table 30 summarizes advantages of a mediation leadership approach over leadership by arbitration with advantaged specific for Kami/Kochi.

Table 30: Advantages of Mediation Leadership in Kochi/Kami

Management Aspect	Leadership by Mediation	Leadership by Arbitration	Advantages of Mediation in Kochi/Kami
Decision maker	parties	arbitrator	Weak legal framework for possible arbitration decision making in Kochi
Control of process	parties	arbitrator	Parties feel safe as control of negotiation process can be maintained. Chance for NGO and small interest groups to share information scientifically
Processing speed	fast	slow	Fast decision making, lower stress factor for forest owners
Cost	low to none	higher than mediation	No risk for costly legal involvement. No or very low expenses for private stakeholders
Risk of party relationship to be damaged	low	high	Chance to establish effective multi-stakeholder relationships.
Scope for strategic behavior	low	high	Parties maintain control of outcome
Chance for successful outcome	≥80%	unpredictable	High chance for success to come up with effective solution.
Type of outcome	high chance for win-win outcome	unpredictable	Win-win scenarios for all stakeholders in Kami
Focus of parties	future	past conduct	Effective negotiation of future sustainability aspects. Chance for alternative, more sustainable forest management approaches
Stress factor	released tension	stressful	Lower stress for parties, especially forest owners
Type of communication	personal, team oriented	formal	Chance to establish friendly and personal relationship
Type of negotiation	collaborative	adversarial	Information sharing and contributing through collaborative attitude
Ability to find solution without dispute	very high	low	High chance to successfully incorporate small NGO and interest groups in negotiation process
Jurisdictional problems after decision	none	possible	Weak enforceability of forest legislation can be a chance for better interpersonal relationships

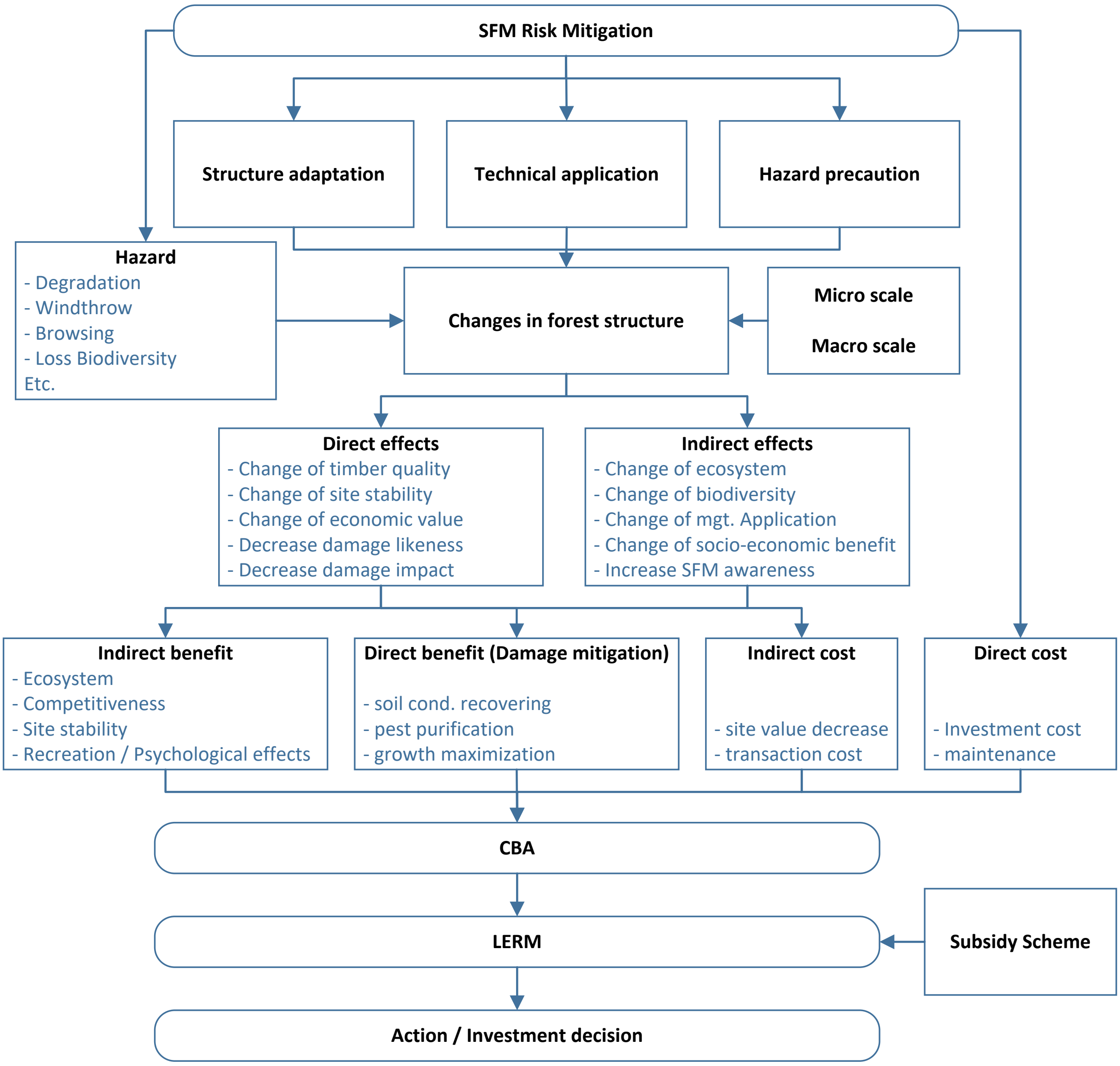
Summarized from: Bowles (2005), Gail (1986), Kahn (1994), International Mediation Institute (2016)

9.4 Cost – Benefit Analysis

Forest management is costly, especially labor costs for the operation of forest works such as planting, felling, thinning and extraction require financial spending. But also technical devices such as cable yarders, harvesters and transportation vehicles are often very expensive and require high investments. In times of increasing demands on the quality and sustainability aspect of forest, as well as decreasing private and public budget resources, meaningful forest management and effective financial spending need to be combined in order to achieve a satisfactory return on investments, and to satisfy the diverse demands on forest. Currently, as discussed in Chapter 5, management of private forest is heavily subsidized, mainly in order to support forest owners to compensate for local management cost such as thinning works in predominantly even-aged hinoki and sugi stands. These forest management projects are evaluated based on the simple and cost oriented cost comparison method (CCM) where projects are to a large extend treated uniformly and decisions are made based on economic objectives. The weakness of CCM is often that a differentiated evaluation of benefit cannot be performed and economic objectives are put on a level with benefit (Dehnhardt et al., 2008). For instance, in the case of forest management in Kochi, the subsidization of thinning works maintains access to private forest and roundwood while temporarily revitalizing forest condition. However, as discussed in previous chapters, uniformly conducted even-aged forestry brings also uncertain effects affecting forest stability and biodiversity. These effects could further worsen with a changing world climate bringing even lower general benefit as currently evaluated. In single certain cases the use of CCM may be useful (investment decision regarding new forest machinery, outsourcing of certain forest works etc.). In complex and uncertain projects, however, CCM can provide little declaration about the true benefit of a management alternative, because the aspect of benefit is addressed insufficiently (e.g. the benefit of biodiversity, carbon sequestration, natural rejuvenation, forest stability, water filtering etc.). Forests being complex ecosystems, each forest management project should be evaluated case-by-case, and management decisions should be made on not only how to most efficiently enhance economic viability but also on how to best improve sustainability aspects. To effectively evaluate sustainability aspects of forest the definition of benefit needs to be reassessed and a cost – benefit analysis (CBA) should to be performed. Forest management being a project with public involvement in Kochi, such a CBA can help estimate whether new forest management related measures (e.g. use of foresters, site assessments, site structure changes, a change in the subsidy scheme etc.) is meaningful from an overall macroeconomic perspective.

9.4.1 SFM risk mitigation – evaluation of measures and application

Figure 31 shows the recommended framework for SFM risk mitigation with CBA in Kami/Kochi. This framework is leaned on the 2008 research report of the cost-benefit analysis of flood protection measures of the German Ministry of the Environment (Dehnhardt et al., 2008). This framework is used to analyses direct and indirect effects, costs and benefits of flood mitigation measures. The results of this analysis are organized in a report (Part I, direct and indirect effect of the planned mitigation measure, and Part II, an economic evaluation), which serves as decision support for the communication of these flood risk mitigation measures with local stakeholders, such as landowners, conservationists and other stake and right-holding parties. The 2008 research report shows that this CBA framework was used successfully for stakeholder consensus building in the case of dike-relocation in the city of Dreieich, Germany.



Source: Author

Figure 31: SFM risk mitigation

As discussed in 8.1 and 8.2, DACA-LERM takes into account the application of alternative management measures that can involve changes of physical structures (forest age distribution, multi-layers etc.) for the enhancement of sustainability, as well as the integration stakeholder opinion, the CBA of flood protection measures of the German Ministry of the Environment is considered applicable in the case of Kami/Kochi forest management. However, for applicability, the German framework for CBA of flood protection measures was adapted to include mediation within LERM leadership and access to the Prefectural subsidy scheme for private industrial forest. Practical application shall be demonstrated on an example (post-site assessment and based on site structure change plan):

Industr. forest site (example 1)

Location:	XXX, 140m above sea level
Type of location:	hill, 55% decline
Owner or manager:	XXX
Tree species:	Sugi
Age group and area:	5, 2ha
Forest road:	Yes
Site condition:	high density, small signs of degradation, low stability
Mitigation recommended:	Yes
Site structure adaptation:	Yes, Conversion to 15% buna, 85% Sugi - Hinoki (dual layer) (refer to structure adaptation plan)
Technical application:	Yes. Swing yarder. Processor
Hazard precaution:	loss of biodiversity, windthrow
Previous forest works:	none
Remarks:	close to settlement, no industry

Steps of CBA

1. Calculation and/or estimation of direct and indirect effects of mitigation measure
2. Calculation and/or estimation of direct and indirect cost and benefit of these effects
3. Production of CBA report
4. Action and/or investment decision

In event risk mediation is required:

4. Communication of CBA report (Parts I and II) with key stakeholders – utilization of applicable financial incentives
5. Action and/or investment decision

9.4.2 CBA report

Table 31 shows part I of the CBA report (direct and indirect effect of the planned mitigation measure) for example 1 above.

Table 31: Practical example for CBA report (Part I – direct and indirect effects)

Industr. Forest Site (Birafu - Kochisan) Age group: 5 - Sugi - 2ha high density - small signs of degradation (140m - 55% decline) close to settlement no industry Forest Road: Yes (uphill)	Micro-scale									
	Conversion to 15% buna, 85% Sugi - Hinoki (dual layer)									
	Direct Effects					Indirect Effects				
	Change Timber quality	Change Site stability	Change econ. value	Decrease damage likeliness	Decrease damage impact	Change Ecosyst.	Change Biodiversity	Change mgt. Applicat.	Change soci.eco. Benefit	Increase SFM Awaren.
Structure adaptation										
Early thinning										
buna planting (scen. 1)			(-)	(-)	(-)					
use exist. buna rejuvenation (scen. 2)			(-)	(-)	(-)					
(+) 20 years										
(+) 40 years										
(+) 60 years										
Technical application										
Restructuring to dual layer site			(-)							
Rebuilding of tree (strip) arrangement										
Planting of buna (in case of scen. 2)										
Hazard precaution										
Soil quality enhancement										
Infestation/degradation elimination										
Object-safety (living)										
Object-safety (industry)										
Information/Forecasting										
Emergency measures (living)										
Emergency measures (industry)										

	positive SFM effect / reduction of possible hazardous effects on forest
	positive (but not direct) influence
	limited effect
(+)	increasing / extending / enhancing
(-)	decreasing / shortening / worsening

Source: Author

Colors indicate the through measurement and/or estimation determined positive (or negative) SFM effects, and/or the degree of reduction of hazardous effects on forest, the planned risk mitigation measure and its associated works has on the project. (+) and (-) either indicate an increase or decrease of a direct or indirect effect value.

Table 32 shows part II of the CBA report (economic evaluation) for example 1 above. Calculated and/or estimated direct and indirect costs and benefits of the planned risk mitigation measure, and its associated works, is organized and contrasted for stakeholder consideration.

Table 32: Practical example for CBA report (Part II – economic evaluation)

Industr. Forest Site (Birafu - Kochisan) Age group: 5 - Sugi - 2ha high density - small signs of degradation (140m - 55% decline) close to settlement - no industry Forest Road: Yes (uphill - 80m)	Economic Evaluation			
	Cost		Benefit	
	direct cost	indirect cost	direct benefit	indirect benefit
Structure adaptation				
Early thinning	thinning cost	opportunity cost (through late thinning etc.)	Growth maximization	Ecological Benefits
buna planting (scen. 1)	planting cost	opportunity cost (through browsing)	little to no rejuvenation mgt.	Ecological Benefits
use exist. buna rejuvenation (scen. 2)	none	rejuvenation mgt.	low cost	Ecological Benefits
(+) 20 years	/	/	high stability	Ecological Benefits
(+) 40 years	/	/	high stability	Ecological Benefits / Recreational effects
(+) 60 years	/	/	high stability and vitality	Ecological Benefits / Recreational effects
Technical application				
Restructuring to dual layer site	extraction cost higher mgt. cost	opportunity cost (through low quality timber)	extended rotation time	Ecological Benefits / Recreational effects

Rebuilding of tree (strip) arrangement	extraction cost (advisory cost)	opportunity cost (through low quality timber)	higher stability and vitality	Ecological Benefits / Recreational effects
Planting of buna (in case of scen. 2)	planting cost plant protection cost	opportunity cost (through low quality soil / browsing)	little to no rejuvenation mgt.	Ecological Benefits
Hazard precaution				
Soil quality enhancement	none	none	Growth maximization	Ecological Benefits
Infestation/degradation elimination	none	none	high stability and vitality	Ecological Benefits value maximization
Object-safety (living)	none	none	lower chance for water and landslide damage	property value increase
Object-safety (industry)	none	none	lower chance for water and landslide damage	property value increase
Information/Forecasting	Communication cost	none	avoidance of damage	higher SFM awareness
Emergency measures (living)				
Emergency measures (industry)				

Source: Author

9.4.3 CBA Limitations

The problem of CBAs in sustainability management is often value evaluation of public goods. While direct and indirect costs of practical works can in many cases be calculated easily and with tangible evidence (if the price of resources human and non-human resources is known or can be estimated with confidence), value evaluation of public goods that are improved through sustainability (e.g. such as biodiversity, pollination etc. is very difficult since they are goods without clear monetary value. For instance, a nature conservationist may evaluate the value of biodiversity higher than a forest owner who is more interested in making profits. Agreement on a common currency for all benefits and costs may not only facilitate consensus building but also ease stakeholder participation and integration processes.

9.5 DACA-LERM Model validation

In the model development stage, sustainability risks and the functions and measures required to mitigate those risks had to be defined. Model validation is a model risk mitigation strategy to minimize the possible adverse effects during the implementation of the target model. DACA-LERM is an ecosystem management model designed for sustainability. Such models are usually not a one-time implementation but undergo a rather evolutionary process (Peine, 1998). Modifications due to external and internal dynamics (e.g. uncertain input data, wrong assumptions, incorrect implementation, misinterpreted outputs) may occur, increasing the complexity for model validation.

Model validation of DACA-LERM follows the reviewing of (1) Model governance, (2) Model input and output data, and (3) Model verification through simulated application.

(1) Model governance

DACA-LERM model is built upon the principles of the Integrated Governance Framework of the United Nations Environment Programme. To summarize briefly, integrated governance is "the system by which companies are (a) directed and controlled, in which sustainability issues are integrated in a way that ensures (b) value creation for the company and (c) beneficial results for all stakeholders in the long term". Integrated governance highlights the need for the management of all types of capital including man-made and natural. Integrated governance is capable of realizing sustainable strategy (UNEP, 2014). A precondition of integration governance, however, is that stakeholders will have to go through a number of changes. DACA-LERM components and subcomponents that fulfill (a, b, c) aspects of UNEP integrated governance:

<u>Direction and control:</u>

- **National long-term vision and objectives** (as described in Japan Basic Forest Act, 1964; NBSJ, 2012) Free of charge access of multifunctionality consultation by public forestry administration (as described in LERM model derivation in 8.2)
- **Public participation, monitoring and reporting** (regular site monitoring as described in risk mitigation plan in 7.3)

Value creation (management of all types of capital)

- Natural capital: **National long-term vision and objectives**

  Principles of multifunctional forestry

- Human capital: **Collaborative Risk Management Process**

  (by adding of human capital (as discussed in 7.2) by introducing expert risk mediator; adding of free of charge access to multifunctionality consultation for educative purposes

- Financial capital: **Long term participation strategies - Market opportunities**
- Physical capital: **Principles of multifunctional forestry**

  (by adapting SFM concept to forest structure)

  Long term participation strategies - Unharmful subsidies

  (for support for maximizing man-made and natural site capital)

- Intellectual capital: **Collaborative Risk Management Process – Risk mediation**

  Long term participation strategies – Silvicultural technology

- Social capital: **Long term participation strategies - Market opportunities**

  Principles of multifunctional forestry

  (by adapting SFM concept to forest structure)

- Financial Return: **Long term participation strategies - Unharmful subsidies**

  Long term participation strategies – Taxation support

  Long term participation strategies - Market opportunities

- Externalities: **Public participation, monitoring and reporting**

  Long term participation strategies – Law development

- Products/Services: **Long term participation strategies - Market opportunities**

Long-term beneficial results

Long term participation strategies

Collaborative Risk Management Process – Risk Mediation – CBA

(2) Model input and output data

When speaking of input and output data in sustainability, besides tangible support data (e.g. environmental data, market data, technical data etc.) that can be used to describe or support arguments regarding sustainability conditions, the type and character of a condition itself can be considered as input data that creates sustainability or unsustainability outputs. Figure 32 summarized the interorganizational conditions identified in this research and the output conditions that they create.

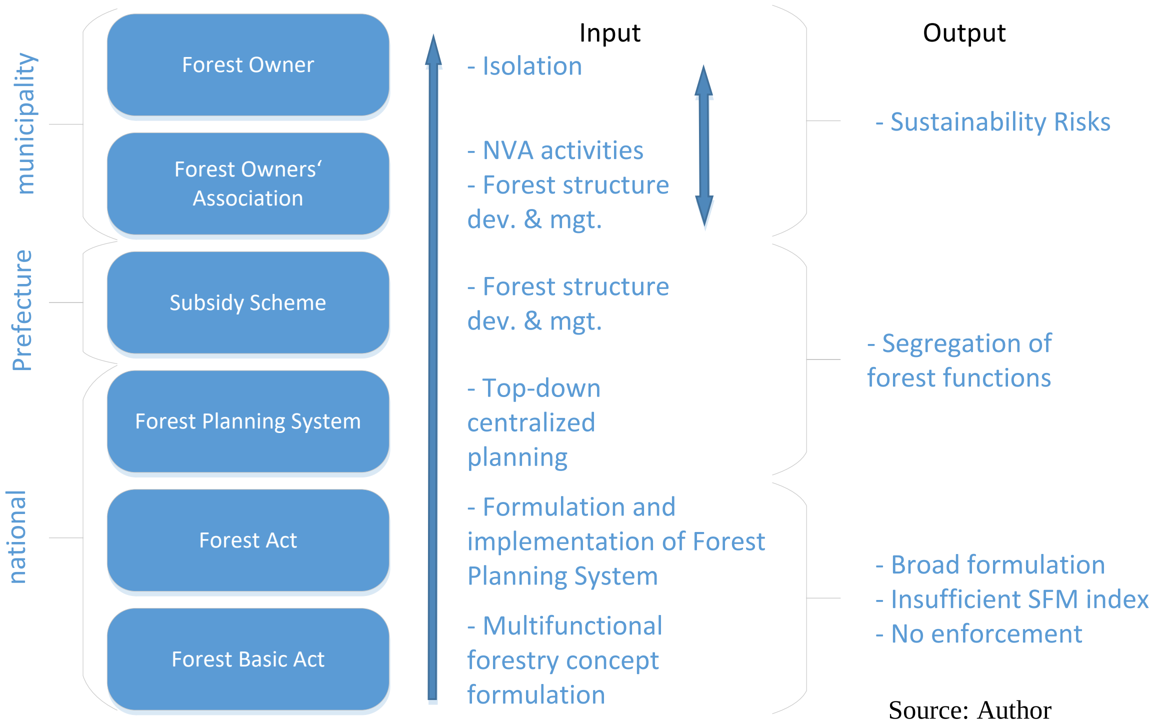


Figure 32: Interorganizational Input-Output of forest management in Kami/Kochi

Following the argumentation of this research so far an adaptation of inputs (adaptation of character of conditions) as shown in Figure 33 is expected to mitigate sustainability risks to create DACA-LERM sustainability outputs.

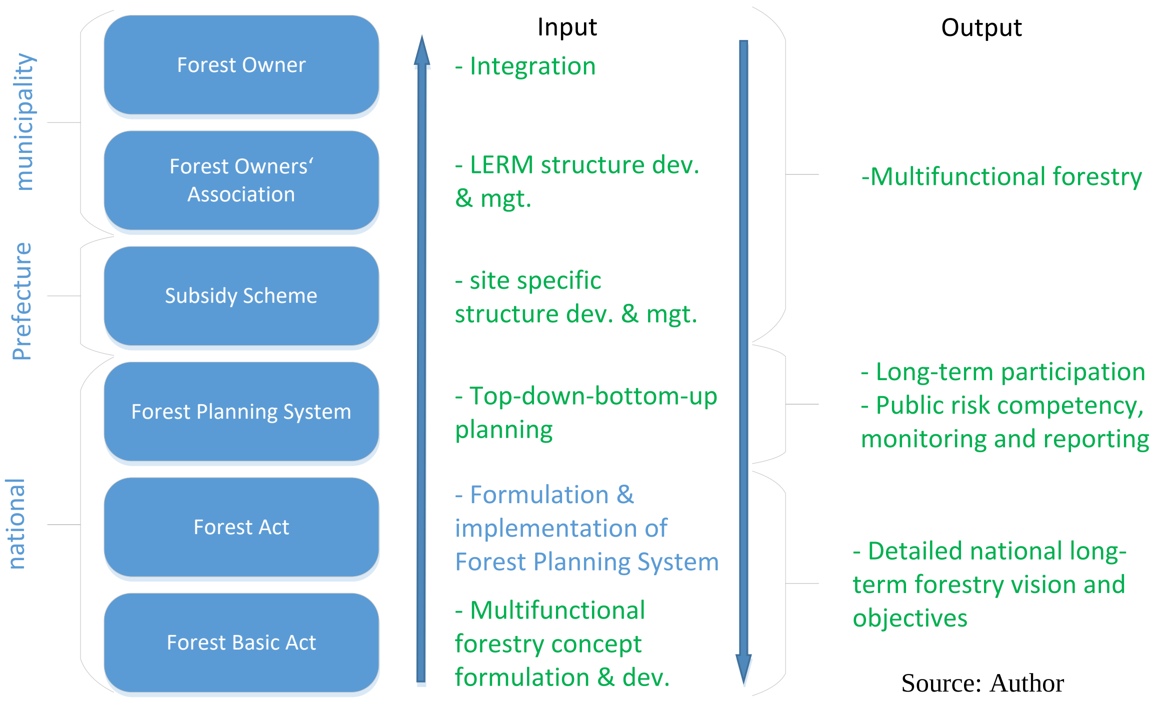


Figure 33: DACA-LERM Input-Output of forest management in Kami/Kochi

Note: Input and output changes are highlighted in green.

(3) model verification through simulated application

Verification of DACA-LERM is performed in the form of a risk assessment performed by key stakeholders on a practical model application scenario. This verification shall be content of the following subchapter 9.6.

9.6 DACA-LERM model verification: Stakeholder risk perception assessment by model application

The four sustainability risks as described in Chapter 8 are a result of research conducted by the author in this study. The probability and impact of these risks under the current condition, and their possible future development, however, need to be assessed. In addition, the risk perception of management with DACA-LERM also needs to be assessed and validated in order to see if and how improvement could be expected. A risk perception assessments of the four sustainability risks was conducted for these two scenarios.

9.6.1 Materials and Methods

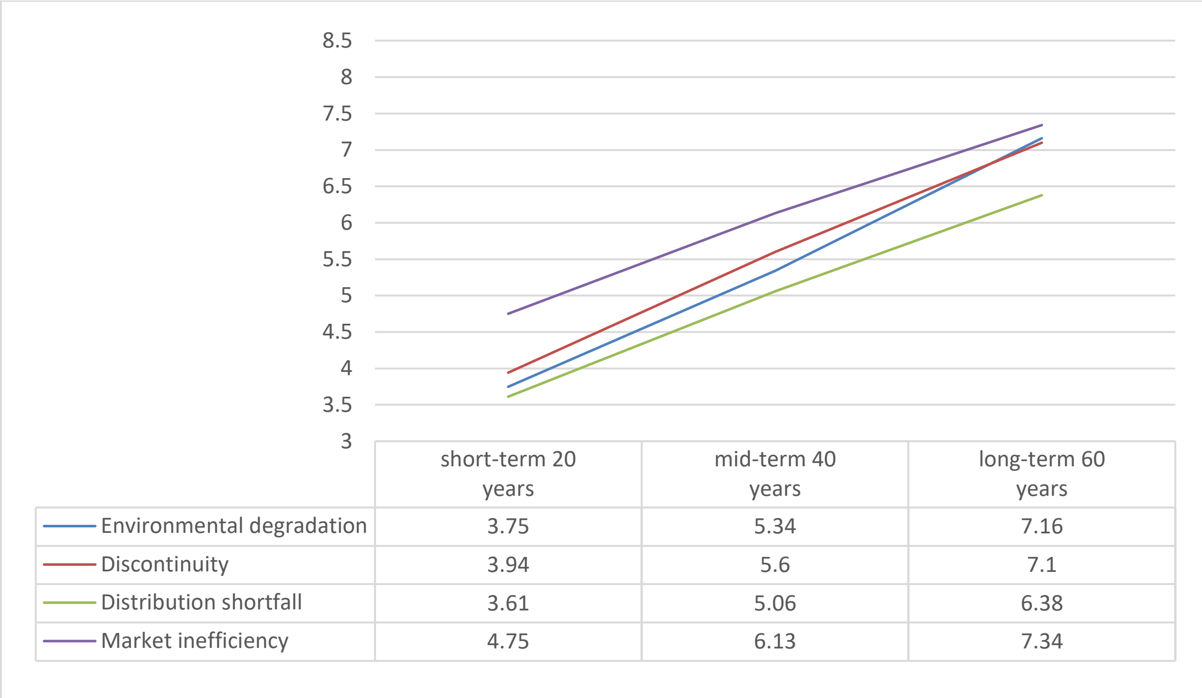
A questionnaire (Appendix C: Questionnaires) was administered to measure short, mid, and long-term risk perception of public and private forestry practitioners in Kochi Prefecture (n=35) for the sustainability risks (a) environmental degradation, (b) discontinuity, (c) resource maldistribution, and (d) future market inefficiency on the realization of integrative forestry. This risk perception assessment was performed for two scenarios: first without a change of the currently used forest management system, and second, after the consideration of the risk mediation plan that includes LERM management. The assessment was designed to rate probability and strength of impact of the four risks on a scale from 1 – 10 for either scenario with 1 being very low risk and 10 very high risk. To ensure a comparable level of knowledge of the participants on the current system and the functionality of LERM, all participants were given a non-biased two-hour lecture in which both systems were explained. After the lecture, ten minutes were provided to discuss the content of the lecture in groups, after which the questionnaire was filled out individually and without further contact to other participants. In addition to the risk assessment, five extra questions were asked. The first question addressed the need for integrative forest management. The remaining four questions were to measure the level of agreement for the necessity to consider the five external factors that are considered to affect successful implementation of LERM. These four questions addressed the issues of (1) the need for sustainable management of industrial forest, (2) the need for a redevelopment of the national forest law in accordance to local integrative forestry, (3) the need to increase society interest in forestry related issues, and (4) the need to promote forestry businesses. Answers to these questions were ranked on a Likert Scale from 1 (agree) to 6 (I don't know). After completion and reception of the questionnaire, average risk perception of probability and strength of impact were calculated for each risk and timeframe and organized into line charts. Risk factor scores for each risk were then calculated for the two scenarios with and without LERM as the product of probability and impact.

$$\textit{risk factor (RF)} = \textit{probability of risk (PR)} \times \textit{impact of risk (IR)}$$

Results were then organized in a line chart with RF levels set to: low risk perception (0 – 25) moderate risk perception (more than 25 – 50), high risk perception (more than 50 – 75), and critical risk perception (more than 75 – 100). Answers for the five questions regarding external implementation factors were organized in a stacked bar chart.

9.6.2 Results

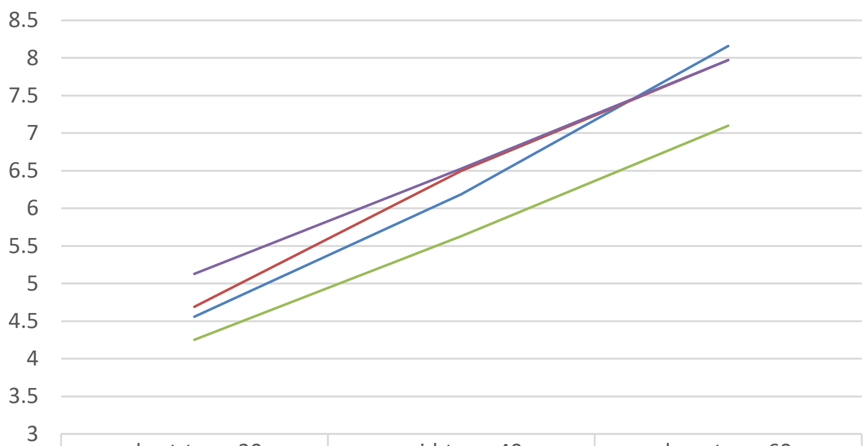
Figures 34 and 35 show the summarized results for short, mid, and long-term risk perception of the participants for the probability (Figure 34) and impact (Figure 35) of the four sustainability risks: environmental degradation, discontinuity, resource maldistribution, and future market inefficiency, for scenario one: without change of the currently used forest management system. The analysis indicates that average risk probability of the four risks is perceived by participants as increasing over the given timeframe. The highest perceived probability risk was future market inefficiency. On a ten-point scale, long term risk of future market inefficiency is perceived approximately 2.6 points higher at 7.34 than short term risk at 4.75. The second highest long-term perceived probability risk is environmental degradation which is approx. 3.4 points higher from 3.75 to 7.16, however, it is the highest increase of perceived probability risk measured. Discontinuity, and resource maldistribution are perceived at: 7.1 and 6.38 respectively.



	short-term 20 years	mid-term 40 years	long-term 60 years
Environmental degradation	3.75	5.34	7.16
Discontinuity	3.94	5.6	7.1
Distribution shortfall	3.61	5.06	6.38
Market inefficiency	4.75	6.13	7.34

Figure 34: Short, mid, long-term perception of risk probability – Scenario 1

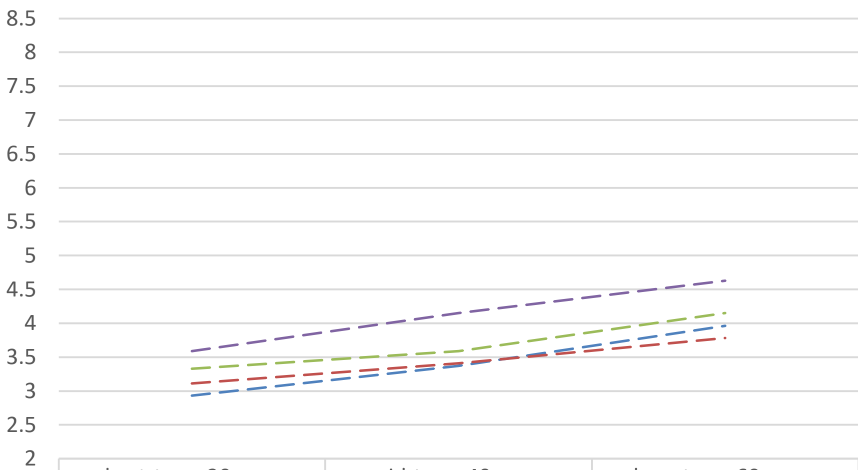
Long-term risk impact perception shows similar results to those for long-term risk probability. All four risks are perceived as increasing between the short-term and long-term timeframes. However, unlike results for risk probability, long-term risk impact of environmental degradation is perceived the highest among the five with an increase of 3.6 points over short-term risk impact (4.56 to 8.16). Between mid-term and long-term, a steeper increase was measured than between short-term and mid-term timeframes. The second highest perceived long-term risk impact is shared by future market inefficiency and discontinuity (7.97). Short-term, future market inefficiency and discontinuity are perceived as the highest impact risks with 3.75 and 3.94 points respectively. Perceived risk impact of discontinuity over the given short-term to long-term timeframe increased 3.16 points (3.94 to 7.1). Risk impact for resource maldistribution was perceived as increasing by 2.85 points (4.25 to 7.1).



	short-term 20 years	mid-term 40 years	long-term 60 years
Environmental degradation	4.56	6.19	8.16
Discontinuity	4.69	6.5	7.97
Distribution shortfall	4.25	5.63	7.1
Market inefficiency	5.13	6.53	7.97

Figure 35: Short, mid, long-term perception of risk impact – Scenario 1

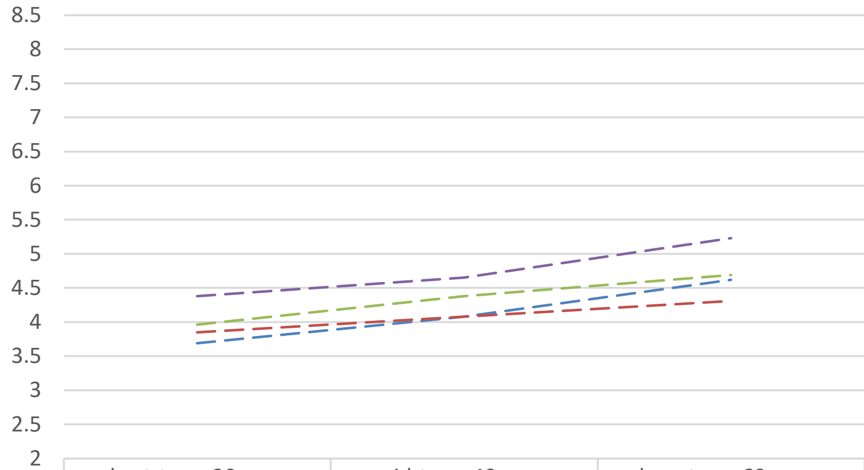
Figures 36 and 37 show the summarized results for short, mid, and long-term risk perception of the participants for the probability (Figure 36) and impact (Figure 37) of the four sustainability risks for scenario two, management after the consideration of the risk mediation plan that includes LERM management.



	short-term 20 years	mid-term 40 years	long-term 60 years
Environmental degradation	2.93	3.37	3.96
Discontinuity	3.11	3.41	3.78
Distribution shortfall	3.33	3.59	4.15
Market inefficiency	3.59	4.15	4.63

Figure 36: Short, mid, long-term perception of risk probability – Scenario 2

Compared to scenario one, perceived probability and impact risks under scenario two also increases, however, the level of increase can be observed to be lower for all four risks. While long-term probability and impact risk perception in scenario one increases between 2.54 and 3.6 points depending on sustainability risk, the perception of these risks in scenario two is shown to be between 0.3 and 0.97. The ranking of the risks can also be observed to be in a different order to scenario one.



	short-term 20 years	mid-term 40 years	long-term 60 years
Environmental degradation	3.69	4.08	4.62
Discontinuity	3.85	4.08	4.31
Distribution shortfall	3.96	4.38	4.69
Market inefficiency	4.38	4.65	5.23

Figure 37: Short, mid, long-term perception of risk impact – Scenario 2

As seen in Figure 36 and Figure 37, long-term perception of risk probability and impact for the risk of future market inefficiency is the highest for scenario two. For environmental degradation, they are perceived lower than in scenario one.

Risk factor (RF) scores for each sustainability risk were organized for both scenarios (1) with mitigation strategies and LERM, and (2) without mitigation strategies and LERM. RF scores are listed in Table 33 and graphically displayed in Figure 38.

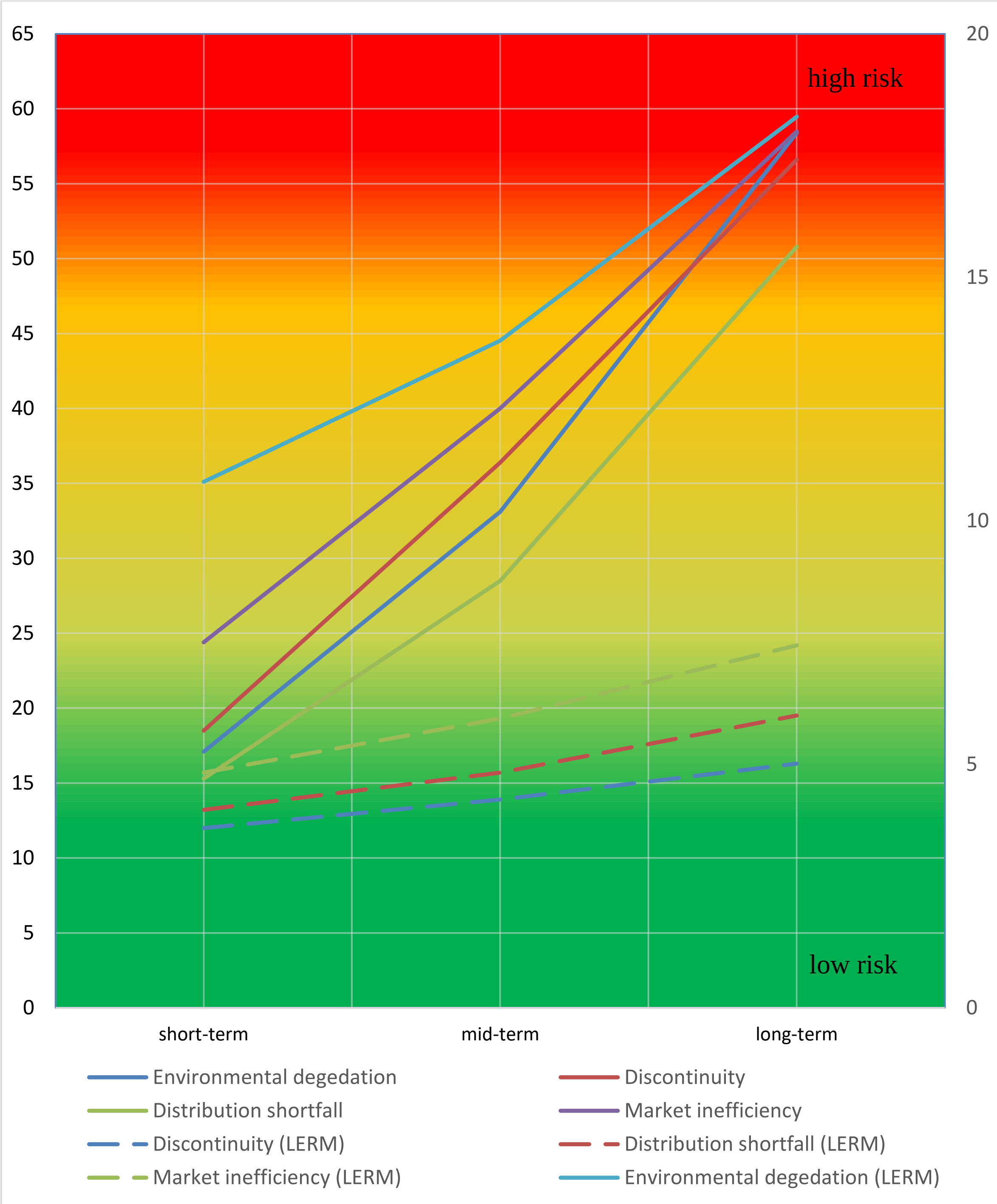


Figure 38: Short, mid, long-term RF Scenario 1 and 2 (LERM)

Table 33: Short, mid, long-term RF Scenario 1 and 2

Type of risk	RF scenario 1			RF scenario 2		
	short	mid	long	short	mid	long
Environmental degradation	17.1	33.1	58.4	10.8 (-37%)	13.7 (-59%)	18.3 (-69%)
Discontinuity	18.5	36.4	56.6	12.0 (-35%)	13.9 (-62%)	16.3 (-71%)
Resource maldistribution	15.3	28.5	50.8	13.2 (-14%)	15.7 (-44%)	19.5 (-62%)
Future market inefficiency	24.4	40.0	58.5	15.7 (-36%)	19.3 (-52%)	24.2 (-59%)

Short-term RF in scenario 1 for all sustainability risks but future market inefficiency is below 20, indicating a low risk. In mid-term, all four risks increase to moderate level ranging between 28.5 and 40. In long-term, a steep RF increase can be observed for resource maldistribution (+22.3) and environmental degradation (+25.3) compared to the other three risks whose RF also increases, but in a less steep fashion: discontinuity (+20.2), future market inefficiency (+18.5). Future market inefficiency (58.5), environmental degradation (58.4), discontinuity (56.6), and resource maldistribution (50.8) have high perceived risk factors.

Short-term RF scores in scenario 2 for all sustainability risks are below 20 (10.8 – 15.7), indicating a perceived low risk which remains low until the mid-term timeframe (12.3 – 19.3). Long-term RF scores show a steep increase for future market inefficiency (+4.9), which enters the moderate risk level at a score of 24.2 while obtaining the highest RF score (24.2). The remaining sustainability risks stay within the low risk level (14.9 – 19.5).

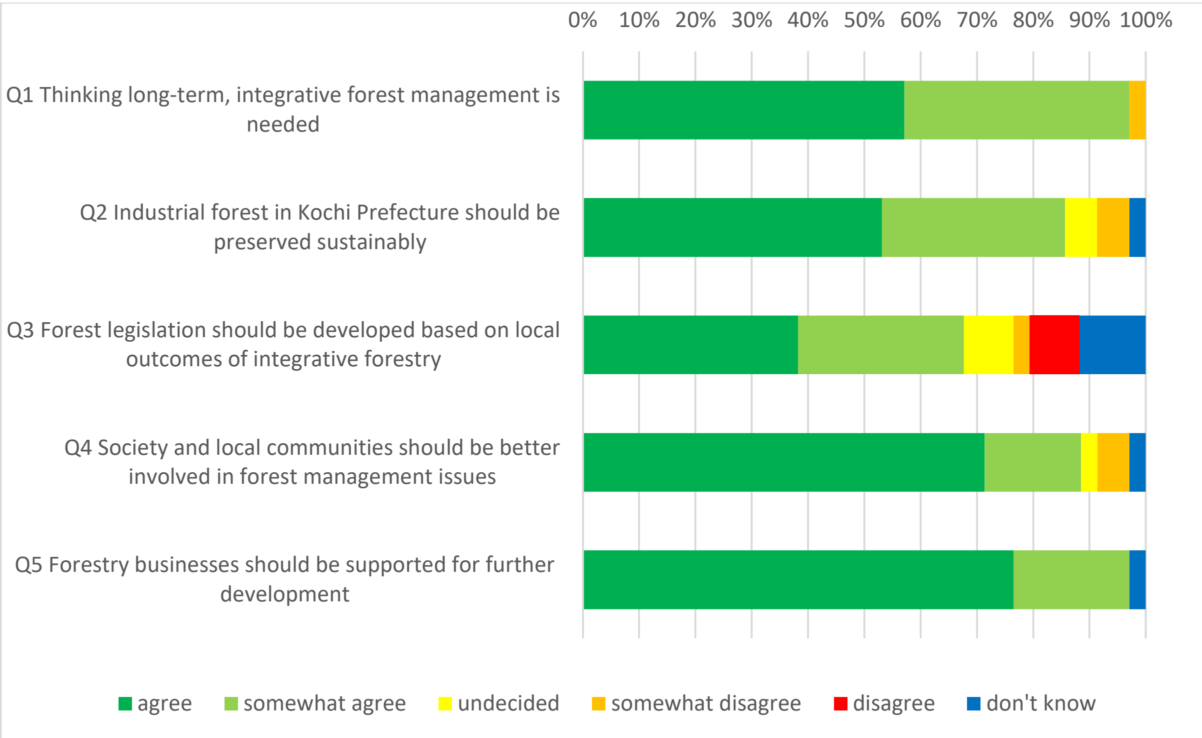


Figure 39: Level of agreement for external factors considered necessary for LERM

Figure 39 shows the results of the measured level of agreement for an integrative forest management approach, and for the necessity to consider the five external factors considered to affect successful internal implementation of LERM (Q2-5): (1, 2) Support and promote, (3) involve, (4) legislate, (5) sustain. More than two thirds of participants agree or somewhat agree to the questions asked. However, the least agreement was realized for question 3, the need to further develop the forest law based on local outcomes of forest management, where 20% of participants were undecided or either somewhat disagreed or disagreed. 12 percent answered: I don't know. The largest agreement of 97 percent (somewhat agree and agree) was measured for Q1 and Q5, which was 97 percent respectively.

9.6.3 Discussion

Overall, results of the risk perception assessment for both scenarios shows a different perception of participants of probability and impact risks for the four sustainability risks. Although scenario 2 shows lower perceived risks in comparison to scenario one, the risks still increase within the given timeframe and does not decrease. This effect of increasing risk perception over time could be accompanied by skepticism of participants due to lack of tangible evidence of LERM working in real life, a – I believe it when I see it – effect. However, the effect of increasing risk perception could be of another complex origin observed by other researchers. SFM is a management concept for the preservation and development of forests against unsustainable external dynamics. Such unsustainability triggering external dynamics are present and cannot be eliminated. Therefore, a certain degree of uncertainty will always remain, regardless the effectiveness of an SFM concept (von Detten, 2011).

Given Results, the lower risk perception of participants for scenario 2 could be a result of a lower uncertainty of the integrity aspect of forest management and how forests may sustainably contribute to society in the future. The presentation of the concept of LERM to the participants could therefore have reduced this uncertainty aspect in the participants leading to an overall reduced risk perception. The risk perception for environmental degradation for scenario 2 was measured as significantly lower than for scenario 1. Interestingly, despite the reduction of perceived risk for future market inefficiency in scenario 2, it remained the risk with the highest risk factor. The reason for this result is probably linked to the fact that forest management can control the structure of forests by influencing how works are applied, however, has little influence on market behavior and their participants. Market dynamics are another uncertain aspect of forest management. The price for roundwood in Japan has plummeted in past decades which could also have led to an increasing distance through anxiety of consumers and forest owners to market dynamics. This experience could also have influenced the risk perception of the participants. Support of forest owners and promotion of forestry businesses can improve sustainability by ensuring stand access and productivity, but market dynamics and consumer behavior are another issue.

Results for agreement of external factors shows exceptionally high acceptance for an integrative forest management concept among participants. The pillars of integrative forestry: environment, economy, protection and recreation, seem to be generally accepted. However, it can be argued that in order to implement such an integrative system, adaptation of national law which enables bottom-up communication for law development is required. As results for Q3 show, local influence on national forest legislation development is least favored. Additional comments from participants mention that improvements of national forest law have been made, however, with weak enforceability. While other participants favor the current law, as stricter rules would put higher disadvantages on forest owners. Others argue that national forest legislation would be very difficult to change from a local or regional level. These comments strengthen the need for improved communication between regional and national authorities as proposed earlier with the external cycle.

9.6.4 Conclusion

Results show, long-term perception of all four sustainability risks under the current management system without LERM tend towards high risk. In comparison to the proposed alternative system with LERM, a reduction of long-term risk perception could be observed. Market efficiency appears to be the risk of highest perception in both scenarios. Results of further questions have shown that the majority of participants agree upon the general framework of the integrative forest management concept LERM. These results are unexpected because of the widely practiced segregative forest management approach[4]. A reason for this result can be the newness and the difference from the existing system. However, it can also have rational reasons and be an indication for dissatisfaction with the current segregative approach. However, since integrative forest management is built-upon the acceptability of a system addressing all of them is yet to be determined.

[4] In segregative management large areas of forest are separated for nature conservation without any type of management from areas with high degree management for economic purposes. In integrative management nature conservation and management for economic purposes are combined including strategies such as the mixing of species for close-to-nature forest management. (Bollmann & Braunisch, 2013)

9.6.5 Implications of Results for Objective 6

- Derive, validate and discuss an integrative forest management framework taking into consideration sustainability risks identified in exploratory and explanatory research.

The purpose for why this study was conducted was to validate an alternative integrative forest management framework for Kochi Prefecture, which was derived based on four sustainability risks identified in earlier exploratory and explanatory research. For this validation, a short, mid, and long-term timeframe risk perception analysis for the four sustainability risks was conducted. Adding to the conclusions of this sub-study, the most important implications that can be made in terms of implementing the SFM Character in Kochi Prefecture is that an integrative concept can have the potential to decrease perceived sustainability risks, possibly through the reduction of uncertainties within the system. Results show large agreement for transition to an integrative management framework, however, the degree of acceptance of all aspects of such a framework needs to be further observed.

9.7 Acceptability

For realizing the dependent variable of SFM Character, as described in Chapter 2, the final independent variable x_5: cognition factor of social awareness and acceptability, remains to be measured. In order to measure x_5 for an alternative integrative management condition, a separate opinion survey was conducted.

9.7.1 Materials and Methods

A questionnaire was designed and administered to measure the level of explicit and implicit acceptability for an alternative integrative forest management system in Kochi Prefecture. The questionnaire was administered to 30 participants with forestry experience (forest practitioners n=15, forest management students n=11, no answer n=4) at a forest management event in Kochi City and was designed in two parts: Part I, SFM function acceptance for management (Economy, Environment, Protection and Recreation), and Part II, four acceptability questions for sustainability supporting measures: (1) monitoring through on-site management, (2) access to forest owners, (3) expert advice regarding general concept of SFM, (4) penalties in events of omitting management. To ensure sufficient awareness of the concept of SFM, all participants sat a 120-minute lecture about the concept of SFM. After the lecture, the questionnaires were filled out individually without contact to other participants to avoid influence and to focus on personal opinion. Answers to Part I were either YES for acceptance, or NO for rejection of management including the selected SFM function. Answers to questions in Part II were ranked on a five point Likert Scale ranging from 1 (agree) to 5 (I don't know).

9.7.2 Results and Discussion

Figure 40 shows the results of Part I of the survey. The acceptance of the 30 participants for management including the four basic functions of SFM – Environment, Economy, Protection and Recreation can be seen. Results show an opinion gap in the integration of forest functions with a superior opinion for economy, 93 percent. 63 percent of participants believe the aspect of environment should be a matter of forest management. The functions protection and recreation are evaluated 53 and 47 percent respectively. 33 percent of applicants believe forest management should be conducted integratively, including all four functions. Evaluating these results, relatively strong acceptance for a management approach including economy and environment can be observed, however, a general preference for segregation of forest functions with overall economy preference can be detected.

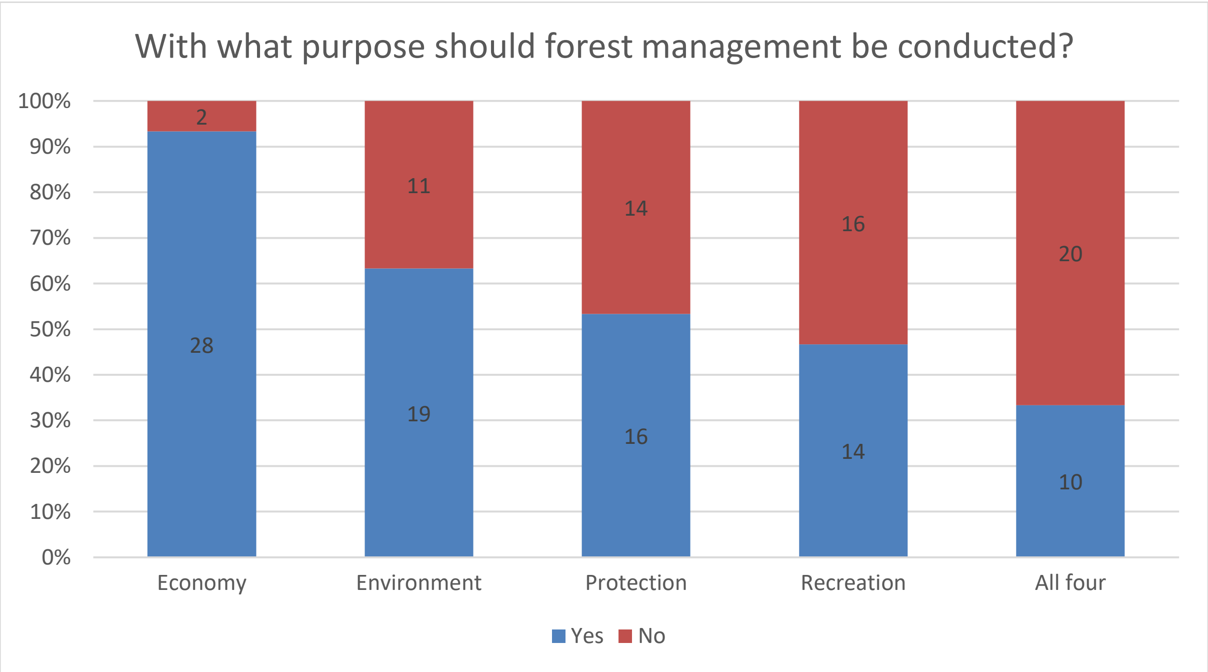


Figure 40: SFM Acceptability Questionnaire Results – Part I (Question 1)

Sustainability suggests an integrative focus on all four functions. Reasons for preference for segregation can be due to the typical segregation influencing factors found in Kochi Prefecture as described and discussed in Chapter 5. In addition to the typical segregation influencing factors, there may be reasons for a neglecting of the aspects of protection and recreation. For the aspect of protection by forest, Kochi Prefecture has times of extreme natural phenomena which often have a destructing effect on the physical condition of forest which may not clearly show the advantages of this aspect. There have been events in which exceptionally strong rainfall during the rainy season in June and July led to landslides which caused destruction. Such landslides have also occurred after earthquakes. Tropical storms often cause damage such as windthrow and flood which in some cases can cause damage of nearby objects such as vehicles and homes. In some cases, windthrow and flood may even cause injuries. Although the aspect of protection seems an important management measure to pursue, especially under such harsh natural conditions, perfect protection cannot be guaranteed, even if management for protection can be considered to be carried out flawlessly. With frequent natural catastrophes involving damage of and by forest, the idea that management can increase the protective aspect may not be well understood and its importance therefore neglected.

Neglecting the management function of recreation can have several socio-cultural and socio-demographic reasons. Culture is the behavior that was learned and is shared by members of a society. Unlike societies in many western nations, Japanese society strongly identifies itself with employment and workplace. Clear separation between work and privacy is less accepted. Because of this, it is common for many workers in Japan to work overtime, often without extra compensation. Even adolescents are expected to participate in daily club activities in school, or attend a cram school until late hours, and even during weekends. Free time that all family members are available at the same time is scarce in many households. Therefore, time availability may be one disturbing factor for recreation in the forest.

From a socio-cultural perspective, little interaction between the ecological system and the socio-cultural system induced by infrastructural deficiencies may have led to little awareness of the positive effects of recreation in the forest. In Kochi Prefecture, general forests are not made for recreation purposes. Access by car is often difficult, especially because of inappropriate road conditions for small passenger cars. Access is also not allowed for many roads used for working and heavy machinery. Oftentimes road conditions are not appropriate for walking. Moreover, industrial forest often being dark and lacking variety may not be visually appealing to everyone. Forest areas specifically designated for recreation that are close to settlements are rarely seen.

The creation of interaction between the socio-cultural and ecological systems, however, should be taken seriously. Interruption of this interaction may lead to unsustainability effects through social collapse. An example for such a social collapse in Kochi Prefecture could be the strong population decrease in mountain villages with people moving out to larger cities to seek better opportunities.

One third of participants believes that all four aspects of SFM: environment, economy, protection and recreation should be equally addressed in forest management related decision making. Especially for this study, this result is surprisingly low, given the fact that participants listened to a lecture about the concept of SFM shortly before the survey was conducted. This indicates an only 33 percent acceptance for an alternative integrative forest management approach. The most frequent comments by participants were related to economically driven management being more important than management that balances out all four functions (All participant comments can be found in Appendix C). However, analyzing answers of Part II of the survey, the majority of participants agree or somewhat agree with sustainability supporting statements in questions 2 – 5, suggesting implicit acceptance of changes which would promote integrative management (Figure 41).

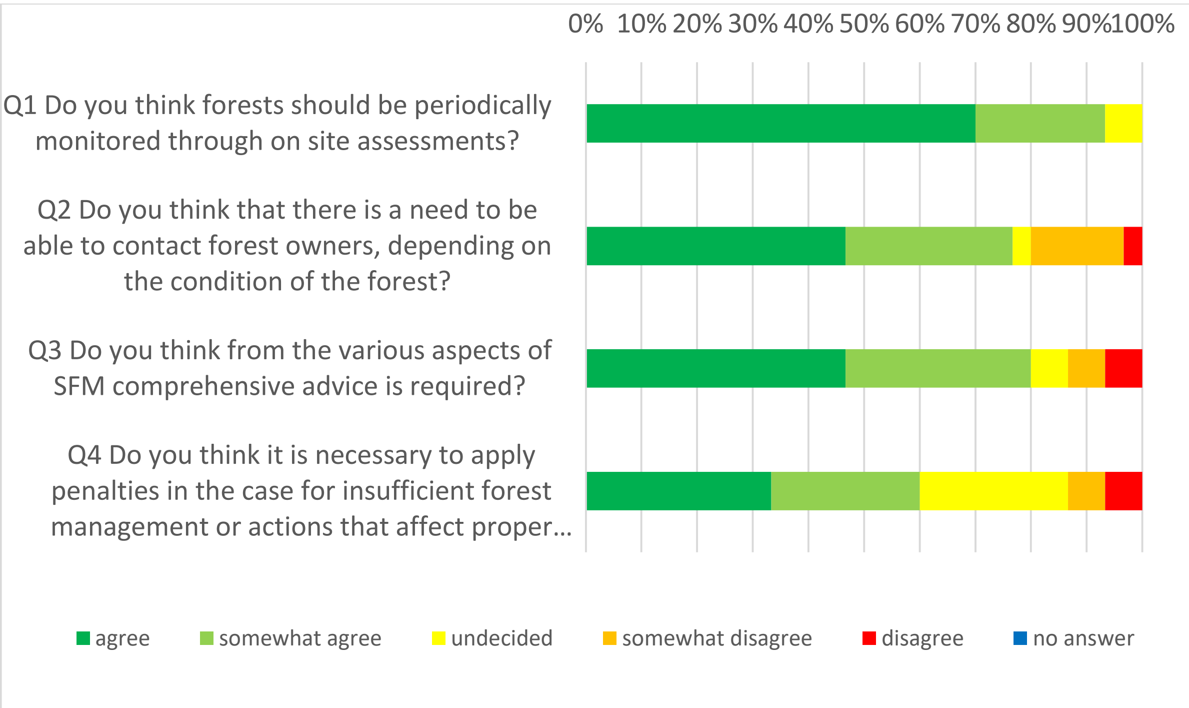


Figure 41: SFM Acceptability Questionnaire Results – Part II (Questions 2 – 5)

93 percent of participants agree or somewhat agree that forests should be periodically monitored through on-site assessments, 7 percent are undecided. This result indicates that introducing on-site assessment would be a widely accepted and welcomed change into current management. In regards to forest accessibility, 77 percent agree or somewhat agree that it should be possible to contact forest owners depending on the condition of the forest, 3 percent are undecided, 20 percent somewhat disagree and disagree. This result can point out awareness of the current problem of disturbed accessibility of private forest owners. Without being able to contact forest owners in events management intervention is necessary, unsustainability effects may not be avoidable. This is another result for implicit acceptance for integrative management by the majority of participants. However, one fifth of participants explicitly state that there is no need to contact forest owners, regardless forest condition. This opinion could be associated to the Japanese privacy law. However, to satisfy the majority opinion for a need to improve accessibility to private forest owners, a change of this law may be necessary, since under the current law, this may be difficult to accomplish without the consent of every forest owner.

Another sustainability supporting management aspect that the majority of participants – 80 percent – agrees or somewhat agrees upon is access to advice regarding SFM. 13 percent somewhat disagree or disagree while 3 percent are undecided. Although 67 percent of participants in survey Part I have the opinion that forest management should not incorporate all four sustainability aspects of SFM, 80 percent believe advice for SFM is needed. This result is significant as it reevaluates the general acceptance of SFM, especially the theoretical and practical implementation of this concept. In theory, the majority believes it is necessary, however, when practically administered, segregation rather than integration is favorized. This being said, education showing concrete examples for practical implementation may be necessary to increase also practical acceptance. Expert on-site risk assessment and practical advice for realization to forest owners as proposed with LERM could be one way to achieve these interactions.

Compared to questions 2 – 4, a larger discrepancy among participants could be observed for the final question 5. While 60 percent agree or somewhat disagree that penalties should be applied for actions that hinder proper forest management, 27 percent are undecided, 13 percent disagree or somewhat disagree. The fairly large undecidedness regarding the application of penalties could be both seen as a risk and as a chance by the participants. Today, penalties (regardless from those that can be applied through littering) are not common practice to apply in forest legislation in Japan. Sanctioning forest owners can have an adverse effect with forest owners wanting to sell their land and escape from forest management. On the other hand, law enforcement through the application of penalties does not necessarily mean that they will actually be applied on a regular basis. On-site assessment and governmental support

Integrative forestry can be considered a still new and yet widely unpracticed management concept in Kochi Prefecture. Content-based education with specific practical examples of the advantages of integration, including a concrete framework of how to implement this concept in Kochi may be required for wider acceptance and to enable interaction between socio-cultural and the ecological system forest.

9.7.3 Conclusion

According to survey results, conclusions can be drawn on explicit and implicit acceptability of an alternative integrative forest management system in Kochi Prefecture. Explicitly, the majority of participants prefers a segregative rather than integrative management approach. Especially the functions of recreation and protection were evaluated by the lowest number of participants for being the least important functions. Implicitly, however, the majority of participants would accept changes that would contribute to integrative management. To enhance explicit acceptability of an integrative management approach, a closing of the gap between explicit and implicit may bring improvement. Though improvement of explicit acceptability of integrative forest management, and with it a sustainable development of society is not only a civil responsibility but also an interesting local experience. Many people still do not seem to see the long-term benefits of management leading to sustainability, for themselves and the generations to come. Thus, it is a local challenge to develop appropriate education programs to be responsible and sustainable citizens. Without adequate education programs and well qualified educators to implement them, the gap between explicit and implicit acceptability of integrative forest management in Kochi Prefecture may not be closed. Without integrative forestry, environmental risks are higher and our children may suffer from it in the future.

9.7.4 Implications of Results for Objective 7

- Identify the degree of local acceptance for an integrative forest management framework among key stakeholders in Kochi Prefecture – **Analysis V**.

The initial problem posed for which this survey was conducted was the requirement of acceptability to realize the dependent variable of the SFM Character. This survey tried to measure explicit and implicit acceptability for an alternative integrative forest management approach, one that would be capable of mitigating the four sustainability risks identified in Chapter 8. Although an acceptable rate of implicit acceptability was measured, explicit acceptability was only 33% among key-stakeholder participants. To convince local governmental institutions to adapt forest management structures to enable integration, a higher level of explicit acceptability is needed. Even if management was changed in a short-term perspective, without acceptability from the general public and especially key-stakeholders, small system failure may not be tolerated and the new system could be replaced again with the old one. It is desirable to have a larger acceptance in the local public which would tolerate small system failures longer during the implementation period of the new system.

9.8 Practical application of LERM

Figure 42 shows the sequence of the application of LERM with on-site assessment from stand selection until the initialization of forest works in Kami/Kochi.

<u>Selection of stand</u>

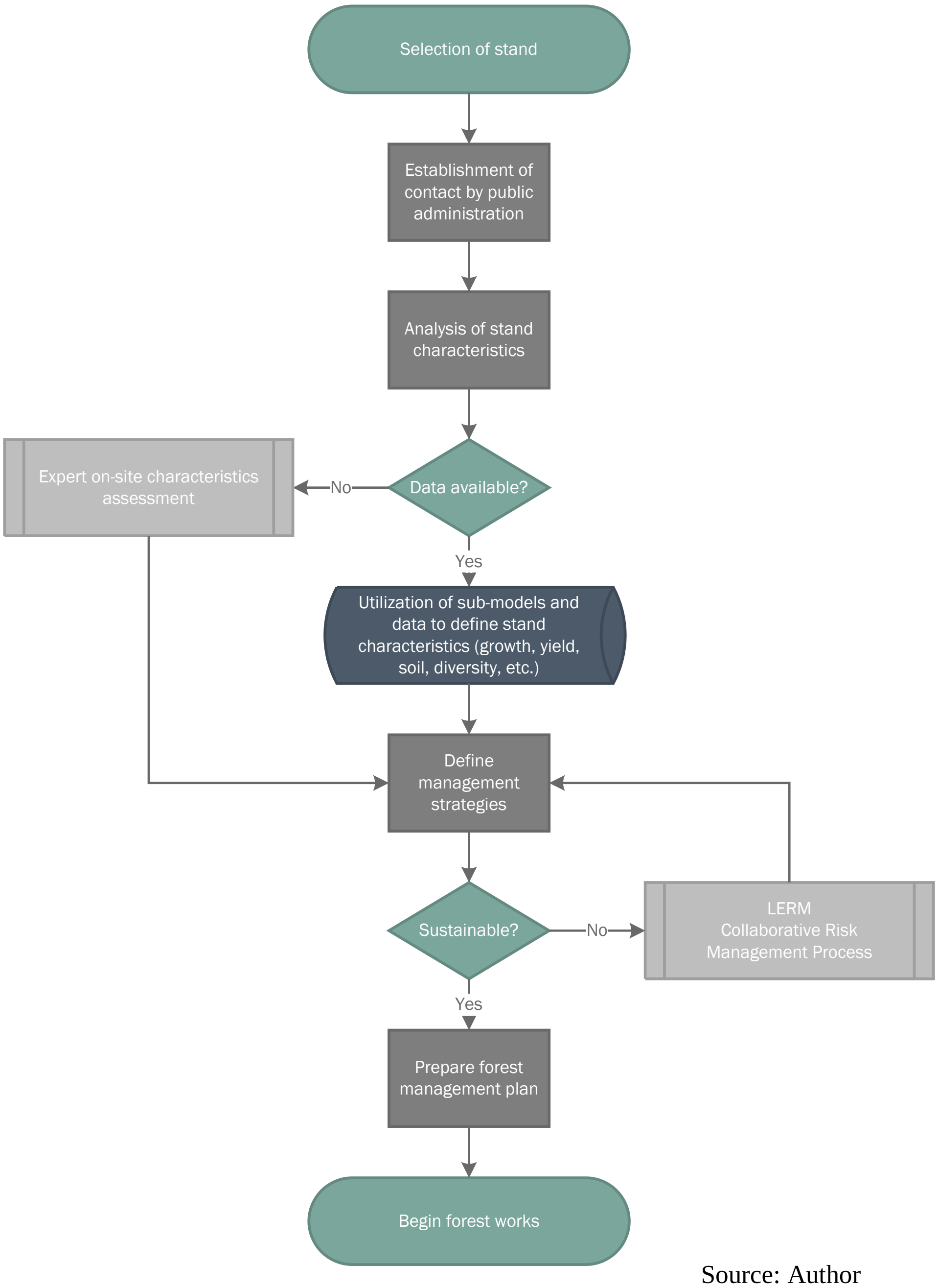
Stands are selected for forest works based on stand age and monitoring data.

<u>Establishment of contact by public forestry administration.</u>

For all kinds of larger forest management activities, Kochi Pref. Forestry Department or any other relevant public administration body is contacted prior the execution of any type of works. In events forest owners do not make contact, the responsible public forest administration office directly contacts the forest owner when the time for the application of forest works is considered suitable. In this first stage of establishing contact, first goals and strategies of the desired type of management are communicated. In events where contact cannot be established, alternative ways of making contact are to be examined.

<u>Analysis of stand characteristics</u>

Once contact was established and first goals and strategies communicated, an economic and environmental stand assessment is performed. In this assessment, the most sustainable strategies of maximizing economic, ecological and social outcomes are selected based on preexisting local data to define stand characteristics. This data should incorporate sustainability indicators such as growth, yield, soil, diversity, water etc.



Source: Author

Figure 42: Practical application sequence of LERM in Kami/Kochi

<u>Define management strategies</u>

Strategies may involve the improvement of underplanting, non-silviculture related measures to enhance biological diversity, approaches to extend rotation periods, and plans for structure enhancement or conversion. If sufficient data is not available for this assessment, an on-site stand characteristics assessment shall be performed by the expert risk mediator. In this on-site assessment visual evaluation of quality factors such as of forest layers, soil and diversity is performed. If additional third-party advice is required, qualified experts shall be consulted.

Sustainability evaluation

Once strategies have been defined, a sustainability evaluation is performed by the expert risk mediator. If strategy is not considered as sustainable and requires multi-stakeholder consensus, a LERM collaborative risk management process shall be planned. In this stakeholder meeting superior strategies for realizing the SFM character shall be discussed and mediated. Long-term participation strategies may be used by the mediator as incentives to reach consensus and to maximize sustainability.

Prepare forest management plan

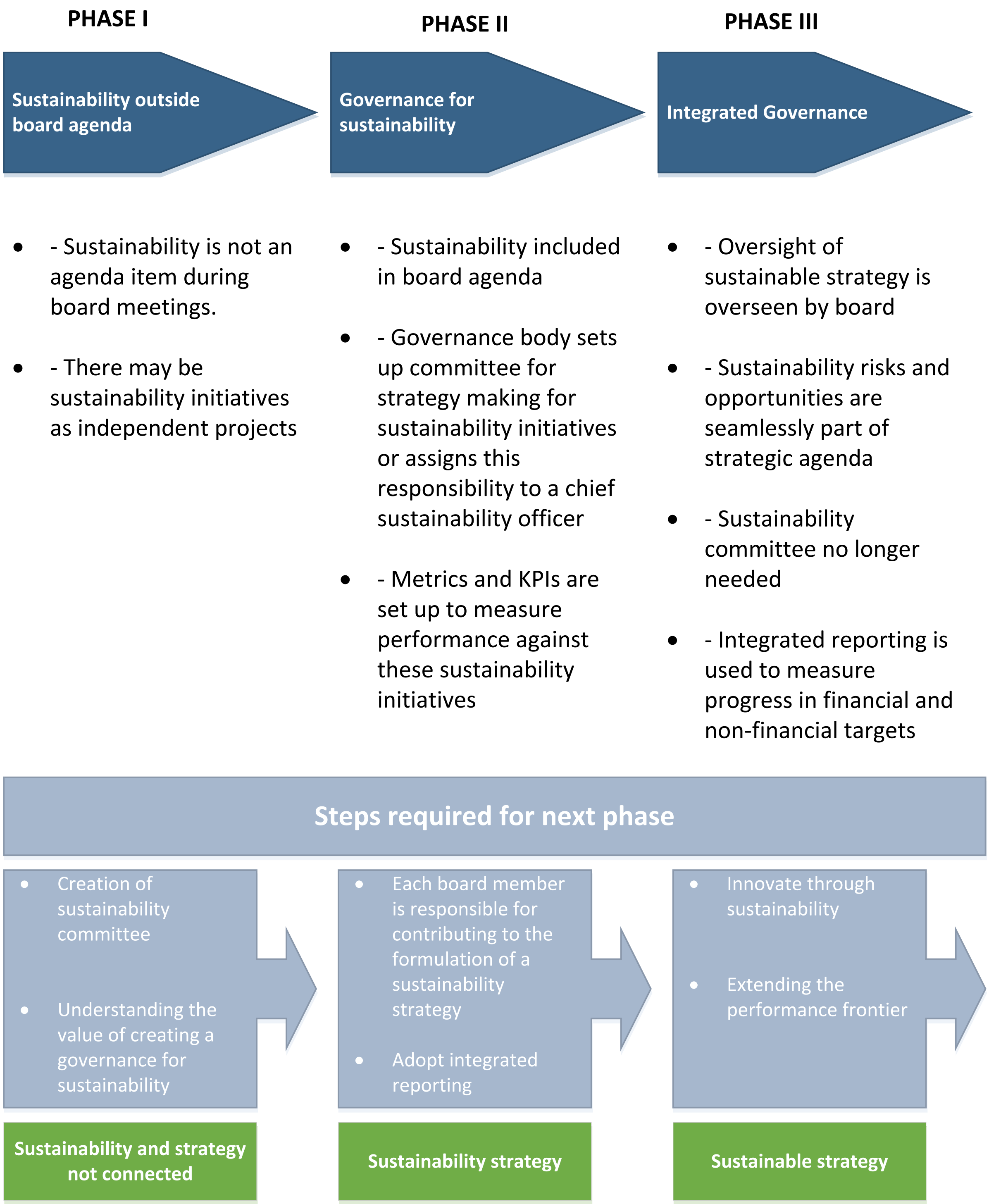
If an appropriate management strategy was determined, a forest management plan shall be made. In this plan management steps, measures, timely execution etc. shall be joined as a project. This project is to be documented and monitored by the expert risk mediator.

Begin forest works

Once the project management plan was made, works become the responsibility of the forest owner. They shall be performed by the qualified owner or by a third party selected by the owner. Assistance by selecting a qualified third party to apply the works may be provided by the expert risk mediator or the responsible Kochi Pref. forest agency.

9.9 DACA-LERM model adoption

Adoption of new management models, especially sustainability models, is seldom accomplished instantly. In the case of Kami City, DACA-LERM does not only need to be adopted into public organization (forest administration, NGO, institutions of education etc.) but also into the private and corporate sector. The adoption of DACA-LERM management into local corporation (FOA, Jibatsu and other private forestry business performing forest works), private forest (owners and third party managers), and public administration, follows the three phases of Integrated Governance shown in Figure 43. Recommended actions for advancement to each next phase are listed for the three stakeholder groups in Kami/Kochi while considering local infrastructure requirements as previously discussed in Introduction and throughout this research.



Source: UNEP, 2014

Figure 43: Corporate practices for adoption of integrated governance

9.9.1 Adoption of DACA-LERM into local corporation

Creation of sustainability committee

- Selection and sustainability committee creation of leading members in main corporate divisions: leadership, accounting, marketing, sales, forestry, reforestation etc. Member(s) with knowledge and/or experience in silviculture management and SFM should be included. Assign leader of committee for external communication (e.g. with LERM risk mediator)

Adopt integrated reporting

- Set sustainability goals.
- Identify material issues that may affect the corporation's operations and organize these in a materiality matrix to display risk and opportunities of the corporation against those of external stakeholders.
- Identification of short and long-term trends and risks that may affect corporation.
- Committee monitors sustainability strategies and makes recommendations for improvement to head of corporation.
- Communication of sustainability progress to corporation.

Innovate through sustainability

- Development of strategies for sustainability enhancing technology (e.g. technology to increase efficiency of thinning works), and measures (e.g. ways to reduce non-value-added activities) in current forest works that are based on SFM criteria and indicators, and linkage of these strategies to business priorities.
- Perform cost-benefit analyses for forest works that involve or suggest a change of forest structure as a decision making support during the communication with external stakeholders.

Extending the performance frontier

- Incorporate sustainability related issues into the corporation's code of ethics.
- Collaborate with external organizations to reach own sustainability goals and assist other organizations reaching their goal(s).
- Systematic integration of ESG (Enabling Sustainable Strategy) into business strategy for long-term competitiveness.

9.9.2 Adoption of DACA-LERM into private forest

Creation of sustainability committee

- Forming of local or regional forest unions to communicate aspects of SFM among members. Leadership is rotated among members and is timely limited.

Understanding the value of creating a governance for sustainability

- Forest unions are encouraged to stay informed about SFM principles and developments.

Adopt integrated reporting

- Each union member is responsible for contributing to the formulation of sustainability strategy(ies).
- Set sustainability goals.
- Identify forest management and forest structure related issues that may interfere with sustainability goals and organize these issues to find collaborative ways for effective and efficient mitigation (e.g. joint thinning operations to lower cost, gamma diversity, and habitat connectivity).
- Union leadership monitors sustainability strategies and progress, and gives recommendations for improvement to other union members.

Innovate through sustainability

- Development of sustainability enhancing strategies, especially those that involve a rethinking and improvement of forest structure and its inventory.

Extending the performance frontier

- Consideration to change forest structure into a close to nature structure which includes "highly valuable" alternative tree species (only if they can be introduced to ecosystem without major risks) as an ESG in the forest owner's business strategy to strengthen long-term competitiveness.

9.9.3 Adoption of DACA-LERM into public administration

Creation of sustainability committee

- Assign members of public forest administration to plan the broadening of prefectural forest administration to include a "sustainable forest management division" which acts as central DACA-LERM administration in Kochi Prefecture. Members of this sustainability committee should be considered to include participants fond of DACA-LERM, SFM and the Japanese law. Assign committee leadership.

Understanding the value of creating a governance sustainability

- Members of the sustainability committee should be well informed about the concept of sustainable development and should support the general concept of SFM.

Adopt integrated reporting

- Set milestones for the creation of the sustainable forest management division.
- Identify administration related issues that may interfere with later application of DACA-LERM and organize these issues to find ways for effective and efficient mitigation (e.g. adjustment of financial support schemes to allow a more effective application of forest structure management or enhancement of forest owner identity management to ensure that owners can be contacted when necessary).
- Committee leadership monitors the progress in the reaching of milestones and gives recommendations for improvement.

9.9.4 Adoption of DACA-LERM: application requirements

A number of local infrastructure requirements need to be met for the successful adoption of DACA-LERM into communities in Japan.

Functional interorganizational relationship

Other than Kami/Kochi access and responsibility of forest administration (prefectural and local) may be different. For instance, Kochi Prefectural Forest Technology and Information Center is situated close to local Kami FOA. Officials of both organizations meet at a very regular, sometimes even unofficial basis, which has built trust and an overall good interorganizational relationship. Kami FOA has and being selected for various “special” treatments in regards to new governmental forestry projects involving subsidized technology and labor. Although access to such special treatments is not a precondition for the adoption of DACA-LERM, this model requires ongoing interorganizational communication and a close and good public administration – corporation relationship, is likely to facilitate model adoption significantly. Forestry businesses without adequate access to public administration may even not be able to fully adopt DACA-LERM into their business. Access to public administration may have to be improved to an adequate level in those areas.

Access to private forest

Enhancement of sustainability of the common private industrial even-aged forest in Japanese communities, will more or less involve a change in forest structures, which requires agreement and participation from owners who need to be contacted in advance for consultation. Currently, identification and contact of private forest owners is not (yet) backed by law and a change is beyond DACA-LERM. Efforts in the identification and contact needs therefore to rely on current strategies. It is likely that the scope of DACA-LERM can only reach to “what is available at the moment” until less restrictive structures have been developed. However, once local implementation of DACA-LERM has been accomplished to a satisfactory level, and the advantages of it are backed by tangible evidence, a change of the law regarding forest owner participation may become easier to initiate.

Flexible financial support

Forest works are expensive. The common desire of private forest owners to maximize returns is pursuable. However, to maximize sustainability, forest structures in private forest may have to be changed site-specifically, in a way that its lowers returns for the owner, especially when the introduction of broadleaf species are involved, for which there are no big domestic market structures in Japan. Therefore, to compensate for financial loss of the forest owner through forest structure change, as well as to be capable of changing forest structure site-specifically, financial support schemes need to go from subsidies for predetermined management to flexible, site-specific subsidies. This is a crucial LERM application requirement without sustainability risk mediation for forest structure change would be very difficult, if not impossible to accomplish.

Developed domestic markets for broadleaf timber

As mentioned above, there are no well-developed market structures for broadleaf timber (including high valuable broadleaf species for e.g. parquet flooring or furniture) throughout Japan. In Kochi Prefecture, the only significant buyer (the author is fond of) of broadleaf timber is a biomass power plant which burns broadleaf timber a minor wood resource to generate electric energy. In addition, this power plant is also situated quite remotely and therefore not easily accessible for most private forest owners. The planting of broadleaf timber in industrial forest to enhance sustainability, as it is performed in Europe, does not make much sense from an economic perspective at the moment, and will likely be the main reason for rejection by forest owners in during risk mediation. Access to markets, especially for native domestic broadleaf timber would make the planting of such species more meaningful, and would likely facilitate risk mediation. The building of market opportunities is a part of the long-term participation component of LERM, however, a kick start may be needed in most communities.

SFM education and training

The application of DACA-LERM into any community in Japan requires access to education and training in the concept of SFM for stakeholders to understand the crucial aspects of sustainability in forest management. Especially adequate education and training to accomplish the job as risk mediator is necessary. In order for DACA-LERM to function, education and training for SFM will need to be kick started in communities.

Summary

In Chapter 9, a proposal was made for an alternative integrative forest management framework for Kochi Prefecture/Kami City, one that is capable of mitigating the risks identified in exploratory and explanatory research, and which creates the foundation for successful implementation of integrative local forestry. A concept of internal (LERM) and external (DACA) strategic management cycles, and their interplay regarding the development of national and local strategies was introduced and model components were derived. The functionality of both cycles was describes and a graphical schema was shown how support, promotion, legislation, involvement and sustainment should be communicated between the two cycles. The advantages of this internal-external ongoing learning process in regards to sustainable development of society were presented.

To validate DACA-LERM, model governance and model input and output data was reviewed based on the Integrated Governance Framework of the United Nations Environment Programme, and a model verification in the form of a risk perception assessment was conducted in Kochi Prefecture. Key stakeholders participated in a post-lecture survey in which the risk perception of two management scenarios, one without, and one with DACA-LERM was measured. Results showed a significant decrease of perceived risk for the four sustainability risks in the DACA-LERM scenario.

To measure the level of explicit and implicit acceptability for an alternative integrative forest management system, another survey was conducted. Results of this acceptability survey show large explicit agreement for integrating the economy and environment functions of SFM, but not the remaining functions recreation and protection. Yet, the majority of participants implicitly agree to measures such as on-site assessments, vital for the integration of all four pillars of SFM.

The central role and benefits of expert risk mediation in regards to local sustainability leadership was discussed. The benefits of performing CBAs as a support tool during risk mediation to facilitate consensus building among stakeholder in works that involve a change of forest structure was displayed in a practical example. To demonstrate the local application of LERM, operations from stand selection to the beginning of forest works was shown. Suggestions and requirements for DACA-LERM model adoption in Kami/Kochi and other communities in Japan concluded Chapter 9.

References

Arborgast, T. (24.03.2015). Taxation and other economic strategies that affect the sustainable management of forests (Indicator 7.47): An assessment of taxation provisions and financial assistance programs in the United States through the Montreal Process Framework (master's thesis). Retrieved from NCSU Libraries.

Barde, J. P. & Honkatukia, O. (2003). Environmentally harmful subsidies. Contribution to the ERE 2003 yearbook. Convention on Biological Diversity.

Bollmann, K. & Braunisch, V. (2013). To integrate or to segregate: Balancing commodity production and biodiversity conservation in European forests. Integrative approaches as an opportunity for the conservation of forest biodiversity. European Forest Institute.

Bowles, H.R. (2005). What could a leader learn from a mediator? Dispute resolution strategies for organizational leadership. Harvard University.

Brett, J.M., Goldberg, S.B. & Stephen, B. (1983). Grievance mediation in the coal industry: A field experiment. Industrial and Labor Relations Review, 37, 49-69.

Buchy, M. & Hoverman, S. (2000). Understanding public participation in forest planning: A review. Forest policy and economics 1(1), 15-25.

Clark, J. R., Matheny, N. P., Cross, G. & Wake, V. (1997). A model of urban forest sustainability. Journal of Arboriculture 23(1), 17-30.

Dehnhardt, A., Hirschfeld, J., Drünkler, D., Peschow, U., Engel, H. & Hammer, M. (2008). Kosten-Nutzen-Analyse von Hochwasserschutzmaßnahmen. Umweltforschungsplan des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit. Foschungsbericht 204 21 212, UBA-FB 001169. Umweltbundesamt.

FAO. (2000). Asia-Pacific Forestry Commission: Development of National-Level Criteria and Indicators for the Sustainable Management of Dry Forests of Asia: Workshop Report. Bangkok, Thailand: United Nations.

Gail, B. (1986). Resolving environmental disputes: A decade of experience. Conservation Foundation.

Gain, D. & Watanabe, T. (2013). The contribution of forest regulations on the realization of sustainable forest management: a comparative law study of Japan and Germany. Internet Journal for Society for Social Management Systems, Vol. 3 SMS13-3086.

IMI. (2016). The IMI mediation library. https://imimediation.org/mediation-library (accessed on 28 October, 2015).

Japan Forest and Forestry Basic Act (1964).

Kahn, P.H. (1994). Resolving environmental disputes: Litigation, mediation, and the courting of ethical community. Environmental Values, 3 (3), 211-228.

Lax, D. & Sebenius, J. (1986). The manager as negotiator: Bargaining for cooperation and competitive gain. Free Press. New York.

Lele, U., Kumar, N., Husain, S. A., Zazueta, A. & Kelly, L. (2000). The world bank forest strategy: Striking the right balance. The World Bank. 1st Edition. Washington, USA.

MCPFE (Ministerial Conference on the Protection of Forests in Europe). Public participation in forestry in Europe and North America. MCPFE. Vienna, Austria.

Moskell, C., Broussard Allred, S. & Ferenz, G. (2010). Examining motivations and recruitment strategies for urban forestry volunteers. Motivations and Strategies for Engagement in Urban Forestry 3(1), Article 9.

Nellmann, C., MacDevette, M., Manders, T., Eickhout, B., Svihus, B., Prins, A. G. & Kaltenborn, B. P., (Eds). (2009). The environmental food crisis – The environment's role in averting future food crisis. A UNEP rapid response assortment. United Nations Environment Programme, GRID-Arendal, www.grida.no.

Peine, J. D. (1998). Ecosystem management for sustainability: Principles and practices illustrated by a regional biosphere reserve cooperative. Lewis Publishers. Washington, D.C.

Pruitt, D.G. & Rubin, J.Z. (1986). The intervention of third parties. In social conflict: Escalation, stalemate and settlement. Random House. New York.

Sarukhan, J., Urquiza-Haas, T., Koleff, P., Carabias, J., Dirzo, R., Ezcurra, E., Cardeira-Estrada, S. & Soberon, J. (2015). Strategic actions to value, conserve and restore the natural capital of megadiversity countries: The case of Mexico. Bioscience 65(2), 164-173.

Sun Park, M. & Lee, H. (2016). Legal opportunities for public participation in forest management in the Republic of Korea. Sustainability 8, 369.

The Montreal Process (2015). Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests. Retrieved April 29, 2016 from: http://www.montrealprocess.org/documents/publications/techreports/MontrealProcess September2015.pdf.

UNEP (United Nations Environment Programme) (2014). Integrated governance: A new model of governance for sustainability. A report by the asset management working group of the United Nations Environment Programme Finance Initiative.

von Detten, R. (2011). Sustainability as a guideline for strategic planning? The problem of long-term forest management in the face of uncertainty. European Journal of Forest Research 130, 451-465.

Woziwoda, B., Kopec, D. & Witkowski, J. (2014). The negative impact of intentionally introduced Quercus rubra L. on a forest community. Acta Societatis Botanicorum Poloniae 83(1), 39-49.

Chapter 10: Conclusion

This dissertation was designed to investigate the role of SFM in Kochi Prefecture/Kami City and derive a potential model for improvement. While findings with regards to the research objectives have been discussed and concluded in earlier chapters, the final answers and implications of this study shall be presented.

The hypothetic question this study raised: "*Integrative leadership through expert risk mediation can facilitate the realization of SFM by decreasing the uncertainty of sustainability risks in Kochi Prefecture/Kami City"* argues local sustainability of private industrial forest through mediating stakeholder integrity.

The answers and implications that were found to answer this question indicate that:

- Sustainability risks in Kami/Kochi seem to occur as a combination of vertical and horizontal institutional effects triggered by nonenforceable forest law.
- Sustainability risks seem to be only effectively mitigatable together rather than alone.
- Management structures are needed that are capable of communicating and mitigating sustainability risks dynamically in a top-down-bottom-up pattern among national and local-level stakeholders.
- To combine sustainability and strategy of key stakeholders, development of integrative governance is needed.
- Leadership by mediation may be more applicable than leadership by arbitration to join the agendas of key stakeholders.
- There is a perception among key stakeholders that sustainability risks can be lowered by 30 to 70 per cent, if forest management is adopted by the introduced DACA-LERM framework for SFM.
- Adoption of this framework can be achieved in three phases if certain infrastructure requirements are met.

This work contributes to the literature by demonstrating in a case study the origin of sustainability risks and how they affect management issues. It provides a new concrete interdisciplinary suggestion for the mitigation of these risks and for realizing SFM at local level.

These findings could benefit / be of interest to:

- Policy makers seeking ways to realize SFM and translating its concept into national and local policy.
- Stakeholders seeking ways to improve stakeholder integrity
- FOAs who want to implement a sustainability strategy into their code of ethics
- Stakeholders seeking ways to introduce alternative forest structure concepts
- Risk managers who are interested in the origin and mitigation of sustainability risks in SFM

Recommendations for future research

The weaknesses and limitations of knowledge developed in this research study have indicated areas for further work:

1. This work proposes a model for the integration of forest functions through multi-stakeholder leadership by mediation. This model was derived from local sustainability risks identified in exploratory research and from the general conception of SFM. In this research, various regional comparisons were made with Bavaria/Germany and Steiermark/Austria. Findings of this comparison were partly incorporated in the derivation of the LERM model. Although much effort was made to eliminate infrastructural differences of these countries, some degree of infrastructural difference may still remain and be relevant for evaluation. This also applies to cultural differences, especially those regarding the inter-relationship of land property and nature.
2. Building on the finding of the four sustainability risks in Kochi/Kami, an expert assessment of actual risk factors should be performed and compared to the perceived risk factors identified in this study.
3. To fully test the hypothesis and simulate the efficacy of expert risk mediation, a pilot study is recommended. This pilot study should:
    a. Develop the mediation element of leadership during key-stakeholder negotiation and take into account different process capabilities.

b. Monitor key stakeholder behavior and opinion in the decision making process, especially regarding the incorporation of SFM criteria for sustainability realization.

c. Test key stakeholder willingness for establishing a feeling of integration, especially in situations where decisions are necessary where a key stakeholder is appealed to adjust opinion.

d. Forest management is complex decision making. Develop a methodology of how to properly educate and train mediators to achieve an appropriate level of inter-disciplinary scientific background to evaluate and weigh competing theories.

e. Assess the amount of financial resources required for the short, mid, and long-term application of LERM in contrast to current subsidization strategies.

f. Identify possible stakeholder communication noise that could affect stakeholder integrity.

g. Develop a concept for the kick starting of required infrastructure for adopting DACA-LERM

Adding to the severity of the four problems: Resources, Accessibility, Efficiency and Integrity, described in Chapter 1, the four identified sustainability risks can be tackled through collaborative risk mediation within the framework proposed in this study. As the author, I believe that the more integrative and certain forests in Kochi are managed, the more sustainable and successful the prefecture as a whole will be. We have a responsibility to ourselves to create a sustainable society; one worth raising future generations in, one where people work together to maintain culture and values, one worth being a part of and a happy member of – the Kochi Family（高知家）.

Acknowledgements

A great many people have contributed to the production of this dissertation. I owe my gratitude to all these people who helped to make this dissertation possible and because of whom my doctoral student experience has been one that I will always look back to with joy.

My deepest gratitude goes to my supervisor Prof. Tsunemi Watanabe, who gave me the freedom to explore on my own while giving me guidance on how to successfully navigate my research in Japan. Prof. Watanabe helped me to understand reality when I have been too optimistic, and taught me to calm my feelings in unsuccessful times. Prof. Watanabe's sometimes maddening attention to detail taught me that research is work done for all and not for oneself.

I thank my co-supervisors Prof. Mabuchi, Prof. Nakagawa, Prof. Kunishima and Prof. Saijo for their productive comments during the preliminary assessment which helped me to widen but also to deepen my research. A big thank you goes to my lab members for their very productive critical comments. I learned to cherish even the smallest of a comment.

I am indebted to all workers at Kami FOA, Kochi Forest Technology and Information Center and other officials in Kochi who supported me with data collection and who became good friends of mine in depressing times.

I am grateful to Mr. Toda for numerous discussions about the problems of forest management in Kochi and for all the new connections I could make through him.

I thank Mr. Nojima, Mr. Mitani and Mr. Morimoto for taking me to harvest sites to explain technological and marketing aspects of forest management in Kochi. My gratitude also goes to Mr. Loschek, Mr. Pusch from MM Forsttechnik, and all the other people who provided data and who were involved in our wonderful study tour in Austria.

I am also grateful to Siggi and Nathan who helped me see things from different perspectives.

Another big thank you goes to Ms. Tokihisa from Kami City BOE, and all other teachers who I have worked with who always supported my research throughout the program. I am also thankful to all the people who helped me explain and translate certain pieces of writing from Japanese to English.

Last but not least, none of this would have been possible without the love and patience of my family. My beloved family who has been a constant source of love, strength and support.

Appendices

Appendix A: Field trip summary

This summary was written as a joint project by the participants of the field trip.

高知工科大学海外森林マネジメント調査ツアー
ｉｎ　グラーツ、　オーストリア

平成２７年度
３月２２日（日）　－　３月２７日（金）

日程：

３月２２日（日）	０７：４０	高知龍馬空港発
	２４：００	ホテル　アドリアハ到着
３月２３日（月）	０９：３０	フローンライテン製材所　見学
	１２：００	森林学校ピヘルで昼食
	１３：００	森林学校ピヘルのプログラム
	１５：３０	森林管理エクスカーション
	１８：００	ホテル　アドリアハに帰る
３月２４日（火）	０８：３０	MM　Forsttechnik 社　見学
		昼食はMM社でいただきます
		山と自然保護管理局
３月２５日（水）	０９：３０	森林所有者訪問、森林共同体
	１２：００	アルメンランド自然公園、　昼食
		パサイル市　地域暖房　見学
３月２６日（木）	０８：３０	グラーツ市役所迎接、フォレスター管理局、
		レクリエーション林　見学、グラーツで昼食
	１６：１５	グラーツ空港発
３月２７日（金）	２２：２０	高知龍馬空港着

1. レオーベン市マイヤーメルンホフ社製材工場　2015.3.23

説明：MM 社 メットニッツアー氏

レオーベン市にあるマイヤーメルンホフ社（以 下 MM 社）の製材工場は、MM 社が1950 年創業した 場所にある。ここは製材工場だけではなく、MM 社 の本社機能も備えてとり、2009 年に新しい社屋に 建て替えられた（写真①）。

この製材工場があるシュタイアーマルク州は、オーストリアでも一番森が多いところである。

レオーベン市はシュタイアーマルク州の中心であり、高速道路、川などがあり木材を出すために非常に良いところである。

①MM 社製材工場及び本社社屋

創業当時（1950 年）の原木の量は 10 万 m3 であ ったが、2008 年には 130 万 m3 になった。

材の価値を上げるために、地元の木材だけの販 売を考えている。

マイヤーメルンホフは一番この地方で一番大きい会社であり、他の小さい会社から木材を購入することもある。

②CLT でできた受付カウンター

○原木ストックヤード 原木のストックヤードには、5万 m3 のストックがある。

③原木ストックヤード（皮剥ぎ後）

④ストックヤードの大型グラップル

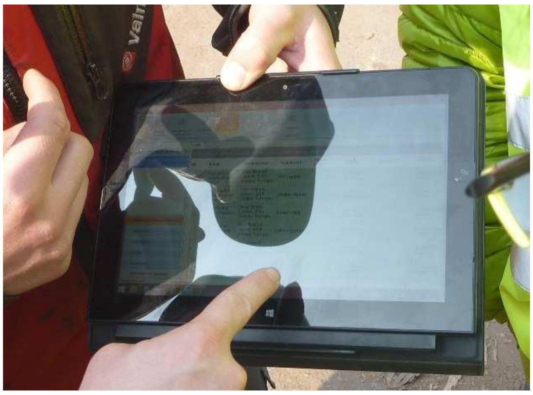
○原木の流通について

原木の流通にはオンラインシステム（e コマーズ）が使われる。フォレスターが対象の山林について、伐採可能な材積や価値（価格？）をシステムに入力し、その情報が本社のコンピュータに登録される。購入希望者（製材工場）はその情報を見てシステムで注文をか ける。

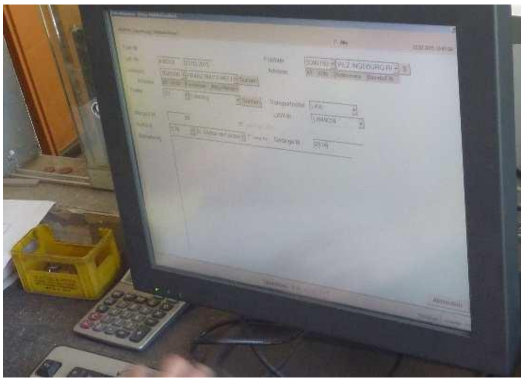
注文を受けたら、伐採業者が伐採し、伐採後に運搬業者が材取りに行き、工場に直接運搬する。

日本と異なる点は、流通過程に原木市場がなく、製材工場等の木材加工業者が直接立木を購入し、伐 採、集材、運材を全部自社（委託することもある）で行っている点である。

原木運搬車の運転手はタブレット（windows）端末を もっており（写真⑤）、タブレットにインストールさ れたシステムにより山林所有者や原木の購入者の情 報を管理することができる。領収書の作成や、伐採後の情報を写真にとって、山林所有者へ伐採状況を報告することも可能である。 このシステムは2014年12月に稼働し、値段は タブレット端末込で2000ユーロ（26万円程度）である。


⑤原木運搬車のドライバーが持つタブレット

とても効率的なシステムであるが、運送業者にとっては、出発から到着までのすべての行動が記録されるのでプレッシャーがあるとのことであった。


⑥運材時に登録を行う端末 バーコードを発行する

〇原木の運材のシステム

MM 社の事務所に原木の運搬を管理するパソコン端 末がある（写真6）。

このシステムに運搬の情報を入力すると、トラックごとにバーコードと番号が登録される。
そのバーコードは製造過程に受け継がれ、製品の管理に使われる。

〇選木機

長さ3mから5m、直径は55cm までの材 を選木可能。ほとんどは長さ4mの材で平均 直径は25cm である。

オペレータ室で原木の質と樹種を入力する。長さと径は自動で判別される。

原木すべてを写真に撮り管理する。24時間で6000m^3 まで選木できる能力があるが、今の仕様時間は1日16時間である。

樹種はトウヒとカラマツが97%である。


⑦選木機のオペレータ室 コンピュータとモニターで管理

この工場は針葉樹だけで広葉樹は別の工場で加工する。材質は良質材(ファイン)とそれ以外の2種類に分け られる。原木の購入時には材質は関係なく同じ金額で購 入するが、材を売るときには材質が値段に反映される。製品は建築用だけではなく、パルプ、合板になるものも多い。外国に行くものは建築材が多い。

⑧原木を写真で管理

○バイオマス利用

⑨大型ペレタイザー2機

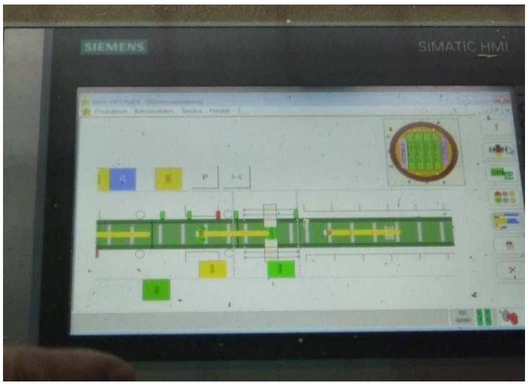
⑩ペレット工場外観

樹皮や枝条、製材の不要部分はバイオマスの発電所に持っていている。
約 4.5MW の電力と、21MW の熱エネルギーを作ることができ、熱はペレット作成に使われる。
約10MW のドライヤー(熱エネルギー?)で乾かす。
年間6万 t のペレットを作ることができる。工場の敷地内に原木の選木機、製材所、発電所、ペレット工場があり、製材とバイオマス利用を1つ
の工場内にまとめることで、運搬のロスがなくなり、効率が良くなる。

○製材ライン

製材ラインは3つあり、直径 50cm までの材を引くことが可能な分速 110m で稼動するラインと、直径 25cm までの材を引くことが可能な分速 140m のラインがある(もうひとつは不明) 同時に動かせるのは2つのラインまでである。
原木から製品になるまですべてが自動化されており、最終チェックだけ人が行い、五段階の品質に分けられる。

昨年 12 月に新しい自動採材システムを導入した。原木の径や形によって、最も良い採材ができるように自動で調整される(写真⑪)。
販売形態は2種類で、原木のままの販売と、製材の販売である。製材は乾燥させてから販売する。



⑪自動採材システムの画面

〇出荷ライン

製材工場からは、一日でトラック45台分の製品を出荷している。

製品の3分の1がオーストリア、3分の1が海外に

⑫ 出荷のトラック

出荷している。海外ではパキスタン、日本にも輸出している。原木はトラック150から200台、それ以外にもカーゴトラック（？）で搬入されてくる。トラックの数が多いため、物流のシステムが重要になっている。木は水分が多く、材の70%の水分を除去しなければ無駄な水分を運ぶことになる。材の運搬では、乾燥させることが重要である。

⑬場内へ鉄道が乗り込み製品を出荷している

〇その他

この製材所は通常視察を受け入れていないが、香美森林組合は特別なので今回受け入れたとのこと。マイヤーメルンホフの家族は元々牧場を経営していた。跡取り以外の息子はでていかなければ行けなかったので、製鉄の会社を造った。製鉄のために木を必要とした。製鉄に必要な炭を作るための組合がたくさんでき、1854 年にウィーンからレオーベンまでの鉄道ができた。その後、鉄道でポーランドから石炭を持ってくるようになり、炭が必要無くなったため、山の価値が下がった。製鉄の会社を経営していたマイヤーメルンホフは、製鉄の会社を売ってその金で山を買った。1862～1872 年の間に 44,000ha を所有するようになった。オーストリアにはかつて相続の法 律が無く、持ち主が死ぬと持ち主が分からなくなった時代があった。(現在は相続の法律有り)

昔は3つの工場があり、1つの大きな工場は7万6千 m^3 を製材していた。これは山の年間生長量に匹 敵する。

昔は林道が無く、山から木を転がして落としていたため、材が割れたり傷がつき品質が良くなかった。今は、間伐が増えたことで、生長量も上がり、伐木集材技術が上がったことで、生産量も上がった。トラック(トレーラー)は木材を 44 トンまで運搬することができる。オーストリアでは通常のトラッ クは 38 トンまでだが、木材は 44 トンまで運搬できるようになった。これは、2008 年に強風により木が大量に倒れたことがあり、風倒木を搬出するために上限が上がった。

丸太の直径は 40cm までのものが多いが、50cm 以上の もある。そのような材はこの工場では加工できないた め、一旦ここのストックヤードに持ってきて、この製材 所以外のところに持って行っている。見学中にも空荷の トラックが入ってきていたが、それは 50cm 以上の原木 を取りに来たものであった。50cm 以上の大きい木は板以外の窓枠等に利用されて いる。

2－1. ピヘル森林学校 学校の概要説明 2015.3.23

説明：ピヘル森林学校校長 マーティン クロンドーファー氏

ピヘル森林学校があるピヘル城は約450年前、1949年に立てられた（写真①）。
シュタイアーマルク州だけの森林学校であり、山と川に興味のある方々をトレーニングするための学校である。
ピヘル森林学校では、教育に使われてい る森が350ha あり、その 95%は針葉樹で ある。

学校の組織としては、校長の下に大学の ①ピヘル森林学校 外観 事業者二人と、フォレスター二人と、技術

者が2二人いる これだけでは学校の運営はできないので、講師も何人かいる。ロシェック氏や、後日お会いするグロ

ーバー氏も講師である。年間の生徒数は約4500人である。2012年は生徒が4555人だった。一番若い生徒は16歳である。216のコースがあり、1日から5週間までのコースがある。宿泊施設もあり、宿泊実績は2262日である。

コースの中には、森林管理者という職業を目指すコースや、チェンソーの技術を学ぶ技術的なコースもある。これらのコースは1週間から2週間のコースである。この学校で取得した資格はオーストリアで有効である。

1～2日のコースでは、造林、森林技術、法律、森林管理、狩猟、エコロジー、バイオマスの講義がある。講義の中で一番人気があるのは、狩猟であり、その次に人気があるのが造林技術である。

建築のコースもあり、フェンスから家のつくり方を勉強できる。フォレスターは森について学びたい人には教えなければならない。そのため（森林学習の講師）のコースもある。

また、初心者でまったく森のことがわからない人のためのコースもある。

職業訓練のコースもある。5週間のコースで、現場で必要な資格を取ることができる。学校で学ぶのは5週間だが、実際に山で働けるようになるには3年間かかる。

森林管理マイスターコースでは、職業学校に通って3年間仕事しながら資格を取得し、それから2年間のマイスターのコースに行くことができる。

ここで学ぶのは11週間しかかからないが、現場もあわせて2年から3年かかる。

7年前にはバイオマス管理者という職業ができた。平成27年度の7月からは、日本人向けのバイオマスのコースができる。1週間のコースである。

プログラムを作ったばかりなので、今から募集をかける。

森林管理者のコースを受けることができるのは18歳以上である。その前に、森林管理か農業管理のコースを受講するか、森林組合（のようなところ）で勤めるか、山を管理している実績がなければならない。

オーストリアの死亡事故が減った理由として、教育がとても重要だったと思う。2013年は死亡した方が全国で40人、2014年はそれより大分減った（まだ人数は不明）。もちろん、災害の時、天気が悪いとき、風が強いときなどは死亡事故が起こりやすいが、それ以外での自己では、教育がとても重要である。

いつも現場に行くときには、安全第一である。

オーストリアでは、事故は個人の責任である。

個人が作業をしているときは、周りをきちんと見るべきである。

コースの45％は勉強、55％は現場である。通信教育とか、そういうものは勉強にはなるが、現場で体験することが一番大事であると思う。学校では、マイスターのコースと森林管理者のコースを通信教育にしようとしているが、森林学習は実際に体験するのが大事なため、通信教育では無理ではないかと思う。

広葉樹の木もとても大事な木なので、針葉樹より、広葉樹のほうが切るのがむつかしい。1つのコースの生徒は最大6人である。

タワーヤーダなどの林業機械の講義もある。日本のイワフジの機械もある。30年前に購入し、まだ壊れていない。日本の機械はオーストリアの山に合っている。

マイスターのコースは21歳から受講できる。マイスターのコースを受講する前に、森林管理者のコースを受けなければならない。森林管理者は最大1000ha の森林を管理できるようになる。

バイオマスのコースは26日かかる。バイオマスのコースも受講する前に森林管理者のコースを受けなければならない。

1～2日間のコースでは、チェンソーのコースや木材を売るコース、タワーヤーダのコース、木に登るコース、女性向けのコースもある。

夫婦の働き方で、男性は会社で仕事、女性が森林管理をするという方法もある。女性の比率は、依然は1．2%だったが、今は20%まであがった。

風倒木やかかり木処理などの処理の方法をシミュレーションすることもできる。

生まれつき障害のある方や精神病の方のプロジェクトであるが3年前にはじまった。無職で、仕事に就きにくい方々が森林関係の仕事に就くことを支援している。

それは社会的な仕事であり、森林管理は障害者が少ないので、興味のある人のためにもこのようなプロジェクトがあったら、世の中がよくなると思う。

経済と自然の二つに障害者が入れるように作ったプログラムである。

ピヘル森林学校はいろいろな国とつながりがあるが、日本との協力が強くなってきている。特に岐阜、長野との協力関係が強い。

クオリティ高い教育を高めるため ISO29990 を取得している。

2－2. ピヘル森林学校講義 森林管理と持続可能な水の管理 2015.3.23

説明：ピヘル森林学校校長 マーティン クロンドーファー氏

〇森林面積 オーストリアの森林面
積は 3990,000ha

シュタイアーマルク州の森林面積
1,006,000ha 2013 年の木材生産量
17,390.000m3

オーストリアでは 64%が針葉樹で 24%が広葉樹、木がない林道や草地が 12%である。オーストリアに元々あるスプルースが非常に多い。

オーストリアの面積は 8,387,100ha で、森林率は 47.6% シュタイアーマルク州の面積は 1,640,100ha で、森林率は 61.0%

〇森林所有者

森林面積の54%が200ha 以下の森林所有者、31%が200ha 以上の森林所有者、15%が国の 所有である。

〇人工林のヘクタール当たりの生長量 人工林 9.0m3 保全林（天然林含む）4.9m3 利用量 7.7m3 保全林（天然林含む）3.8m3

人工林が一番多いのがシュタイアーマルク州である。

2－3. ピヘル森林学校講義 森林と水｢いのちの故郷 2015.3.23

説明：ピヘル森林学校講師 オートマー・グローバー氏

グローバー氏は元々森林管理の仕事ではなかったが、35年前から水と川の仕事をしている。水を理解したい方は三次元で考えなければならない。水を理解したい方は、水がほかのものとどこが違うのか理解するべきである。そのためには、目の前のことを考えることよりも、昔のこと、海のことを考えることが必要である。

水には心がある。私は水は何かを理解していますが、まだ理解できていません。
水の流れはさまざまであり、水には心があり、流れがいつも変わるダイナミックなものである。
水と森林はいつもセットで考えなければならない。水だけはない。森林だけはない。
水の流れは水際ではコントロールしない。水自体の中からコントロールする。

1930 年に天気（雨を降らす）の仕組みが分かっていた。山に木がなければ、雨は土にしみ込まず、すぐに川に流れ込む。山に木がある場合は、雨は土に入り、
ゆっくりと土の中を流れる。木から水が蒸散する循環ができる。土に水がしみ込こむことは、川の管理に関して世界的に注目されている。
グローバー氏はモロッコに行ってこの循環のことを教えることになっている。

木の有る場所と無い場所では土の温度が異なる。木が無い場所では日光が直接土に当たるため温度が
上昇し、これが今、アフリカで問題になっていることである。土の温度が高くなることは川にとっても良くないことである。

今後気温が 3.5 度以上上昇した場合（温暖化による影響で？）は、川がどうなるかわからないので心配である。
かつて、アメリカのアリゾナでは川が無くなったところがある。将来、そのようなことが起こることが心配である。

森は川を冷やして川を守る。もし冷やさなければ、土の温度がもっと上がる。ヨーロッパでは1930年と比較すると森林が増えている国が多い。しかし、世界的にみるとそうで

はない。広葉樹の場合は約47%の水が地下水になる。35%は木や植物に入り、18%は蒸発する。針葉樹の場合は約33%の水が地下水になる。33%が木や植物に入り、34%は蒸発する。広葉樹のほうが蒸発は少ない。針葉樹、広葉樹の混交林は、洪水が減り、山がより元気になり、自然に良い。これは世界がヨーロッパから学べることである。

蒸発の量を比べると、針葉樹は広葉樹の約 2 倍です。スキー場に雨が降ったら早く流れる。地面に入らない。皆伐の場合は、場合によって、地面に入らな
い。水は土に浸透しなければならない。

洪水を防止するため、金をかけてダムを作っているが、混交林の山を作ったほうが経済的ではないか。

1 立方メートルの森の土は、約２００リットルの水を貯めることができる。 木の根が大きくなったら、フィルターの効果で水の質が良くなる。根の大きさが大事である。

100 年の広葉樹の木は、年間 4600kg の酸素を作ることができ、この酸素で一人の大人が１３年間生きることができる。

山が元気でないと、水が元気ではない。土も元気ではない。森が多いところは水がきれいである。 オーストリアの首都、ウィーンは人口２００万人の町であり、この町の水は、森の水を処理しない（濾過も消毒もしていない）でそのまま使っている ウィーンの水源では年間一億三千万立方メートルの水を取水している。 雨が降って地下水になるまでに6時間かかる。地下水をくみ上げるポンプや処理場もあるが、使われていない。

水は秋と春の季節によっても異なる。水を理解するためには、水はケミカルではなくフィジカルなものなので、水の調査についてもフィジカルな調査方法も必要である。

水は命である。川のシグナルをとって（川にマイクを入れて）音楽を作る。 このシグナルは体のシグナルと同じである。

地下水（汚い水）に音楽を流すと生物が元気になって、早くきれいな水になる。人間の条件反射（食 べ物を見るとよだれが出る）と同じのと一緒だと考えている。

２－４. ピヘル森林学校見学 実習状況と天然更新施業地故郷　　2015.3.23

説明：ピヘル森林学校校長 マーティン クロンドーファー氏

実習状況 先生１人に対して生徒が二人ついて教えている。ジャッキを使った伐倒の実習が行われていた。

①ジャッキをつかった伐倒実習状況１ 追口切り

②ジャッキをつかった伐倒実習状況2 ジャッキアップで木を倒す

③伐倒後 枝払い状況

〇水源林と天然更新施業林 演習林面積 350ha。年間降水量 850mm

皆伐後に再造林した若齢林。皆伐した理由はベリー（野イチゴ類）を増やすため。オーストリアでは0.5ha までの皆伐は無届けで可能。0.5～2ha までは許可必要。2ha 以上の皆伐は不可である。

天然更新している森林でもシカの食害はある。しかし稚樹の数が膨大なので食べられてもダメージ少ない。天然の稚樹の方が育苗苗よりも栄養が少ないのでシカに食べられにくい。

水の管理は森林管理の大事な部分である。間伐した後、できるだけ自然に木が生えるようにめざしている。

ピヘル森林学校の演習林から出る水は市の水道のためのものであるが、ピヘル森林学校にもお金を支払ってもらいたい（管理費として？）。

ここの水は石灰が多い。川の水は石灰がないが、地下水は多い。天然更新の苗は栄養が少ないため、シカに食べられにくい。ピヘル森林学校の森はモミが少ないので、モミを増やしたいが、モミはしかに食べられやすい。

天然更新の利点は、管理が簡単になることである。苗が自然に生えてくるので、必要なものだけを伐採すれば良い。ただし、大径木を伐ったとき、周辺の小さな木にダメージを与えるので注意が必要である。

天然更新の森では、1本当たり10年間で材積が1m^3 増える。皆伐ではこれほど増えない。木の直径が大きくなると価値が下がる時期があったが、今はそのようなことはない。ウォーターマネジメントを考えると、広葉樹を多くする必要があるが、この森林は土が良くないため広葉樹が少ない。
この森林の土に植えられる広葉樹もあるが、光を多く必要とする樹種なので育たない。
シュタイアーマルク州には、単一樹種の森林はない。

斜面の急な山は、道と道の間隔が離れているため、伐木集材の事を考えると仕事が難しい。広葉樹は売りにくいが、100 年の木は 100 年で売っても 120 年で売っても良いので、売れる時期を見極めて売ると良い。

オーストリアではシカもイノシシも食べるが、食べてもらうためにはプロモーションをする必要がある。プロモーションをしなければ皆がシカを食べなくなり、シカが増えて困る。プロモーションはほとんどが新聞で行っている。オーストリアではシカを食べる人が多いので、採ったシカはほとんど個人で食べられている。

単に森林管理をするのではなく、水もシカも森のもの全てを含んだ森の管理が必要。今回のような交流はとても大事だと思う。

オーストリアでは森林や林道は関係者以外立ち入り禁止である。林道の入り口には立ち入り禁止の看板がある。

3. マイヤーメルンホフ社 会社説明等 2015.3.24

説明：MM 社 ルンツ・ピッケンパック氏

〇オーストリアの森林の概要 オーストリアの森林所有者は 21,4464 人である。

所有面積毎では、2ha 以下は 79,544 人、2ha から 20ha までが 11,7264 人、20ha から 200ha までが16,323 人、200ha 以上は 1,268 人、森林を所有する公的機関が 12 機関ある。森林面積の割合では、2ha 以下が 2.4%、2ha から 20ha までが 22.9%、20ha から 200ha までが 23.4%、200ha 以上は 35.6%、公的機関は 15.7%の面積を管理している。

〇林業の歴史 昔は斧の伐採からのこぎり、おのを使って山から切り出していた。

1929 年にチェンソーが開発された。とても重くて二人で使っていた。それが現在のチェンソーになり、 現在のハーベスタになった。ハーベスタは斜面でもケーブルを使って自身を支える伐採を行なうことが できる。
一般のハーベスタは勾配が約40%まで使えるが、ケーブルを使えば50%から60%ぐらいまでつ かえる。
良い点は、ケーブルがついていれば、あまり地面にダメージを与えることがない。
タイヤをのけてクローラのものを作った、クローラは地面の形状に合わせて動くので、ダメージが少ない。

伐採の方法は、山できって、修羅で運搬し、とび、つるで原木を引っ張り出していた。
雪の時にはそりをつかって木材を出していた。馬をつかってだすこともあり、川を使って流すことも
あった。春になると雪解け水をつかって木材を出していたが、水がとても冷たいので健康に悪かった。
ダムを作って水をため、原木を流すこともあった。
川ではいかだを組んで下ることもあった。
フランス、スイス、ドイツの故郷あたりにライン川がある。ライン川に原木をながし、オランダに原木を運んでいた。
川の大きさによっていかだのサイズを変えていた。いかだに乗ってオランダに下った作業員は、800km 歩いて帰っていた。
1950 年にモーターロバという木材運搬車が開発され、その後トラクターやスキッダになった。

架線技術は、1922 年には長い距離を木材を運ぶ手段であった。集材機はとても重いものであり、山の上に持っていくのが重労働であった。

1956 年にタイヤ付ウインチが開発された
1961 年にクローラ付きウインチが使われていた。
1963 年に初めて MM 社のタワーヤーダが使われた。
1972 年にトラック搭載型のタワーヤーダが使われ、シンクロファルケは 1995 年に開発された。

1950 年の集材コストを 2011 年現在に置き換えると、1m3 当たりの伐採のコストが 99 ユーロ、運搬が 79 ユーロであったが収益は 63 ユーロしかなかった。

将来は足の着いた集材機や、ヘリコプターのように空中の集材ができるかも知れない。現在はリモコンでケーブルヤーダを操作し、ケーブルを操作できるようになった。

〇MM 社概要

MM 社はオーストリアで一番大きい民間の森林所有会社である。事務所はフローンライテン市に 2 箇所、レオーベン市に 1 箇所ある。所有森林面積は 32,600ha そのうち人工林が 28,000ha である。林分構成は、トウヒとモミは約 75%、カラマツが約 15%で、広葉樹が約 10%である 広葉樹は低いところに多い。
国の方針で、今後広葉樹を増やすようになっている。広葉樹を増やすことによって山が安定する。標高は 430―2,200m
勾配が約 62%である。自社の山が急であり、原木を搬出する手段がなかったため、自社でタワーヤーダを作った。

1972 年から 2004 年まで現場作業員が大きく減っているのに、生産量が増えている。 伐採量が $180,000m^3$ であり、そのうち用材が $130,000m^3$、チップが $50,000m^3$ である。伐採のうち、28%が自社直営で行い、残りの 72%は外部委託している。
外部委託する会社は伐採技術や所有する機械もさまざまである。シンクロファルケを所有している会社、ワンダーファルケを所有している会社、それぞれの現場に合った機械を所有している会社に委託する。
タワーヤーダは高価な機械であり、採算を取るためには大径木を効率よく搬出しなければならない。
そのために安定的な山をつくることが、経済的な山にするために大事なことである。

〇MM 社の業務・施業について
MM 社の直営の業務量は、森林管理や伐採作業が 25%で、製材などの伐採後が 75%である。森林施業の方法は、間伐(天然更新施業)が 63%、皆伐が 37%である。皆伐は潜在植生に戻すための皆伐と、経済的に行なう皆伐がある。オーストリアは山の勾配が急であるため、皆伐をしないと経済的な林業がやりにくい。タワーヤーダを使用した急斜面での集材では、上げ荷集材でないと周りの木に当たって、残存木を傷つけやすい。
皆伐施業では、面積が 0.5ha までは許可が必要なく、0.5～2ha では許可が必要となる。それ以上の面積では皆伐はできない。
日本の列状間伐や、架線等の線下の伐採もオーストリアでは皆伐となる。
皆伐の面積ができるだけ狭くなるように目指している。

〇収益について
1974 から 2004 年今まで、賃金は上がっているが、木材の値段は下がっている。
平均の木材価格は $1m^3$ あたり 74 ユーロ(9,000 円)ぐらいである。経費の内訳は、作業費(斜面の場合)が 28 ユーロ(平地を含めた平均は 18 ユーロ)、運送費が 10 ユーロで、収益が 36 ユーロである。補助金はない。木材価格が上がらないので、作業費が上がらないようにしている。作業員の給料が上がっており、機械の値段も上がっているため、一人当たりの生産性を高め、より多くの材を効率よく出すようにしている。
林道、作業道開設費など、他にかかる費用はすべて収益から引かれている。

〇林道について 林道は自社で作っており、補助金は入っていない。
MM 社の路網密度は 44m/ha 総延長 1350km の林道・作業道がある。

〇その他
間伐材は殆どパルプチップにしている。
広葉樹からは服、セロハン、染料、ビネガーを作っている。

別会社で、小水力・風力・ソーラ・バイオマス発電をしている 11 名のハンターがいる。(フォレスターも 11 名)

（車中でのロシェック氏の話）
フローンライテン市に MM 社の製紙工場があり、年間 50 万トンの段ボールを作っている。フローンライテン市のフローンは赤、ライテンは急な山という意味。つまり、赤い山。広葉樹を混ぜると針葉樹がまっすぐ育つ。

昔は林道もなく、木を山から落としていた。作業道の平均勾配は 14 度。

樹高5m までの間伐は切り捨てる。

4ー1. MM 社 タワーヤーダによる集材作業現場見学　2015.3.24

説明：MM 社フォレスター クルーク氏

①フォレスターのクルーク氏

MM 社フォレスターのクルーク氏が管理する 現場。

クルーク氏は年齢 48 歳、以前は森林管理局 でフォレスターをしていて、2010 年から MM 社 のフォレスターとなり、今の地方の担当とな った。

2,300ha を管理し、その内森林は 1,900ha。標高は 450m～1,900m。

年間 14,500m3 を生産し、その内 4,500m3 は間伐（チップ）、残り 10,000m3 は主伐

14,500m3 のうち 7,000m3 は MM 社の直営で、残り 7,500m3 は外注である。

②集材作業中のタワーヤーダ

○施業地、施業方法の概要

この現場の平均傾斜は 60%。タワーヤーダ で集材している。土壌があまり良くなく、岩も多いので木の成 長が良くない。ランクは7～8ぐらい、14 が 最高ランク。所有者は、トウヒを増やしたいが、スタビリティー（安定性？）を増やしたいのでブナも大事にしている。

ブナは天然更新で、トウヒは MM 社で作った 苗を植えている。

樹高が5m になった時に間伐をしてどのような山にするかを決めている。

林分構成は、トウヒ 80%、カラマツ 10%、残りがブナで、樹高が5m になった時にトウヒとカラマツ を間伐し、ブナは間伐しない。ブナが良く成長するようなら、ブナの割合を 30%にする。トウヒの成長 が良かったらトウヒにする。

目標の林分構成は、ブナ 30%、カラマツ 30%、トウヒ 40%。日当たりが良いのでこの割合にした。1,600 本/ha を植栽し、樹高が5m の時に 1,000 本/ha にするが、ここは 1,200 本/ha ぐらいある。木 材価格が低かったのであまり切らなかった。そのため、木が小さい。

間伐する木の選定方法は、フォレスターが山に入って6m 間隔で一番元気な木を選びその周りの木を切る。（クルーク氏がマーキングした。）一番元気があり、中ぐらいの木があると、中ぐらいの木を間伐し、弱い木は切らない。中ぐらいの木を間伐すると、弱い木も成長が良くなる。間伐率は決めない。風の強いところは切らない。一番切りたい木は、元気のない木や病気の木、大きなブナ。大きなブナは早く切り出さないと、大き くなったときに出しにくくなる。

本当にきれいに成長したブナがあったら、周りのトウヒを切ってブナの成長を促す。
今間伐している山は 36 年生で、約7ha。２週間でやっている。
38 ユーロ/m3 で外注し、機械は MM 社のものを使用。
間伐された材は、25%が製材用、25%が服に（ブナ）、50%がパルプ用になっている。
直径が大きくなると m3 当たりの収入が増え、コストが下がる。（写真③）
標高が高くなると広葉樹の割合が減る。
枝条は全部搬出することはない。虫の発生するリスクが高い場合は全て搬出する。

③直径と収穫＆コストの関係
赤：収入 青：コスト

直径8cm 以上のものを運搬している。それより小さくなると、工場が受け入れてくれない。MM 社が自社のトラックで運搬する。

〇タワーヤーダについて この現場では、2014 年製の新型ワンダーファルケコンビマシンにより集材している。ハーベスタのヘ ッドはウッディー50、タワーヤーダの主策の延長は500m。

自動で木の重さを判断し、調整している。
ラインが長くなると重くなるので、日本では長くしない方がよいかもしれない。
荷上策に新しいタイプの線を使っており、荷上用の モーター（エンジン）がいらなくなった。下で荷掛を する人が楽になる。

モーター（エンジン）があると、メンテナンス費や燃料費が掛かり、重たくなる。無いと軽くなるので落ちてもダメージが少ない。機械（搬器）は全体的に 軽く作りたい。

操作するリモコンは香美森林組合のものとあまり変わらない。タワーヤーダのコンビマシンを購入した企業は、１ /3を前払いし、残り2/3を5年間で支払うように

④新型ワンダーファルケのコンビマシン

なっている。支払いが完了すると使用者の所有となる。
タワーヤーダは 5,000 時間のサービスがある。

〇フォレスターの仕事について
午前中は山の管理をしている人（パート）へのアドバイス。パソコンでの事務作業も増えてきた。

外注先のそれぞれの会社が伐採した木のデータ入力。
林道の線形を図面に書いて提案する。OK が出ると外注先にお願いする。

施業には、樹高を色分けした図面を利用する（写真⑤）
シュタイアーマルク州が、州内を上空からレーザースキャンして、高さのデータをホームページ で公開しており、それを利用して
MM 社の GIS で 作成している。

⑤GIS のデータ 樹高ごとに色分け

4－2. MM 社 ハーベスタ･フォワーダによる施業地見学　2015.3.24

説明：MM 社フォレスター クルーク氏

〇ハーベスタでの間伐の現場
この現場では、斜面の傾斜が 20 から 25 度と勾配があまり急ではないのでハーベスタで間伐をしている。傾斜各 30 度の現場でもハーベスタで作業することがある。
ハーベスタでの作業は土壌水分が多ところでは難しい。

①斜面で伐採作業中のハーベスタ

間伐面積は4ha、搬出材積は 100m^3/ha、作業コストは 28 ユーロ/m^3。
間伐率は 30%以上で、できるだけ早く大きな木を作るため立木を少なくしている。
この現場は間伐木の品質が良くないので、
後部にウインチが付いている
16%が新聞用、37%が製材用、47%が紙用。
ハーベスタは両側 10m を伐採することができ、20m 間隔でハーベスタが林内に入っていく。
間伐でできるギャップを5～6m 以内にしようとしているので、悪い木でも残す場合がある。
伐木の枝をハーベスタの走行する部分に敷き、土壌を保護している。

②ハーベスタの作業道

ハーベスタでの間伐終了後にフォワーダがウインチを付けて林内に入り、集材する。
外注先は相手方の機械の保有状況によって決枝葉が敷かれているめる。外注先は 10 社程度で、引き続き施業する場所では、90%は同じ業者と契約する。

cハーベスタについて
このハーベスタはバルメット社（小松が買収）製。機体保持用のウインチは後から付けた。
H26 年 12 月から使用している。
このハーベスタでは直径 77cm の木まで伐採することができる

③林分密度維持のため、二股になった木でも残す

〇機体サポート用のウインチについて
ウインチは RITTER 製。機体サポート用のウインチはハーベスタの前後に付けることができる。

斜面を登りながら作業する場合には前に、下りながら作業する場合には後に付 ける。下りながら作業する方がやりやすいが、オペレータには少し怖い（この現場で は下りながらの作業で、ウインチは後部についていた）。

ウインチ使用するワイヤーはΦ＝14mm、400 ～450m 張っている。

このハーベスタではウインチ無しでも傾斜 角 35 度ぐらいまでは作業できると思う。それ ぐらいの勾配までは機械が自立できる。

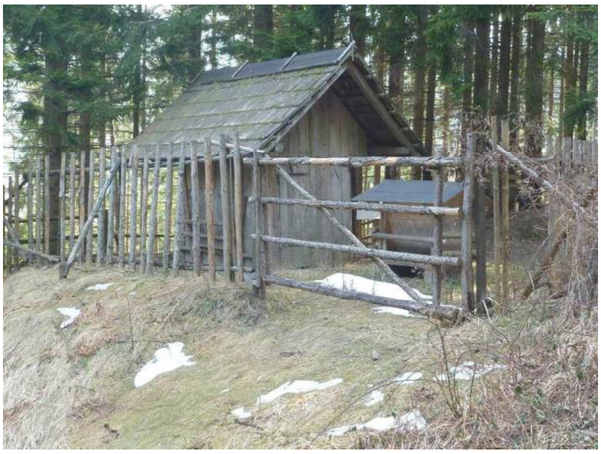
このウインチだけでは機体を支えることはできない。ウインチはサポートのためにつけているが、無ければこの作業はできない。ウインチのサポートが無ければ森の土壌を荒らすことになる。

④フォワーダ作業
ハーベスタと同じワイヤーロープで保持されている

〇フォワーダについて
ハーベスタと同じく機体サポート用のウインチ付き。ハーベスタが作業をした後の道を使って集材する。

ウインチのワイヤーを固定するアンカー木の直径は 40cm、樹高 17m くらい。
ワイヤー径は 15mm で長さは 300mある。

〇シカの食害について
この山はシカが多く、シカの食害を受ける。
そのため、立木本数を多くしている。
冬に餌でシカを集めて柵で囲い、冬の間そこで餌を与えている。これは、冬の間は餌が無く、木の皮をはいでしまうためで、食害を防止するため、冬の間餌を与え続ける。
狩も大切な収入源なので、冬の間はシカは殺さない。春になると柵から放す。７月から若いシカを打つことができ、８月から大人のシカを打つことができるようです。
（期間が決まっている）



⑤鹿の餌付け場所
アカシカと普通の鹿がいて、これは普通の鹿用。
アカシカは大きいので柵がもっと大きくなる。

ワナは法律で禁止されている。フォレスターもハンターの仕事をする。MM 社ではハンターも重要。

5ー1. MM 社 タワーヤーダリモコン説明 2015.3.24

説明:Paar Mechatronik 社 社長 マークス パー氏

香美森林組合のリモコンが誤作動することがあり、リモコン開発担当者(マークス パー氏)に相談した。

仮に違法電波として同じ周波数の電波が飛んできたとしても、リモコンから発する電波には独自の信号を含んでおり、受信側で識別しているので原理的に誤動作は起こらない。組合のリモコンの周波数は 429Mhz。送信機または受信機の近くで強い電波を発する無線機などを使用した場合に誤作動する可能性が考えられるが、かなり強力な電波でないとその現象は起こらない。

①リモコンをチェックする装置

②タワーヤーダの模型

5－2. MM 社 タワーヤーダ工場見学　　2015.3.24

説明：MM 社 CEO トーマス プッシュ氏

これまでにシェルパを 600 台作り、世界に販売した。

最新型のタワーヤーダは前のものより弱冠大きくなった。車体の高さは 3.6m であり日本にも対応して いる。

フィルター部分が外から見える位置になり、交換が容易になった。

エンジンが大型化して 102kW となった。
電源は 12V か 24V を選択できるようになった。

①プッシュ社長

日本ではトラック搭載型のタワーヤーダでは、オーストリアで使っている MAN（ドイツのメーカー）のトラックシャーシよりも、ボルボのほうが小さいので良 いと思う。

日本のトラックメーカーであるいすゞのシャーシも使えると思うが、いすゞは車高が低いので林道を走 行するのは難しいかも知れない。1台取り寄せて確認 する必要がある。

小さいパーツは自動選別機能つきのラックに収められており、部品番号を入力すると必要な部品が入ったラックが自動で選択される（写真③）。

②組立て中の牽引式シンクロファルケ

パーツだけで5億円の価値がある。エンジンは CAT を積んでいた 平成 27 年7月頃から、タワーヤーダのスペアパーツを日本にも置くようにする。すべてのパーツを置くつもりであるが、そこでもし無かったとしても、48 時間以内にオーストリアから取り寄せられるようにする。

③パーツラック
自動で必要なパーツが入ったラックが選択される

④ベースのトラックシャーシ
MAN（ドイツのトラックメーカー）のもの

6. 山と自然の管理局の説明 2015.3.24

説明：自然保護官 カーラル シマー氏

〇制度について シュタイアーマルク州の全ての市町村に管理局があり、自然保護官は法律（自然保全保護法？）が守られて いるかどうか取り締るのが仕事である。

①中央の白いヒゲの方がシマー氏

ボランティア（無償）で活動しているが、州が認めた資格を有しており、法律を守っていない人を取り調べ、訴えることができる。

山を担当する資格と、川を担当する資格の2種類があ り、シマー氏は川の担当である。
フローンライテン市では山の担当が7名、川の担当がシマー氏１人。１年間で山の資格を取ることができ、川の資格は山 の資格を取ってからさらに1年で取ることができる。資格を取るとエンブレムと資格証がもらえる。

〇仕事の内容 例えば、捕獲禁止の鳥を捕った疑いのある人を見つけた場合、その人の行為を止めて、取り調べ、訴えることができる。

また、景観の保全が義務図けられている地域では、それを破壊する行為を見つけた場合も、同様のことができる。

②資格証（左）とエンブレム（右）

捕獲を禁止する動物や植物を管理局が調査し、リストを作成している。

EU になってからこのリストに掲載される動植物の種類が増えた。この地域で普通にいる動植物でも、他の地域で数が少なくなると EU がリストに追加する。
景観や文化を守るため、森の2/3は保護区になっている。

〇その他
ロシェック氏は、今の景色は昔の人が作ったものなのに、それを守るのはおかしいのではないかという意見だった。農家は、自分の畑に糞由来の堆肥（肥料）を入れることができない時期がある。これは、地下水に糞が入っていかないようにするためである。

景観や自然を保全することは金儲けよりも大事なこと。なぜなら、お金は食べられないから。自然環 境がよければ食べていくことはできる。（食料の生産はできる？）

7. フラッドニッツ地域暖房　2015.3.25

説明：ピヘル森林学校 講師 フーバート クラムラー氏

地域暖房：ひとまとまりの地域に、熱供給設備（地域暖房プラント）から温水などの熱媒を配管を通じて供給し、暖房などを行うシステム。
見学したのはフラッドニッツ地域暖房の熱供給プラント（社名：Biomasse Fernwärme Fladnitz a.d.T. GmbH）

①帽子をかぶっているのがクラムラー氏

○クラムラー氏について クラムラー氏はパサイルの地域暖房会社の代表であり、牧場と森林を経営している。ピヘル森林学校の講師でもある。森林マイスターの資格保持者。

代表の仕事はカスタマーサービスと原料の調達である。
2011 年にフォレスターのロシェック氏と一緒に高知に来たことがある。

②ガソリンスタンドも暖房はバイオマスエネルギー

○フラッドニッツ地域暖房の取組みについて
バイオマスによる地域暖房の取組みは 30 年前
に始まった。

バイオマス暖房を地域で始めるまでが大変で、地域での話し合いは難しかった。

話し合いでは、「バイオマスはここにある木を使うが、石油は遠くから持って来て使うことになる。それは、アラブの人がここのバイオマスを持って行って使うのと同じことであり、
そんなことはおかしい」ということで説得した。

③地域暖房施設外観

地域の方との話合いでは、はじめは同意していなかった人でも、2～3時間話し合うと同意してくれた。
30年前は石油の値段が安かったので石油を使っていたが、今はバイオマスと同じくらいである。石油は価格が変動するが、バイオマスは変動しないため、石油の使用にはリスクがある。
最近の建物はすべてバイオマスエネルギーの暖房を使っている。
ガソリンスタンドの経営者であるガイトナー氏 は、石油を売っているのに、暖房をバイオマスに変えた（写真②）。

〇施設概要

この地域にはパサイルとフラッドニッツの2箇所のバイオマス地域暖房がある。パサイルは約5．5MWのエネルギー量で、550世帯の暖房をまかなっている。フラッドニッツは約4．5MW のエネルギー量で、隣にあるゲーベル社（Josef Göbel）の 家具工場と300世帯の暖房をまかなってい る。ゲーベル社は1MWのエネルギーを使い、 家庭用は3．5MWのエネルギーを使用して いる。


④おが粉を圧力で噴射させるボイラー

バイオマスのボイラーは、1984 年、1994 年、2011 年に1基ずつ建造し、合計3基ある。 2つは年中稼働、1つは冬季のみ稼働。

フラッドニッツの地域暖房は30年前に2 5名の農家とゲーベル社の工場が立ち上げた。

建設費用の負担金（補助金以外）の半分は25名の農家が出資し、残りをゲーベルの会社が出資した。


⑥水分の多いバイオマス用のボイラー
水分は 40%まで（バークは使えない


⑤チップを押し出して燃やすボイラー
中央下の青い部分をゆっくりと材料が送られていき、
その間にバイオマスを乾燥させる

パサイルの地域暖房も同じ方法で建設したが、農家は55％でゲーベル社は45％だった。地域暖房の施設整備に対し 30 年前は 55%の補助金があったが、その後 50%、40%、30%、25%と

段々下がり、10 年前から補助金はなくなった。以前は特別な施設だったので補助金が必要だったが、今では特別なものではなく誰もができる施設なので、このような施設には補助金は必要無いと思う（ロシェックさん談）。

〇バイオマス燃料 原料は山からの原木と、隣接する家具工場
からでる未利用材。

2～5年間、暖房施設脇の広場に発電用の原木・材を置いて乾燥させている。雨が少ない（年間降雨 量は 700～1,000mm）ので屋根が無くても乾燥する（写真⑦）。

最近チップにしたときの含水率は 14～16%だった。バークも使用するが、製材工場から直接運ばれてくるので、水分管理が難しい（写真⑧）。家具工場からのチップは含水率が高く、貯蔵場所では発酵して湯気が出ていた。発酵によりエネルギーが無駄に消費されるので早く燃やす。

⑦バイオマスのストック
２～５年間、乾燥させる

⑧バークのストック

8. 自伐林家施業地見学　　2015.3.25

説明:ピヘル森林学校 講師 フーバート クラムラー氏

〇クラムラー氏の管理する会社（牧場と森林）
標高 780m、36ha の牧場と 21ha の草地で 40 頭の牛（うち 20 等は乳牛）を飼育している。
トウヒ、カラマツ、ブナの森林が 15ha あり、面積は小さいが会社にとっては大事な部門で、製材用の原木とエネルギー用の原料を供給している。
奥様は保育士で、自宅で5名の幼児を預かっている（写真①）。枝は牧場に放置して1年間乾燥させている（写真②）。

①奥様と自宅と保育の子どもたち

写真③は 35 年生の森。親が 35 年前に植えた。
シラカバが多かったが、生長があまり良くなかったので切り出し、トウヒと他の広葉樹の森を作ろうと した。
しかし、広葉樹は虫と菌で枯れたため、
トウ ヒの多い森になった。

隣の所有者の森が防風林になっていたが、所有者が木を全部伐倒したため、半年後の風の強い日に $20m^3$ の木が風害の被害を受けた（写真④）。
トウヒは風に弱いが、カラマツとブナは風に強い。

②牧場に放置された枝

③35 年生の森

④風害地

〇天然更新施業地
クラムラー氏の父が皆伐し、天然更新により稚樹が徐々に進入し、成長しているため、色々な高さの木がある（写真⑤）。

ここは傾斜が緩いので天然更新がうまくいっているが、急傾斜地では難しい（写真⑥）。

2013 年 12 月に雪の多い日があり、樹冠に雪が積もり、凍ってダメージを受けたがこの森はあまりダメージを受けなかった。良く間伐をしているため、樹冠の形状がよいのでダメージを受けなかった。

⑤天然更新状況（樹高がさまざま）

⑥天然更新状況（幼樹が生えてきている）

写真⑦のクラムラー氏が立っているところが森林の所有界で、斜面下側（写真右側）のクラムラ ー氏の森は間伐されており、日が当たるのでトウ ヒの苗が生えているが、斜面上側の森
（写真で人 が立っている場所）は
手入れがされておらず、苗 が生えていない。
写真⑧のクラムラー氏の森は間伐を行っているので播種更新がなされている。写真⑨の他の所有者の森は手入れがされていないので稚樹、下層植 生が生えていない。
広葉樹の割合は 20%程度がよく、その方が
針葉樹の形質も良くなる。

⑦クラムラー氏（赤いジャケット）の足元が所有者境

⑨隣の森

⑧クラムラー氏の森

木を伐るのには理由が必要で、木が成長したからとか、お金にするためというのは理由にならない。
隣の木が成長する場所を確保するためとか、樹種の割合を調整するといった理由でないといけない。
ドイツ語で森は「Wald」これは、Wir alle leben davon（我々はみんなそれを使って生きている）の略？

9. マイヤーメルンホフ社 天然更新施業林　2015.3.25

説明：MM 社フォレスター アントン カロン氏

見学した施業地を管理しているのは、MM 社のフ ォレスター、アントン カロン氏（31 才）
石灰岩質の土壌なのでドイツトウヒの育ちが悪く、ブナに負けないよう管理しなければならない。
もともとブナが多いので、ブナが多くなりすぎないように注意する必要があるとのこと。

①2 か月前に伐採した皆伐地

写真①は2か月前に、タワーヤーダ（シンクロ ファルケ）に よる施業を実施した皆伐地。
ブナ の天然更新があるが、除けない。
トウヒも生えて いるのでトウヒを増やしていく。

写真②③は 10 年前に皆伐した場所。林内にト ウヒの苗が生えてきたので、天然更新させるた めに皆伐した。樹高の幅で帯状に皆伐する。伐期 は 120～130 年。

伐採時、写真②の左側から苗が進入しており、 右側に苗が少なかったため、苗へのダメージを 減らすため右側に伐倒し、タワーヤーダ（シンク ロファルケ）で集材した。

皆伐後、3年目に天然更新の苗を間引きする。 トウヒは成長が早いので早く間引いた方が良 い。皆伐によるダメージを受けた苗も間引く。

皆伐後2～3年経つと、写真②の奥の側の林内にも苗が生えてくるので、同じように皆伐し、天然更新させる。（写真④の絵のように縦に左から右 に順番に皆伐し、天然更新させていく）

③ 10 年前に皆伐した区域

④ 列状皆伐更新の図

写真は⑤トウヒの苗が生えてきたので、2年前に皆伐した場所。
皆伐から2～3年目に写真の右側の林内にもトウヒが生えてくるのでそこを皆伐する。
この方法でやると4～5ha の山を順次天然更新させていくことができる。
この皆伐方法は、「ザオンヒープ」という。

風の方向に注意し、風下から皆伐していく。皆伐の幅が広すぎると風で苗が倒れる危険性がある。

ブナは成長するのに光をあまり必要としないので、そのままにしておくと大きくなりすぎてトウヒが育たなくなる。
オーストリアでは、通常の皆伐は～0.5ha は無許可、0.5～2.0ha は許可制、2.0ha～は皆伐禁止だが、 天然更新の場合は～1.0ha まで無許可で皆伐ができ る。

⑤ 2年前に皆伐した区域 稚樹が生えている

この山は傾斜がきついので、タワーヤーダを使う 必要があり、コストがかかるので価値のあるトウヒを多く残す。

オーストリアにとって木材は 2 番目の産業なので、できるだけお金になるもの（トウヒ）を多く育て たいが、広葉樹（ブナ）も 25%の割合で残す。

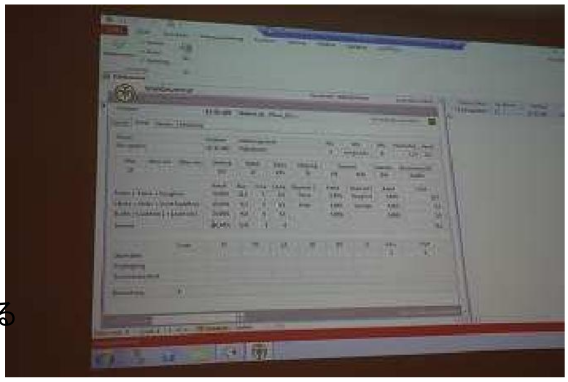
樹種の割合は会社（MM 社）で決める。
天然更新すれば保育コストも抑えられる。

10. MM 社 GIS 説明 2015.3.25

説明：MM 社 森林管理担当 マーティアス アウラー氏

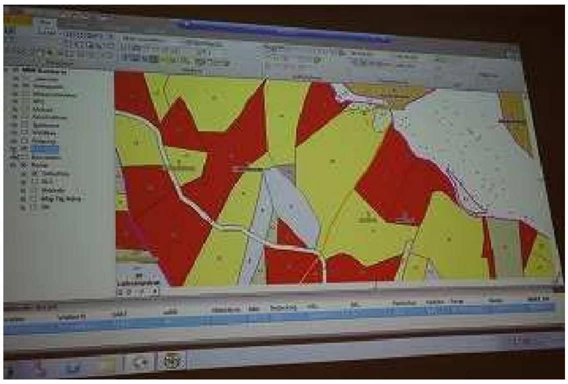
MM 社では社有林管理のために GIS を導入している。
 今の GIS は 2011 年に導入した。ベースとした GIS ソフトウエアは ArcGIS。本社のサーバと支社、個人のタブレットすべてがネットワークで繋がっている。

山では携帯電波が入りにくいので、衛星電話回線を使って繋がるようにしている現地でフォレスターが調査した内容は、現地でフォレスターが端末に入力することで、GIS システム に反映されるようになっている。



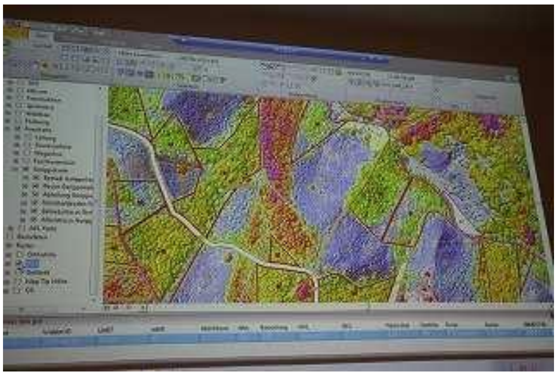
①位置情報データベース

資源情報は、天・人区分、樹種、樹種構成割合、材積、面積、傾斜、標高、樹冠疎密度など。
データベースは Microsoft アクセスで管理。
シュタイアーマルク州では、州の全土を航空レーザーでスキャンし、州のホームページで公表・販売 している。
希望者は2ユーロ/ha でデータを購入で きる。
（誰でも買うことができる）そのデータを利用し、樹高の色分け図等を作成している。



②森林管理の色分け図

レーザー測量は 10 年に 1 回実施しており、その 間の 5 年目では計算値により補正しているレーザー測量成果を購入しているが、施業を実施する前などは現場で樹高を実際に測って入力している施業履歴はすべて入力している。入力作業は大変だが重要な作業。



③樹高の色分け図

11. グラーツ市 レクリエーション林見学 2015.3.26

説明：グラーツ市フォレスター ペーター ペテング氏

○グラーツ市 グラーツ市はシュタイアーマルク州の州都でオーストリア第2の都市。人口 25 万人、面積12,756ha 森林面積 3,200ha、森林率は約25%。周囲を山に囲まれている。グラーツ市北部の森林は水源林となっており、市の飲み水の約 1/3 を取水している。グラーツ市はアルプスの北（東？）にあり、ア ルプスの終わり（始まり）に位置する。

①レクリエーション林内にある学習施設

○グラーツ市の森林とフォレスター 見学したレクリエーション林は都市部の中心地にある。 グラーツ市は、市の業務（ゴミの収集等）を行うためにそれぞれの業務ごとに管理会社をつくっており、市の森林を管理する森林管理局もオーナ ーがグラーツ市の会社組織になっている（第三セ クター方式）。

②森林学習施設内の様子 写真中央がペテング氏

市のフォレスターであるペテング氏は森林管理局の職員である。森林管理局では約 700ha の森林を管理しているが、森林が分散しているので管理が難しい。森林は利用目的によりエリア分けされており、人工林として管理可能な森林が最も多い。市民の利用するエリアや保護林は伐採ができない。

③森林管理の図面 GIS のデータを利用

グラーツ市は 2001 年に現在の新しい森林管理計画を策定した。それまではあまり森林の管理を していなかった。以前は、森林を管理する林道を作るようなことでも環境破壊であり、森には何もしないほうが自然にとって良いことだと市民が思っており、森林管理というものが理解されていなかった。しかし、2001 年、虫の被害によりトウヒが大量に枯れたため、森は管理をしなければダメになるということが理解された。トウヒが枯れた原因は、もともとトウヒが無かったところに植えたことだった。 以前グラーツ市の西部で雪崩による被害があり、その時は 15,000 本のカラマツを植栽した。カラマ ツを植えた場所にグッターバウム（ニワウルシ）の種子が進入し、カラマツが負けている。都市周辺の森林ならではの問題もある。

2001 年まで森林の管理が十分にできていなかっ た
こともあり、林齢が 120 年生以上の森林が一番多い。
この比率はこれから先もそれほど変わらな い。

④ケーブルパーク

樹種構成は、針葉樹が 35%、広葉樹が 65%と
広 葉樹が多い。トウヒが虫の被害で枯れたことが
原因である。近年はもともとここになかった樹種の
種（グッターバウ？）が飛んできて問題になってい る。

立木密度は 1,009 本/ha から 726 本/ha に、
蓄積 は 389m^3/ha から 280m^3/ha に、
平均林齢は 79 年生 から 92 年生となった。

2001 年から森林管理を始めたことにより、2012 年には
林内路網密度が 16m/ha から 45m/ha になり、
シュタイアーマルク州の53m/ha に近づいた。以前は林道が
なかったため、タワーヤーダを使うことができなかったが、
今は林道があるので林業機械による管理ができるようになった

⑤林内を散策する子どもたち

近年は森林管理のために様々な図面が
整備 され、森林管理の業務が楽になった（写真3）。
図面があるこ とで、森林の機能のバランスが取りやすくなった
森林管理局の正職員は2名で、残りはパート職員。
ハンター の資格と森林管理の資格を持っている。
フォレスターは森林の管理だけでなく、街の景観も考えている。
フォレスターのこれからの目標は、管理局が管理している
小さ な分散した森林を周囲の民有林の購入や交換等で広げ、
市内の 景観を良くしたい。

〇市民と森林について
グラーツ市は大きな街なので様々な人が
住んでおり、市民とコミュニケーション（環境学習）を図ることで
管理がしやすくな る。レクリエーション林内にある施設も
森林学習のためのもので ある（写真①）。
市民の方々はレクリエーションのためにこの森に来ている、
レクリエーション林は森林の持つ多様な機能を理解してもらう
ことも重要な役割である。オーストリアでは自由に森に入ることが
できないが（森林は関係者以外立入禁止であるため）、
市民にはもっと山に入っても らいたい。山には入る際には
マナーを守って入ってもらいたいので、特に子供達に
山のことを教えている。

⑥林内の散策道

グラーツ市の学校の子供達にここの
レクリエーション林に来 てもらい、夏休みや冬休みに
1 週間程度の環境学習や自然の中で
身体を動かす活動をしており、
林内にはケーブルパークもある（写真④）。

グラーツ市には大学もあり約 1 万人の学生が
教室で勉強をして いるので、このような
レクリエーション林があればもっと外に
出 てくるのではないか。

⑦林内の様子 根本にあるのは子どもたちが枝で作った「秘密基地」管理上問題がなければ片 づけるようなことはしない

年間 2,000 人の生徒が訪れ、９月の学校の始まる前に
3つのツ アーがある。参加人数は1つのグループ当たり
25 名程度。グラーツ市の周囲の山は石灰が多いが、
このレクリエーションの森は石灰が少ない。
昔は、ここの土を使って煉瓦を作っていたが、
煉瓦作りをしなくなったので、ここに森ができた。

レクリエーション森の中に立派なブナがあるが、
第 2次世界大戦の時の爆弾の破片が
中に入ったままに なっている。
林内には昔のケルト人の墓（古墳）も
残っている（写 真⑧）。
昔からこの地域には人が生活していた。

⑧盛り上がった部分がケルト人の墓 レクリエーション林内で保全されている

12. グラーツ市庁舎訪問　2015.3.26

説明：グラーツ市 市長秘書官 ペーター ストックラー氏

氏の紹介により、グラーツ市長に昼食の招待を受けた。市長とは会議で面談できなかったため、市長秘書官のストックラー氏と面談した。グラーツ市は工業製品の生産が盛んである。

音楽の町で、多くの日本人が音楽を学びに訪れている。格式高いオペラから子ども向けのミュージカルなど、さまざまな音楽に関するイベントが公演されている。

工科大学の渡辺教授は、「～物部川に感謝する日～ のぞいてみんかえ物部川」で、物部川保全に関 するミュージカルを企画・出演しており、音楽やミュージカルを通じた森林教育について興味を持たれ ていた。

①グラーツ市役所

②中央が市長秘書官

Appendix B: Interviews

May 13, 2014

Interview regarding the purpose of clear-cutting and the sales of roundwood in Kami

Interviewer: Dennis Gain, Yukiyo Gain

Interviewee: Mitani, vice president of Kami Forest Owners Association

Place: Recently clear-cut 20ha private *sugi* plantation in Kahoku Town

Q: How large was this forest area?

A: It was approximately 20 hectares.

Q: What types of tree species were planted?

A: This stand consisted partly of *sugi*, and partly of *hinoki* monocultures

Q: **Who owns the land?**

A: This is private land owned by one individual from Kami. The owner and the prefecture had a lease agreement for the duration of 40 years. In these 40 years the prefecture was responsible for the management of the plantation. This lease agreement has expired and we bought the trees and decided to clear-cut.

Q: Did you buy the trees from the landowner or the prefecture?

A: Since the prefecture was responsible for the management they received 60% of the business while landowner received the remaining 40%.

Q: **How old were the trees at the time of the clear-cut?**

A: They were 50 to 55 years old.

Q: What was the condition of the trees at the time of the clear-cut?

A: We would evaluate the condition to be between medium and lower medium quality.

Q: Was a thinning not possible or reasonable under this condition?

A: The terms of the contract were to clear-cut when the contract expires. The owner did not extend the duration of this contract.

Q: **According to Kochi Prefecture Forest Policy, clear-cuts require governor permission and can be denied under certain circumstances. Was Kami Forest Owners' Association granted permission by Kochi Prefecture officials for clear-cutting this stand?**

A: Permission was not necessary. The land was managed under a forest management program which was also certified by Kami City.

Q: **Who is the buyer of the logs?**

A: Monobe Stock Yard

Q: How will the logs be processed?

A: Mostly Pulp, chip and building material

At this time of the interview, the interviewer recognized a log with a diameter of approximately 50 – 60 cm lying by the road.

Q: Was this log also sold to Monobe Stock Yard?

A: No. Logs with diameters larger than 40cm are difficult to sell. Since there are not many trees with such large diameters, there are no facilities that could process them or institutions that could make use of them.

Q: When will this land be reforested?

A: The landowner does not seem to be able to reforest and manage the land himself. We expect management to be taken over by a third party.

Q: Do you know what trees this third party intends to plant?

A: We've heard that he would be interested in planting torreya nucifera (kaya) or another coniferous species.

End of interview

May 27, 2014

Interview regarding the transformation of *hinoki* and *sugi* monocultures to mixed forests and forest simulation

Interviewer: Dennis Gain

Interviewee: Tanabe, Engineer for remote sensing at Kami Forest Owners' Association

Place: Kami Forest Owners' Association Headquarters

Q: I have visited several thinned stands and clear-cut stands in Kahoku Town and Monobe Town that appear to have shrub and new young trees in them. Were any stands artificially rejuvenated by Kami Forest Owners' Association?

A: Not that I know of. We do the thinning and the stands rejuvenate naturally.

Q: **Foresters from Germany and Austria who visited Kami in the past years to evaluate the condition of forests in Japan, such as Mr. Sonnleitner and Mr. Loschek, were concerned that natural rejuvenation, based on their expert assessment, may be difficult to accomplish due to the rocky soil condition of the forest floor. Does Kami Forest Owners' Association assess the progress of natural rejuvenation in the stands that were thinned?**

A: We do not have a contract with landowners to do that, and in fact we have never thought about it.

Q: In order to make forests and tree-covered hills and mountains more resistant to windthrow, landslides, as well as climate change, and pest, the European Union encourages the transformation of monocultures to sustainably managed more nature close coniferous and broadleaf mixed cultures. Sustainably managed forests are also the vision of the Ministry of Forestry and Fisheries. Does Kami Forest Owners' Association suggest or even give recommendation to forest owners to transform monocultures to mixed-cultures?

A: We have never thought about that. We do offer planting assistance but since we are a commercial business, I don't think we feel responsible for that.

Q: Does Kami Forest Owners' Association use any forest simulation software to prognosticate tree growth?

A: There are tree growth list that we have access to, but those are for certain tree species only.

Q: Would you have access to forest simulation software?

A: Not that I know of.

Q: There are forest simulators that can predict tree growth under a variety of growing conditions, for instance, newly established mixed cultures, or how young trees of any species would develop in a recently thinned monoculture. Would Kami Forest Owners' Association be interested in such software?

A: I think so. I personally would be very interested.

End of interview

Appendix C: Questionnaires

Survey I - National biodiversity strategy objectives 2012-2020 (Focus Group Discussion)

	National biodiversity strategy objectives 2012-2020					
Subsidy 補助	**Development of diverse forests** 多様な森林づくりの推進		**Forest conservation and management** 森林の保全・ 管理		**Control of wildlife damage to forests** 鳥獣による森林被害対策	
	Direct 直接	Indirect 間接	Direct 直接	Indirect 間接	Direct 直接	Indirect 間接
Subsidies for private forest under management planning systems						
1. Improvement thinning 除伐	☐	☐	☐	☐	☐	☐
2. Early thinning 保育間伐	☐	☐	☐	☐	☐	☐
3. Commercial thinning 搬出間伐	☐	☐	☐	☐	☐	☐
4. Renewal thinning 更新伐	☐	☐	☐	☐	☐	☐
5. Thinning for environmental development 環境林整備間伐	☐	☐	☐	☐	☐	☐
Subsidies for self-administered forest management, environmental enhancement and timber production						
6. Commercial thinning 搬出間伐	☐	☐	☐	☐	☐	☐
7. Improvement thinning 除伐	☐	☐	☐	☐	☐	☐
8. Early thinning 保育間伐	☐	☐	☐	☐	☐	☐
9. Thinning 間伐	☐	☐	☐	☐	☐	☐
Subsidies for reforestation and protection from deer damage						
10. Reforestation 再造林	☐	☐	☐	☐	☐	☐
11. Protection from deer damage シカ被害防護施設	☐	☐	☐	☐	☐	☐
12. Shrub removal 下刈り （隔年）	☐	☐	☐	☐	☐	☐

Survey II – Risk Perception Survey for Integrative Forestry with LERM

性別
☐男性　☐女性
年齢
☐20 才未満　☐20 代　☐30 代　☐40 代　☐50 代　☐60 才以上
職業（林業学生の有無）
☐ 林業関係者　☐林業学校の生徒
森林の経験
☐ 0－4 年　☐5－9 年　☐10 年以上

ドイツ、日本と高知県の森林管理制度の話をして、高知県の人工林（天然林）も長期的に考えれば**統合管理**の方が持続的という意見を説明しました。**統合管理**は多面的機能を実現するからです。

① 今の状態が続けば、高知県に五つの管理リスクがあると考えています。

その五つのリスクについてそれぞれどのような可能性があるのか、またどのような影響があるのか 1～10 で示して下さい。（数字が大きくなるほどリスクは大きい。）グループで相談してかまいませんが、自分の意見を書いて下さい。

例）

リスク	**可能性**			**影響**		
	短期	中期	長期	短期	中期	長期
環境破壊	4	6	8	5	7	10

短期：環境破壊のリスクが起こる可能性が 4 だとすると、起こったら 5 の影響が出る。

今の状態が続ける場合のリスク

リスク	**可能性**			**影響**		
	短期	中期	長期	短期	中期	長期
環境悪化						
不連続						
リーソウス流通						
屈曲性						
マーケット無能						

② 同様に LERM 制度を高知県で使うと五つのリスクの可能性と影響がどのように変わると思いますか。

LERM 制度を使う場合のリスク（**リスクの削減計画を見ながら**）

リスク	**可能性**			**影響**		
	短期	中期	長期	短期	中期	長期
環境悪化						
不連続						
リーソウス流通						
屈曲性						
マーケット無能						

③ 以下の質問に答えてください。

質問１
長期的に考えると統合的な森林管理が必要。
□そう思う　□ややそう思う　□どちらでもない　□あまり思わない　□思わない
□わからない
理由

質問２
高知県の人工林を持続可能に維持することがいいこと。
□そう思う　□ややそう思う　□どちらでもない　□あまり思わない　□思わない
□わからない
理由

質問３
地域で統合的な山管理をして日本の法を発展する。
□そう思う　□ややそう思う　□どちらでもない　□あまり思わない　□思わない
□わからない
理由

質問４
社会－地域を今よりも森林に巻き込んだらいい（興味を持つ）。
□そう思う　□ややそう思う　□どちらでもない　□あまり思わない　□思わない
□わからない
理由

質問５
林業ビジネスをサポート、発展しましょう。
□そう思う　□ややそう思う　□どちらでもない　□あまり思わない　□思わない
□わからない
理由

Answers and Comments – Question 1

No.	性別	年齢	林業・生徒	森林の経験	質問1：長期的に考えると統合的な森林管理が必要。	
					選択	理由
1	男性	40 代	林業関係者	10 年以上	選択なし	
2	男性	30 代	林業学校生徒	0ー4 年	選択なし	
3	男性	20 代	林業学校生徒	0ー4 年	選択なし	
4	男性	20 代	林業学校生徒	0ー4 年	選択なし	
5	男性	20 代	林業学校生徒	0ー4 年	選択なし	
6	男性	60 代	選択なし	選択なし	そう思う	
7	男性	20 代	林業関係者	5ー9 年	ややそう思う	
8	男性	30 代	選択なし	5ー9 年	選択なし	
9	男性	50 代	林業関係者	10 年以上	そう思う	
10	女性	60 代	林業関係者	10 年以上	ややそう思う	

11	女性	60才以上	林業関係者	10年以上	ややそう思う	老齢化が進み山に入る人がいなくなると思うので。
12	男性	40代	林業関係者	0ー4年	そう思う	
13	男性	40代	林業関係者	選択なし	そう思う	但しマーケットがすべて？
14	選択なし	選択なし	選択なし	選択なし	そう思う	今日の講習を聞いて
15	女性	60代	林業関係者	10年以上	ややそう思う	
16	男性	50代	林業関係者	10年以上	あまり思わない	
17	男性	40代	林業関係者	10年以上	ややそう思う	
18	男性	20代	林業関係者	0ー4年	ややそう思う	森林の多面的機能を発揮するため。
19	男性	30代	林業関係者	10年以上	そう思う	
20	男性	40代	林業関係者	10年以上	ややそう思う	
21	男性	20代	林業学校生徒	0ー4年	ややそう思う	

22	男性	20 代	林業学校生徒	0−4 年	ややそう思う	将来性を考えると統合的な森林管理は必要ではないかと思う。
23	男性	30 才未満	林業学校生徒	0−4 年	そう思う	やっぱり管理はした方が良い。
24	男性	40 代	林業学校生徒	0−4 年	ややそう思う	
25	男性	20 代	林業学校生徒	0−4 年	そう思う	今よりも森林がより良くなると思うから。
26	男性	20 代	林業学校生徒	0−4 年	そう思う	
27	男性	20 代	林業学校生徒	0−4 年	そう思う	今のままやっても自分の給料に反映されなさそうだから。
28	男性	30 代	林業学校生徒	0−4 年	そう思う	
29	男性	40 代	林業学校生徒	0−4 年	ややそう思う	木材の供給量を増やそうなら大規模な森林管理が必要かと思います。
30	男性	20 代	林業学校生徒	0−4 年	ややそう思う	
31	女性	20 代	林業関係者	0−4 年	そう思う	
32	男性	40 代	林業学校生徒	0−4 年	そう思う	
33	男性	40 代	林業関係者	10 年以上	そう思う	歴史が証明しているように国の豊かな発展に森は必要不可欠。

34	男性	50 代	林業学校生徒	0－4 年	そう思う	市場に影響されることが無くなり改善される。
35	男性	20 代	林業学校生徒	0－4 年	そう思う	
36	男性	50 代	林業学校生徒	0－4 年	そう思う	
37	男性	30 代	林業学校生徒	0－4 年	ややそう思う	
38	男性	20 代	林業学校生徒	0－4 年	そう思う	エコノミーやエコロジーのため。
39	女性	20 代	林業関係者	0－4 年	そう思う	
40	男性	20 代	林業学校生徒	0－4 年	そう思う	
41	男性	30 代	林業学校生徒	0－4 年	ややそう思う	林業に従事する人間があまり多くないから。

Answers and Comments – Questions 2 and 3

No.	質問 2：高知県の人工林を持続可能に維持することがいいこと。		質問 3:地域で統合的な山管理をして日本の法を発展する。	
	選択	理由	選択	理由
1				
2				
3				
4				
5				
6	そう思う		そう思う	
7	ややそう思う			逆、日本の法が先と感じる。
8				
9	ややそう思う	齢級配分に偏りがあり、すぐには転換できない。	ややそう思う	Legislation has been developed but not yet enforced enough.
10	ややそう思う		ややそう思う	

11	ややそう思う		ややそう思う	
12	そう思う		ややそう思う	
13	ややそう思う	但しマーケットがすべて？	ややそう思う	但しマーケットがすべて？
14		人工林を良い状態で維持するが可能か		
15	そう思う		そう思う	
16	そう思う		あまり思わない	
17	あまり思わない	全ての人工林を同じように扱うことは現実的でない。	どちらでもない	
18	そう思う	人工林多く占めており、維持することが重要。	ややそう思う	
19	そう思う		どちらでもない	統合的な山管理を行うには国家的な観点でのもしくはレベルでの動きが必要。地域から行うには、ハードルが高すぎる気がする。
20	そう思う		分からない	
21	ややそう思う		ややそう思う	

22	そう思う	人工林は人の手は加わっているし、手入れもいいので、人工林を増やすべきだと思う。	思わない	法は今のままでいいと思う。
23	そう思う		分からない	
24	ややそう思う		分からない	
25	ややそう思う	維持した方が森林の量を安定することができると思うから。	思わない	先祖の土地を大事にする人が多いので法を発展することが厳しいと思うから。
26	そう思う		ややそう思う	
27	あまり思わない	切らなきゃ仕事にならない。	そう思う	ちまちま管理してもしゃーない。
28	分からない		そう思う	
29	そう思う	水源管理を考えたらそう思う。	思わない	林業に関する法律より社会保障、福祉などの法整備が急務であると思う。
30	そう思う		ややそう思う	
31	そう思う		そう思う	
32	そう思う		そう思う	
33	そう思う		そう思う	

34	そう思う	森林の森としての価値が高くなる。	そう思う	このままではリスクが高くなると思うので、できるところから改善が必要。
35	そう思う		そう思う	
36	ややそう思う		そう思う	
37	ややそう思う		そう思う	
38	ややそう思う		ややそう思う	
39	そう思う		そう思う	山を所有することの責務をもっと明確にしたらよいと思う。
40	どちらでもない	時代に合わせた林業方針を立てるべき。	そう思う	森林に対する意識を地域から広めていく必要があると思う。
41	どちらでもない	コスト面、環境面から考えて難しいと思う。	どちらでもない	所有者の足並みを揃えるのが大変なように思う。

Answers and Comments – Questions 4 and 5

No.	質問 4:社会、地域を今よりも森林に巻き込んだらいい。（興味を持つ）		質問 5:林業ビジネスをサポート、発展しましょう。	
	選択	理由	選択	理由
1				
2				
3				
4				
5				
6	そう思う		そう思う	高知県、日本を豊かにしたい。こんなにたくさんある森林を活用しない手はない。
7	そう思う		そう思う	
8				
9	そう思う		そう思う	
10	あまり思わない		分からない	

11	そう思う		そう思う	
12	ややそう思う		そう思う	
13	ややそう思う	但しマーケットがすべて？	そう思う	但しマーケットがすべて
14	そう思う	山が荒れるのを少しでもくい止められる（環境問題む含めて）		
15	そう思う		そう思う	
16	ややそう思う		そう思う	
17	そう思う		そう思う	
18	ややそう思う	特に高知県は全国一の森林率であり、活用したらいい。	そう思う	
19	そう思う		そう思う	
20	そう思う		そう思う	
21	そう思う		そう思う	

22	あまり思わない	社会や地域は森林と関係ない物もあるので、巻き込んだ所で何が起きるかどうかはっきりしない。	ややそう思う	
23	分からない		そう思う	ドイツのように大きな産業になればよいと思う。
24	ややそう思う		ややそう思う	
25	そう思う	法やシステムの作成に積極的に行動が起きると思うから。	そう思う	サポートすれば考え方が変わり統合化へと発展しやすくなると思うから。
26	そう思う		そう思う	
27	そう思う	レースやればいい	そう思う	全てはお金と豊かな生活のため。
28	そう思う		そう思う	もうけないからみんなやらない。
29	そう思う	興味を持たせないと何も変わらないから。	ややそう思う	TPP の問題など課題はたくさんあるので、日本の農林業が自立できるようになればよい。
30	そう思う		そう思う	
31	そう思う		そう思う	
32	どちらでもない		ややそう思う	
33	そう思う	国が投資すべきは子供からの教育、森に触れること。散歩したくなるように♪	そう思う	

34	そう思う	市民に森でのレクレーションを楽しむ場を増やす。	そう思う	小規模の森林所有者にもビジネスチャンスを与えることで、管理された森が増えると思います。今が捨てられた状態の森林が多い（所有者不明、不在）
35	そう思う		そう思う	
36	そう思う		そう思う	
37	そう思う	森林の必要性を国民が認識しないと森林保護や自然保護などの社会活動（デモなど）起こらず、社会の構造改革は難しいと感じます。	ややそう思う	
38	ややそう思う		ややそう思う	
39	そう思う	レクリエーション機能をもっと重視したら良いと思うが、日本の文化的に難しい面が多いと思う。（単なる土地所有でなく、先祖から受け継いだという考えがあるから）	ややそう思う	
40	そう思う	森林に対する意識を地域から広めていく必要があると思う。	そう思う	日本は輸入せずとも木があるので地産地消を目指すため林業ビジネスを発展させたい。
41	そう思う	日本そのものが山林が多いから。	そう思う	特に高知県は山が多いという特徴があるから。

Survey III - Survey II - ヨーロッパの持続的な森林経営に関するアンケート

アンケートにご協力ください。当てはまるものにチェックを入れてください。
性別　☐男性　☐女性
年齢　☐20才未満　☐20代　☐30代　☐40代　☐50代　☐60才以上
☐林業関係者　☐林業学校の生徒

質問1.
森林管理をどのような目的で管理すればいいと思いますか？またその理由を答えてください。
☐環境　☐保護　☐林業　☐レクリエーション　☐その他（　　　　　　　　　　　）
理由

質問2.
森林がどのような状態にあるのか定期的に検査・調査する必要があると思いますか？また、その理由を答えてください。
☐そう思う　☐ややそう思う　☐どちらでもない　☐あまり思わない　☐思わない
☐わからない
理由

質問3
森林の状況に応じて所有者に連絡を取る必要があると思いますか？（例えば木が病気になって枯れて倒れているときなど。）また、その理由を答えてください。
☐そう思う　☐ややそう思う　☐どちらでもない　☐あまり思わない　☐思わない
☐わからない
理由

質問4
森林経営者に持続可能な森林経営（環境・保護・林業・レクリエーション）の多様な側面から総合的なアドバイスが必要と思いますか？また、その理由を答えてください。
☐そう思う　☐ややそう思う　☐どちらでもない　☐あまり思わない　☐思わない
☐わからない
理由

質問5
森林管理が不十分や放置されているため問題が発生している場合（ゴミ置き場にされているなど）に罰則を設ける必要があると思いますか？また、その理由を答えてください。
☐そう思う　☐ややそう思う　☐どちらでもない　☐あまり思わない　☐思わない
☐わからない
理由

その他（ヨーロッパの森林管理に関する疑問点・高知の森林管理に対する問題・講義に関するご意見ご感想などお聞かせください）

（　　　　　　　　　　　　　　　　　　　　　　　　）

Answers and Comments - Part I

No.	性別	年齢	林業・生徒	質問1：森林管理をどのような目的で管理すればいいと思いますか？またその理由を答えてください。						
				環境	保護	林業	レクリエーション	その他		理由
1	男性	50代	林業関係者	○	○	×	○	×		私が林業に入った理由は自然と人との調和。自然の中で人として生物としての本来の姿をとり戻したいという思いと、自然の中でヨガをやる場所を求めて入りました。
2	男性	20代	林業関係者	○	○	○	○	×		全て大事だから
3	男性	20代	林業学校生徒	×	×	○	×	×		
4	男性	50代	林業関係者	×	×	○	×	×		林業として考えていけば環境にも保護にもつながると思う。
5	男性	20才未満	林業学校生徒	×	×	○	×	×		持続可能にしていく為にはそれなりの生産性が必要であると思うから
6	男性	20代	林業学校生徒	○	○	○	×	×		循環型社会のシンボルであると思うから。
7	男性	20代	林業関係者	○	○	○	○	×		森林管理はすべての目的で共通している。林業で管理し、環境の面、保護の面を計画的に遂行できる
8	男性	20代	林業関係者	○	○	○	○	×		基本的には生産林と環境林にゾーニングして、それぞれが役割を果たすように管理すべきと考える。
9	男性	30代	選択なし	×	×	○	×	×		生産性を上げつつ、生産に必要な環境等管理の方法を加える。
10	男性	40代	選択なし	○	×	○	×	×		持続しなければ経営じゃない

11	未記入	60 才以上	林業関係者	○	○	○	○	×		森林には多目的機能がある
12	男性	30 代	林業学校生徒	○	○	○	○	○	文化的側面	それも大切な事だけに全体のバランスが数十年数百年先に考えた管理が重要では、ないかと思うわけです。(文化的側面)森林(山)から初まった農村の祭りや山岳信仰の様な考え方、独自の民族性
13	男性	20 代	林業関係者	○	×	×	×	×		その現場環境に応じた管理(主伐・間伐)が必要
14	男性	40 代	林業関係者	×	○	○	×	×		
15	男性	50 代	選択なし	×	×	○	×	×		日本唯一の資源
16	男性	30 代	林業学校生徒	×	×	○	○	×		長期的なスパンで適切な林業を行う事で環境や保護の目的も達成できると思う。また木や林業に関心をもってもらうために、レクリエーションも重要だと思う。
17	男性	20 代	林業学校生徒	×	×	×	×	○	全体的に注目すべき	今日の日本の林業は残念ながら欧州など海外に比べ非常に遅れているのが現状。これからは「これを目的に」ではなく、全体的に広い視野をもって林業を展開しなければならないと考える
18	男性	40 代	林業関係者	×	×	○	×	×		現在の森林管理が林業中心で進められており森林所有者も
19	女性	30 代	林業関係者	○	○	○	×	×		日本では私有林をレクリエーション目的で使用するのは難しいと思うため、それを除く 3 つの役割での管理が必要と思う
20	男性	30 代	林業学校生徒	×	×	○	×	×		他の目的も大切だが、まず木材需要を国産材で賄うようにすれば雇用や経済の改善に繋がり他の目的達成の余裕が生まれると思う
21	男性	40 代	林業関係者	○	×	○	×	×		森林は重要な自然環境であると同時に地域の経済資源でもある。レクリエーションは一部でいい。

22	男性	40 代	林業関係者	×	×	×	×	○	各目的のバランスをとって	
23	男性	20 才未満	林業学校生徒	×	×	×	×	○	全部	4 つを目的としてバランスよく管理すれば良いと思います。
24	男性	40 代	林業関係者	×	×	○	×	×		木材を生産しつつ環境にも配慮する
25	男性	30 代	林業学校生徒	○	×	○	○	×		日本には森林に積極的に親しむという概念が少ないと思うので、そういった機会を増やすことで環境への考え方が変わっていくと思う。
26	男性	20 代	林業学校生徒	×	×	×	×	○	すべて	森林から受けられる恩恵はもれなく頂戴すべき、ただそのためには林業が業として成り立ちの必要がある。自然に対する関心を環境教育を充実させることも大切
27	男性	40 代	林業関係者	×	×	×	×	○	バランス	経済林とそれ以外（環境やレクリエーションなど）に分けて管理
28	男性	40 代	選択なし	○	○	○	○	×		トータルバランスでの日本の国土保全
29	男性	50 代	林業関係者	○	○	○	×	×		
30	男性	20 代	林業学校生徒	×	×	○	×	×		今でも素材として使われてきたし、産業としてとらえることが重要だと思うから。

Answers and Comments - Part II (Questions 2 and 3)

No.	質問 2：森林がどのような状態にあるのか定期的に検査・調査する必要があると思いますか？また、その理由を答えてください。		質問 3:森林の状況に応じて所有者に連絡を取る必要があると思いますか？（例えば木が病気になって枯れて倒れているときなど。）また、その理由を答えてください。	
	選択	理由	選択	理由
1	そう思う	森林の状態がわからないでほっておくと、人は自然破壊をつづける森林のオ状態を把握し、私たちがなにをしないといけないかを知らないといけない	そう思う	少しでも山に興味をもってもらう、目を向けてもらうためには、連絡を取る必要はあると思う、ただし伝え方を考えておかないと思う
2	そう思う	常に森林の状態を把握しているのが理想だから。	そう思う	所有者は全て知る権利があるから。
3	そう思う	林業の発展の為	あまり思わない	
4	ややそう思う	今現在の自分のレベルでは検査も調査知識も少ないので。	ややそう思う	日本でも回りの森の事を考えるフォレスター的な人間がいた方が良い。
5	そう思う	状況に応じた林業施業が必要であると思うから	そう思う	対応を話し合う為
6	そう思う	持続可能性ある森づくりのためにも状態を把握することは大事だと思うから。	ややそう思う	長い視点で見たとき、森がダメになることで災害等の原因にもなりかねないから。
7	そう思う	適切な管理をしなければならない、実際に目で見て、状態を把握する必要がある。	そう思う	連絡を取る必要があると思うが、山村地域は不在村者が多く所有者と連絡を取るのが難しい。
8	そう思う	生産計画を立てる際に、林分の生長量を把握した上で生産可能量を判断する必要があるため。	あまり思わない	民有林の場合基本的に自主管理。災害等の場合は必要と考える。
9	そう思う	全体の状況を把握して、生産活動をした方が計画的な活動につながる。しないといきあたりばったりになる。	そう思う	現状把握のため
10	どちらでもない	検査・調査のコスト、オーストリアのように樹高データなどがあると低コストに管理できると思う。	そう思う	要間伐の時期とか連絡したほうがよい→プランナー

11	そう思う	生態的な推移と社会的要請の変化	そう思う	森林は常に定期的な点検が必要
12	ややそう思う	森林管理をする上で必要性は強く感じるが「誰が検査・調査するのか？」が問題ではないと考えているからで、各省や個人団体をまとめ上げる事が現実的に日本でできるのか？と思うからです。	思わない	例えば留守宅が火事のときに、消していいか、連絡するなんてナンセンス！！
13	そう思う		ややそう思う	
14	そう思う	森林の資源量がわからないと適切な森林管理はできない、5 年に 1 度ぐらいの調査が必要である	あまり思わない	自分で管理すべきできないようであれば管理をほかにまかせるべき
15	そう思う	物部川の濁水問題等身近で様々な環境に関する問題がある。	そう思う	過疎高齢化で地域の所有者山に行けない状況今後も更に増える
16	そう思う	適切に森林管理するために必要だと思う	あまり思わない	所有者の考え方も大事だが、必要があれば行政などが強制的に介入できる方が良いと思う。
17	ややそう思う	現実的には難しいが、やはり管理下にある程度なければならない、特に日本の山林は海外に比べ地形的に管理しにくいが、その為に有用な材の確保が難しく、また生態系においても人と自然との関係が好ましくない状態になってしまう etc…	ややそう思う	欧州のフォレスターのように管理されれば良いということでもないとも思う（強制力の問題）所有者（地主）との密な連絡体制（システム）や協力体制を確立することは重要である。
18	ややそう思う	人的な問題はあるが、森林所有者が自ら把握できない場面が多いことから誰かが調査する必要があると思う。	ややそう思う	別の所有者にも影響をおよばないようにするためにもためにも必要である
19	ややそう思う	所有者が独自の森林を調査し、把握できていればよいが、できていないため公的なところが調査し森林の現状によってその担う役割分担を決める必要があると思う。	そう思う	森林は公的な資源という面もあるが、日本では個人の財産という考え方が強いので、現在の所はそうせざるをえないと思う。
20	そう思う	正しい情報→正しい分析→適切な管理に繋がる	あまり思わない	松枯病など深刻な事態も有り得るがそもそも日本の森林所有者は果たしてそこまで意識が高いだろうか？
21	そう思う	げんじょうを把握しておくことは管理するために必要	ややそう思う	

22	そう思う		そう思う	
23	ややそう思う	見逃していたことなどがわかるから	どちらでもない	自分で判断できる所は自分ですればよいと思う
24	そう思う	少し長いスパンでも調査する必要があると思う。適正に管理されているか把握が必要	ややそう思う	手続きが必要な場合が生じると思う
25	どちらでもない	必要性は感じるが、現状ではそこに人的資源をかけられないと思う	そう思う	病気の種類によっては被害が急拡大する可能性もあり、習慣化した方がいいと思う
26	そう思う	少なくとも、自らの生活圏にある自然環境を知っておくことは防災上必要だと考える。	そう思う	私有林の多い日本では、一本の木が及ぼす影響が大きくなると思われる。特に山麓に住む人にとっては裏山の状態は死活問題のはず
27	そう思う	情報がなければ次の手が打てない、膨大なビックデータをいかに集めるか問題	そう思う	山は公益･公益的要素が強いため
28	ややそう思う	林地の不在所有者が多くなる中、その森林をどうするかを考える意味で	ややそう思う	林地の不在所有者が多くなる中、その森林をどうするかを考える意味で
29	そう思う	森林管理が必要、林業、環境の管理	そう思う	森林管理者に変わって管理する。
30	そう思う	森林は様々な機能を果たすので、調査は必要だと思うから。	ややそう思う	適切な処置をすることができるから。

Answers and Comments - Part II (Questions 4, 5 and extra comments)

No.	質問 4:森林経営者に持続可能な森林経営(環境・保護・林業・レクリエーション)の多様な側面から総合的なアドバイスが必要と思いますか？また、その理由を答えてください。		質問 5:森林管理が不十分や放置されているため問題が発生している場合(ゴミ置き場にされているなど)に罰則を設ける必要があると思いますか？また、その理由を答えてください。		その他(ヨーロッパの森林管理に関する疑問点・高知の森林管理に対する問題・講義に関するご意見ご感想などお聞かせください)
	選択	理由	選択	理由	
1	そう思う	多様な側面がかかわっていることを知らない(私もしらなかった)と思うので伝えることが大切、その人にとって何が心に残るかわからないから	そう思う	なにがきっかけになるかわからない、罰則をうけるからと初めた人が関心をもち、自分から周りに働きかけるようになる可能性がある。	自分が今後どのようにやっていくかを考える、きっかけとなった、今の時点では自分でやっていないので疑問点などはないが自分で動き出すとでてくると思います。
2	そう思う	経営者は多様な面で山をとらえるべきだから。	どちらでもない	罰則以外の方法でストップさせるのが理想だが無理なら仕方ない。	
3	そう思う		思わない		
4	そう思う	フォレスター的な役割の人がいないとだめだと思う。	そう思う	罰則が甘すぎると思います。(規定が無い所も有りますが)ゴミを出さない様にするのが一番だと思いますが、駄目な場合、罰金(多額)と禁固有りとかしないと一生駄目だと思う。	日本と考え方が全然違うことが理解できたが、日本ではなかなか受け入れてくれるかが心配である。佐川町だけでも頑張って行けたら良いと思うので推進して行きます。
5	そう思う	様々な面から一人、一社で考える事は難しいから	どちらでもない	現状の林業従事者数では全てをカバーすることは難しい	
6	どちらでもない	やりたい意欲のある方から先頭に立ってやれば良いと思う。またそうした人がモデリングになることが理想かも。	そう思う	環境破壊であり、水資源などへの悪影響をおよぼしかねないから。	おもしろく興味深い内容で、今後に役立ちそうな内容でした。ありがとうございました。
7	そう思う	官民一体(情報共有・技術的指導)の管理経営を行い、一定の指針を示すことで適切な管理が容易になると考えられるため。	そう思う	ある程度の強制力がある規制をしても変わらないのであれば、罰則を設ける必要がある。	高知は森林資源を上手く活用できていない ヨーロッパ林業の考え方を利用しても改善すること(有効利用)ができるのだろうか。
8	ややそう思う	経営者の目標林型等によるが、林業活動を主とする場合も持続可能とするには、環境配慮等も必要であるため。	思わない	罰則を設けることは、日本の人工林の現状を踏まえると適切でない所有者不明森林や境界がわからない等の課題もあり罰則を設けても機能しない。	〈講義について〉もう少し踏み込んだ内容にしていただきたかったです。例えば森林法であればドイツにあって日本にない条項の書かれ方やその条項があることによる実際の校歌の考察などがあれば興味深く感じます。
9	そう思う	ただ、森林全体のバランス、目標は必要	ややそう思う	実際に対応できるか	

10	ややそう思う	持続的な林業を目標とするべき	そう思う		山から得られる木に対してトータルコスト（環境・経済・社会）を考えて木が使われているのを実感できない。
11	そう思う	経営者から常に全ての森林に関する知見を持っているとは限らない	そう思う	森林はいつも正常な性能に保つ必要があり	森林管理は現場主義で歴史や風土の違う他国の管理手法はそのままマネはできない、参考になる事項を自在に適合できるよう考えます。
12	そう思う	森林組合にインターンシップに行ったときに、山主さんが「収入間伐の時に山のことを考えずに太い木ばかり切る」と怒ってましたが、経営者の立場から考えると、人件費や大型重機の維持費のお金を考えると切らなければならないのはわかる…、アドバイスを実践できる大きな枠組みが重要ではないかと考えているわけです。	どちらでもない	山主さん等管理されている方の高齢化の問題もあるので罰則はきびしいと感じます。必要性に応じて行政が対応すべきではと思います。	大変勉強になりました。ありがとうございました。低コストな自伐型林業家の話も聞いてみたかったです。
13	そう思う		そう思う		
14	ややそう思う		ややそう思う		
15	未記入		どちらでもない	ゴミを捨てているのはほとんどは森林所有者ではないので	
16	あまり思わない	所有者の考え方も大事だが、必要があれば行政などが強制的に介入できる方が良いと思う。	そう思う	農地などでもそうだが、罰則を設けることでより意欲的な経営者の手に渡っていってほしい。	ヨーロッパにおける、レクリエーションや木材の活用法などにつてもう少し知りたかった。
17	どちらでもない	森林=木材=財産という考え方もあるので、所有者、経営者など林業に携わる人は慎重に考えなければならないと思う。また、その為には的確なアドバイスと正しい知識も必要	どちらでもない	管理不十分にある過密状態ならば警告程度でもかまわないと思うがゴミなどは投棄者の問題だと思う。	欧州の重機があれだけのことが可能ならば日本でも十分に活用できるのではないだろうか、例えば海外メーカーに実際に日本の林業現場を見てもらい、日本の地形に合った機械を作製してもらうのは、十分に可能だと思われる。（架線にこだわらない、重機にする短期的集材の可能性…）架線重機のさらなる進化
18	そう思う	森林に関心のない所有者も多いため、林業だけでなく、他の側面からのアドバイスも必要である。	どちらでもない		
19	ややそう思う	林業を産業、経済目的としてだけとらえている人も多いので色んな視点をもってもらうためにも必要と思う。	そう思う	ヨーロッパのように罰則を設け、森林の管理・経営にやる気のない所有者の山は全て国もしくは県や市の山とし、地域で山をデザインしていける方がよいと思う。	地形や歴史山に対する意識など、日本とは全く異なる部分もあるが、林業を産業としてだけでなく環境・レクリエーションなど、4 つの役割をバランスとってみていくことが必要、など新しい見方を得ることができてよかったです。

20	あまり思わない	それが理想だが、日本の林業の経済・経営状況にそんな余裕があると思えない。	あまり思わない	上と同じで管理していない=管理する余裕が無いので罰則を設けると森林を手放すだけなのでは	日本人にとって山は遠い場所（異界、聖域と見なしてきた）→明治維新後産業強化の為に収奪一森林管理の歴史が浅い？ ⇔欧州ではレクリエーション森の中で生活 日本は森林面積が広い=山地・居住に適さない地形が多い=林業を営むのが大変（遠い・険しい・積雪などコストが色々） 川下から川上へお金を循環するために補助金も有りでは？
21	ややそう思う		ややそう思う		
22	そう思う		そう思う		
23	そう思う	アドバイスがあればより良くなると思うから	ややそう思う	問題が解決しない場合はしかたがないと思う	色々とためになる話をありがとうございました。
24	ややそう思う	環境と林業が共存できるようなアドバイスが必要と思う。	ややそう思う		
25	ややそう思う	日本では組合、社会、個人それぞれに非効率的な面が多いと思う、正しいやり方をマニュアル化することが必要	どちらでもない	森林管理に関しては応用のコストがかかり、悪質なものを除いては罰則強化は望ましくないと思う。	高知の林業の問題点はそれなりに理解しているつもりだが、海外の視点からの問題提起等の意見も聞きたかったと思う。
26	未記入	共通意識として、知識的な部分は周知すべきだと思う。	あまり思わない	高齢化でしかたない面がある。集約化施行で確実な管理体制の整備が必要	日本の地形では高性能林業機械で運用することはなかなか難しいどうしても集材に時間がかかるため、自走式搬器を用いた架線集材など（技術の伝承等）円滑な集材・造材システムで普及させるべき。
27	ややそう思う	公益的視点から必要と思うが、私（個人）の纏まりが強い日本では総論賛成、各論反対になると思う。	ややそう思う	公益的視点から必要と思うが、私（個人）の纏まりが強い日本では総論賛成、各論反対になると思う。	現在を知るためには、歴史や文化を知ることも大切と思う。そのあたりがわかれば、今の日本と欧州の違いを知るヒントになるか？そういう講義もしりたい。
28	ややそう思う	低炭素社会・循環型社会の実現、小規模な地域での林業構造の確立	ややそう思う	森林環境税の強化、固定資産税（山林）の増税	
29	ややそう思う		ややそう思う		
30	そう思う	適切かつ効率的なアドバイスが森林経営において必要だと思うから。	どちらでもない	不十分なためにゴミを置いても大丈夫そうな環境を作り出しているから。	フォレスターのような制度は日本にも必要ではないかと感じた。

Appendix D: Supplemental Materials

NBSJ forestry objectives, implementation measures and policies

Objective	Measure	Policy
13. The desirable conditions of forests for maintaining their priority functions and how to develop such conditions	Description of forest functions in the government Fundamental Plan of Forest and Forestry Proposal of forest operation methods to forest owners for the promotion of multi-storied forests made up of various tree species.	Specification of policies to develop forest functions, management by forest planning and other systems
14. Development of diverse forests	Forest road and spur road development Support for clear forest border clarification Support for forest owners with difficulty to implement appropriate management Promotion of reforestation Promotion of efficient forest management, conservation, forest restauration and research and technological development to increase national timber usage Promotion of the dissemination of technology through forestry extension projects Implementation of production and distribution measures Promotion of stakeholder consensus building Promotion of appropriate forest management by entrusted forest owners	Public funding for maintenance and enhancement of forests that fulfill their multifunctional role Provision of financial resources for controlling CO_2 output by increasing carbon sinks through forest management
15. National campaign for the promotion of Utsukushi Mori Zukuri (The Creation of Beautiful Forests)	Promotion of the use of wood as building material Reinvigoration of mountain villages	Dissemination and establishment of proposal-based forestry with clearly presented management costs Development of human resources that undertake forest management
16. Forest conservation and management	Promotion of forest pest and disease control measures	Implementation of designation of public benefit forest Establishment of erosion control facilities for mitigating the effects of natural disasters and water contamination
17. Control of wildlife damage	Promotion of installation of damage prevention facilities and equipment, professional training, development of wildlife control technology and improvement of wildlife control Development of separation of wildlife habitats from human settlements	Implementation of wide-area measures to stop wildlife damage while ensuring wildlife conservation
18. Human resource development	Promotion of forestry and timber industries to create employment Promotion of networking between mountain villages to promote settlement of new residents	Training of human resources for forest conservation and forestry Facilitation of exchange activities between mountain villages and cities
19. Forest operations influencing biodiversity	Promotion of forest certification	Maintenance of natural forest and introduction of broad-leaved trees to artificial forestland
20. Promotion of citizen participation	Promotion of forest management carried out by companies for national forest	Support for forest development activities by NPOs
21. Expansion of environmental education	Promotion of environmental education to improve human resources	Publication of information about the multiple functions of forests
22. Development of forestry and timber industry	Promotion of large-scale sawmills and processing systems Promotion of target-specific strategic management to companies and consumers	N/A
23. Administration and management of national forest	Promotion of diverse management and conservation operations such as the conversion to mixed forest Promotion of "Satoyama" forests and red pine forests Promotion of building stakeholder consensus Promotion of the establishment of cooperative forest management areas	Conservation of protection forests and forest reserves Conduction of habitat monitoring and surveys Establishment of green corridors Establishment of public forest condition report system Implementation of education offers and facilities Support for people engaged in nature restoration
24. Promoting forest resource monitoring	Development of methods for forest dynamics analysis	Implementation of monitoring surveys Preparation of Global Forest Resources Assessment Country Report
25. Promoting SFM on global scale	Action to stimulate international efforts to stop illegal logging. Demonstration of leadership in establishing SFM around the globe	Participation in international dialogue

Adapted from NBSJ 2012-2020 (2012)

Appendix E: Photos

1. <u>Kochi Prefecture – Monobe Fujinkai meeting</u>

The above pictures show a meeting between Kochi Prefecture Information and Technology Center and the Monobe Fujinkai, a private interest group engaged in various environmental conservation activities. Current activities of the Monobe Fujinkai range from the promotion of reforestation of recent and former clear-cut areas, especially those that have not been reforested, the protection of trees from browsing, and the promotion of the consumption of deer meat as a healthy alternative to beef in order to develop local hunting and the local industry for red meat. The Monobe Fujinkai is an active contributor in the annual Monobe River Symposium at which free curry and rice with deer meat is made for the approximately five-hundred local visitors.

At this particular meeting, the Monobe Fujinkai raised the problem that despite the annual deer meat promotion efforts the consumption of deer meat in Kami City is increasing rather slowly. Alternative promotion and marketing strategies were discussed including a strategy to "reinvent" deer meat cuisines in which deer meat cannot be substituted with alternative kinds of meat such as beef and poultry. Mr. Siegmar Schönherr, a professional forestry practitioner from Germany (center of lower right picture), who was an intern at Kochi Prefecture Information and Technology Center at the time of the meeting, suggested to organize a cooking event in Monobe for German traditional deer dishes and to discuss ways to further effectively promote deer meat. This cooking event was brought together successfully and observed by relevant institutions and the local media.

2. Coniferous monocultures in Kahoku Town

The above pictures show various late or unthinned sugi and hinoki stands of age classes between 45-55 years in Kahoku Town with different levels of underplanting. The upper photos show some underplanting and broadleaf rejuvenation. In the lower photos a high tree density with only little underplanting is visible.

3. Thinned sugi stands in Kahoku Town

The above photos show thinned sugi stands in Kahoku Town with unextracted marketable timber left as deadwood and signs of broadleaf rejuvenation from nearby natural forest. Natural rejuvenation of sugi is (yet) rarely seen with stands still being too young and broadleaf rejuvenation being dominant. Not removing marketable timber in a thinning has been common practice since the sharp decrease of domestic timber prices. Despite the environmental benefits of not removing deadwood, these type of thinning operations do not create an economic return and are financed with forestry subsidies.

4. Forest road construction in Kahoku Town

The above photos show newly established and older forest roads in Kahoku Town. The road in the upper left photo has been newly established to gain access to nearby unthinned sugi and hinoki stands. The upper right photo also shows a relatively newly established forest road that was concrete-paved. Plant-cover is not yet visible on the side. The photos below also show concrete paved forest roads with on road (lower left photo) and below road (lower right photo) water drainage systems. Despite the damage to the forest floor, concrete paving of forest roads in certain areas is usually justified by the excessive rainfall that Kochi prefecture experiences every year, normally during the rainy season in June and July. Gravel roads can also be found in less rain affected areas. The building of forest roads is relatively complex due to Kochi's relatively steep topography. Many do not allow the transportation of timber on large and heavy trucks.

5. <u>Tower yarder anchor lines</u>

The upper photos show two common anchors and guy line placement (stump – upper left photo, and log – upper right photo) for the MM-Foresttechnik Wanderfalke tower yarder of Kami FOA. Guy line placement can be difficult in Kami due to little availability of strong stumps and big enough trees in many stands. In addition, slopes are often steep which requires numerous anchors to prevent tip over. The lower left photo shows MM Forsttechnik consultant Mr. Loschek inspecting the works of Kami FOA with their tower yarder including guy line placement and stability. The lower right photo shows the author of this study (left) and Mr. Nojima, the president of Kami FOA. The author joined this visit of Mr. Loschek.

6. <u>Removal thinning</u>

The above pictures show a MM-Forsttechnik Wanderfalke – Caterpillar Processor paired removal thinning operation by Kami FOA in an approximately 50-year-old sugi stand in Kahoku Town. Tower yarder and processor combination devices such as the MM-Forsttechnik Synchrofalke exceed the road limits and can for the being not be utilized in most stands. Similar to combination strategies, both shown machines are operated by one operator simultaneously. The Wanderfalke is relocated within stands by a John Deere Tractor. The Wanderfalke could be moved using its own combustion engine, however, it does currently not fulfill the legal street requirements in Japan.

7. Kami FOA meeting with MM-Forsttechnik and MM Japan distributor

The pictures show a meeting at Kami FOA with MM-Forsttechnik and the at the time official MM Japan distributor Maeda. At this meeting issues of the utilization of MM technology in common forest terrains in Kochi were raised and possible ways for mitigation and improvement including adaptation of technology were discussed.

8. <u>Recreation</u>

This photo shows a small forest recreation area in Kahoku Town. It is mainly used for hiking purposes.

9. Education

間伐のはなし

The above photos show a forest pedagogy event at Kuzume Elementary School in Kami City. This annual event is organized by the Kami City Board of Education and is carried out by Kami FOA. At these events the importance of forest management in regards to environmental preservation and industrial development is taught. At this particular event the significance of thinning in industrial forest was taught.