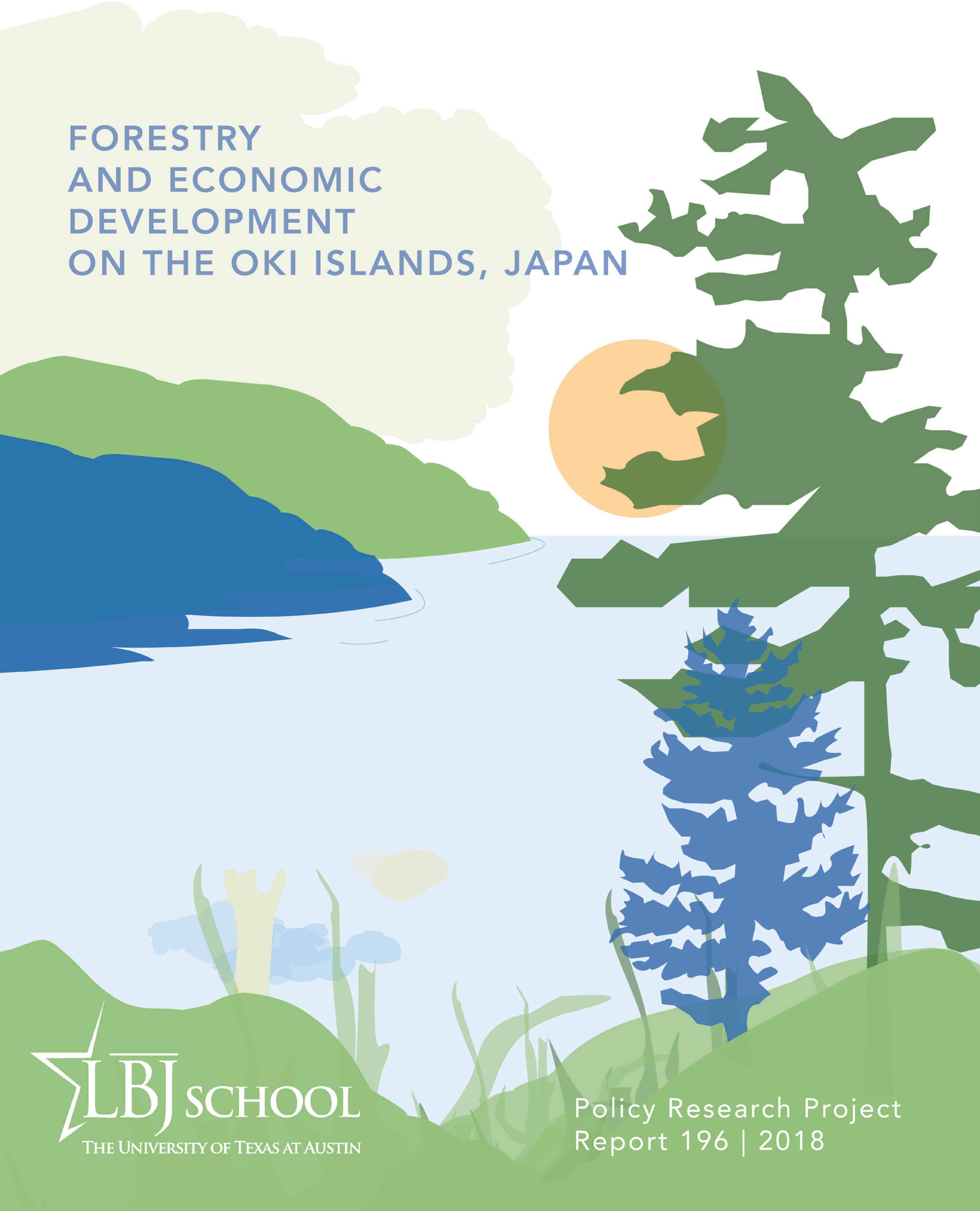
FORESTRY AND ECONOMIC DEVELOPMENT ON THE OKI ISLANDS, JAPAN



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Forestry and Economic Development on the Oki Islands, Japan

Project Directed by

David Eaton, PhD

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Foreword

The Lyndon B. Johnson School of Public Affairs has established interdisciplinary research on policy problems as the core of its educational program. A major element of this program is the nine-month policy research project, during which one or more faculty members direct the research of ten to twenty graduate students of diverse disciplines and academic backgrounds on a policy issue of concern to a government or nonprofit agency. This "client orientation" brings the students face-to-face with administrators, legislators, and other officials active in the policy process and demonstrates that research in a policy environment demands special knowledge and skill sets. It exposes students to challenges they will face in relating academic research and complex data to those responsible for the development and implementation of policy, as well as how to overcome those challenges.

This project evaluates the potential for forestry management innovation to contribute to development, enhance employment, and improve quality of life on the Oki Islands. Project staff reviewed forestry management current practices and proposed plans on the Oki Islands and examined entrepreneurship options in the forestry sector and ecotourism. The study recommends that the appropriate governments (Oki, Shimane, and Japan) can improve the livelihoods and enhance economic development on the Oki Islands by facilitating ecotourism and managing forest resources in a more integrated manner.

The curriculum of the LBJ School is intended not only to develop effective public servants, but also to produce research that will enlighten and inform those already engaged in the policy process. The project that resulted in this report has helped to accomplish the first task; it is our hope that the report itself will contribute to the second. Neither the LBJ School nor The University of Texas at Austin necessarily endorse the views or findings of this report.

Angela Evans

Dean

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Many scholars and experts provided information to students on the Oki Islands, including:

Nathaniel Agola Imai, Associate Professor, Graduate School of Global Studies, Doshisha University

David J. Eaton, Professor, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin

Hisashi Kajiyama, Bioenergy Research & Investment, Board Member of the World Bioenergy Association

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Satoshi Kanayama, Manager, Renewable Energy Section, First Division of Engineering, Energia Solution and Service

Hirotaka Shono, Manager, Hydropower Section, Power System Division, Chugoku Electric Power, Inc.

TAOYAKA Program staff at Hiroshima University managed fieldwork logistics. They included:

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Manuscript Preparation
Michelle Jun, Alice Rentz, and Taisia Kitaysky assisted with travel arrangements to Japan. Michelle Jun managed the website to provide course reading materials. Taisia Kitaysky helped organize the report and assisted in its preparation and editing.

The final manuscript was prepared by graduate student participants of the LBJ School of Public Affairs. Cover photos were provided by LBJ School Oki Islands program student participants. The cover was designed by Taisia Kitaysky. Taisia Kitaysky copyedited the text and formatted the final report, which was printed at The University of Texas at Austin.

As indicated above, many persons contributed to this report. Any errors or omissions are those of the editor, David Eaton, PhD.

Other Acknowledgements
This report was prepared during August 2017 through December 2017. The researchers included as references Internet hyperlinks that operated during that period. No author or editor can assure that hyperlinks remain active on the Internet. As a result, the authors and editors cannot assure that persons who read this report will be able to use any given hyperlink to locate any specific source materials referenced in the report.

This report refers to two currencies, Japanese yen and US dollars. It is not easy to estimate the exact values for any currency conversion, as exchange rates change continuously. Over the past five years the number of yen per dollar has varied from just above 85 yen to one dollar to just below 120 yen per dollar. For clarity, this report assumes that 1 US dollar is equal to 100 Japanese yen. The authors have elected to report some currency values solely in one currency; in such cases no inter-currency conversion is inserted.

Executive Summary

The Oki Islands are composed of four inhabited islands (Dogo, Nishinoshima, Nakanoshima, and Chiburijima) and 38 uninhabited islands located 40 kilometers (24 miles) north of Japan's Honshu Coast. In recent years, the islands have experienced a decrease in the population and changes in tourist preferences that have affected local business. In 2014, the town decided to reduce its reliance on imported diesel fuel for energy production and explore green energy options for meeting local demand. To respond to the changing economy of the islands, the local Oki Islands government, along with the Shimane Prefecture and federal governments, have formulated the Green Complex (GC) project (also known as Midori no Kombinat). This plan's objective is to create a network of small- to medium-sized businesses on the island that will utilize the islands' local biomass resources to develop the economy, create jobs, and reduce the island's reliance on imported fossil fuels.

Faculty members of two Japanese universities (Doshisha and Hiroshima) and the LBJ School of Public Affairs at The University of Texas at Austin (UT-Austin) co-taught a course entitled Forestry and Economic Development in a Remote Area: Oki Islands, Japan. Professor Takeshi Okamoto, PhD, of Doshisha University coordinated the course. Students and faculty worked with Oki Islands (Oki) community leaders and professionals from the forestry and tourism sectors to discuss the feasibility of promoting biomass energy for Oki. During the summer of 2017, students from all three universities listened to lectures and worked together to understand the relation between forestry resources and the Oki economy. During the week of August 21 through August 26, students, faculty, and staff met on Oki to attend lectures and conduct research for this report. Students visited biomass processing facilities, a power plant, energy storage facilities, the lumberyard, and biomass waste management facilities. During the fall semester of 2017, LBJ School students used the research to formulate this report.

This report analyzes the availability of biomasses resources and how those resources can be utilized to enhance the quality of life on the islands. Chapters 1 through 3 describe the diversity of uses of biomass on Oki and the interconnections between forest biomass with economic opportunities. Chapter 4 discusses pellet stove subsidies and how these incentives could increase pellet stove usage on the Oki Islands. Chapter 5 discusses possibilities for economic growth outside of the GC project. Chapter 6 describes the macroeconomic effect of investments in biomass industries and tourism using IMPLAN, an input-output model which estimates the direct, indirect, and induced effects of investments.[1] Chapter 7 reports on a survey on the attitudes of Oki Islands residents and local government officials towards the GC project. Chapter 8 discusses the outcomes from this project with suggestions for options for action by the Shimane and Oki governments.

The research demonstrates that the GC project can generate employment on the islands and increase levels of economic activity. The study concludes that there is enough wood biomass to support green industries on the island; approximately 87 percent of Dogo Island is covered in

forests which can support significant new industries using wood biomass as an input. The use of biomass on the island is more efficient than exporting the wood chips due to the cost of marine transport. Using the biomass for a large-scale power plant is economically feasible. Regarding pellet stoves, the study concluded that financial subsidies are necessary as a prerequisite to a viable industry, because pellet stoves are costlier for citizens than alternate stoves or maintaining existing equipment. Other opportunities exist for economic revitalization beyond the biomass industries, particularly in ecotourism. Complex and opaque ownership of land impedes the use of this resource. The final chapter reports recommendations regarding forest and ecotourism entrepreneurship.

[1]James Andrew Giesecke, "Development of a Large-Scale Single US Region CGE Model Using IMPLAN Data: A Los Angeles County Example with a Productivity Shock Application," *Spatial Economic Analysis* 6, no. 3 (September 1, 2011): 331–50, https://www.tandfonline.com/doi/abs/10.1080/17421772.2011.586722.

Chapter 1: Forestry and Oki Islands

The Oki Islands consist of four inhabited islands surrounded by an archipelago of 38 uninhabited islands 40 kilometers (24 miles) north of the Honshu coast in the Shimane Prefecture.[1] Around six million years ago, two large centers of volcanic activity formed the Dozen and Dogo island areas of Oki. About 400,000 years ago, rough waves, wind, and rain in the Sea of Japan eroded parts of the land to form the Oki Islands.[1] About 20,000 years ago (during the glacial period), the Oki Islands connected to the Shimane Peninsula; these land links disappeared as sea levels rose roughly 10,000 years later. Dogo Island is the largest of the islands, about 16 kilometers in diameter and 151 kilometers in circumference with a roughly circular shape (see Figure 1.1) and an area of 243 square kilometers. The center is mountainous, with the tallest peak at 500 meters in altitude.[2] The other three inhabited islands (Nishinoshima, Nakanoshima, and Chiburi) compose the Dozen District.

The Oki Islands are organized in the Oki District of the Shimane Prefecture with a local government based on Dogo Island. The islands, continuously inhabited for the past 30,000 years, have played a role in Japanese cultural, political, and economic development from the Japanese Paleolithic era to the present. For example, Oki was once the site of exile for two emperors, as well as numerous nobles and advisors. In recognition of their unique geological and cultural history, the Oki Islands are registered as a UNESCO World Cultural Heritage Site as well as a UNESCO Global Geopark. Since 1955, the Oki District has experienced a consistent decline in population and economic activity, which has led to questions about what can be done to improve the lives of Oki residents.

In response to a decline in population and tourism, the Shimane Prefecture government has formulated the Green Complex (GC) project, which aims to promote economic development on the island by exploiting the islands' rich forestry resources. The GC project calls for the creation of a network of small- to medium-sized businesses using wood biomass to generate fuel, increase lumber exports, and develop exports in lignophenol, a chemical compound derived from wood biomass and used in many industries. The GC project will reduce Oki's dependence on fossil fuels and generate employment opportunities.

The Green Complex Project

The Dozen District in the Shimane Prefecture began the GC project to improve the Oki economy through investment in the forestry sector. The GC project seeks to confront the economic and demographic challenges facing the Oki Islands through economic development based on the goal of a low-carbon society and the full utilization of local resources instead of reliance on imported fuels and national subsidies. This report examines the potential for innovation in the forestry sector for green industries, biomass power, pellet stoves, novel wood products, and ecotourism.

Figure 1.1
Map of Oki Islands

Source: "Features of the Oki Islands UNESCO Global Geopark," UNESCO, http://www.oki-geopark.jp/en/features/.

The Oki Islands' four primary challenges are its decline in population, decline in economic activity, high cost of imported resources, and the islands' limited access to the mainland. Oki's population has decreased since 1955 from approximately 38,000 to 15,000 in 2014.[3] During the same period, Japan's total population increased by 40 percent.[4] The islands' population is aging; current residents 65 years old and older now represent 36 percent of the population, while in 1965 this group accounted for 16 percent of the population.[5] In 2010, residents of working age (15–64) represented 54.5 percent of the Oki population, a decrease from 63.8 percent in 1975.[6]

The economy of the Oki Islands has been in decline since a peak in the 1950s. In 2009, Oki's gross regional product was 75 billion yen (750 million US dollars), a decrease of 25 percent from 1999. In 1975, Oki's primary industries (including fishery, forestry, and farming) accounted for 38.3 percent of total Oki employment. As illustrated in Figure 1.2, 2010 primary industries represented 13.4 percent of the Oki employment, with secondary and tertiary industries representing 17 percent and 69.4 percent. The medical/welfare industry has become a major employer on Oki, accounting for 16.5 percent of total employment, followed by the wholesale/retail industry (14.6 percent) and the construction sector (13.1 percent). Recent estimates indicate that both primary and secondary industries continue to decline. Tertiary industries now represent 79.3 percent of total economic activity on Oki, followed by secondary industries (15.1 percent).[7]

The Chugoku Electric Power Company (CEPC) operates 32 MW of electric power capacity on the Oki Islands, unconnected to the mainland power grid.[8] As of 2017, most of Oki's electricity is subsidized by the Shimane Prefecture and Japanese governments and generated by burning heavy fuel oil imported to the islands.[9] There are abundant local renewable energy resources such as solar, wind, hydro, and biomass that could replace the costly energy derived from imported oil.

The Oki District and Shimane Prefecture governments established the GC project to promote new business through underutilized biomass and forestry resources. GC seeks to integrate lumber, energy, pulp raw material, and chemical industries to create new jobs and economic activity on the island. For example, biomass waste from sawmills and carpentry can be used in lignophenol synthesis, which is a valuable feedstock chemical. Encouraging cooperation among biomass companies and government agencies is one challenge facing the GC project's success.

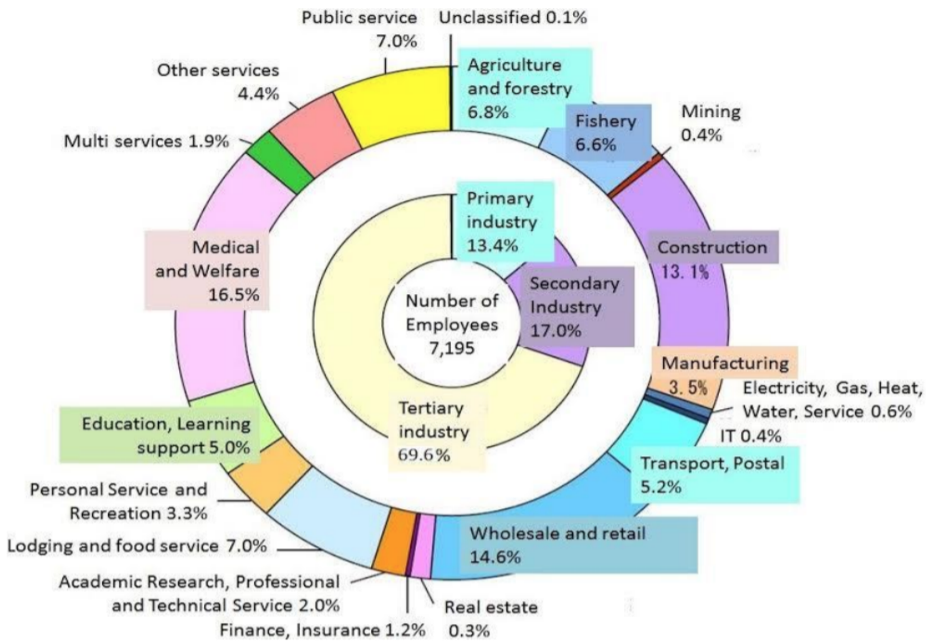
In 2014, the Oki Islands municipality identified itself as a Biomass Industry City in recognition of its activity on the GC project to enhance recycling and encourage Japanese forest management practices to promote green primary and secondary industries. These investments could create new job opportunities and improve the environment of the Oki Islands for residents as well as help stabilize the population (see Table 1.1).

Table 1.1
Green Complex Objectives

- Revitalization of primary industry by utilizing unused resources
- Constant maintenance and rehabilitation of Satoyama/Satoumi environment
- Promotion of secondary industry with development of alternatives for petrochemical products and new products using woods and seafood
- Promotion of activity-based tourism, such as ecotourism
- Establishment of low-carbon society

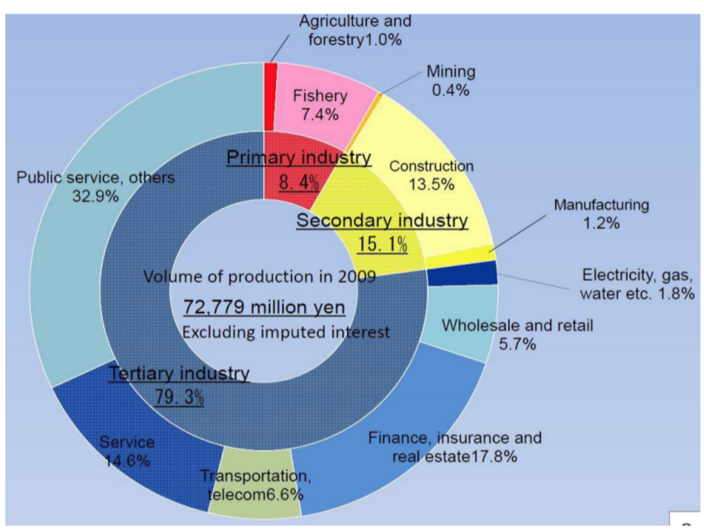
Source: Unpublished materials provided to project staff, "Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received August 2017.

Figure 1.2
Oki Employment by Sector



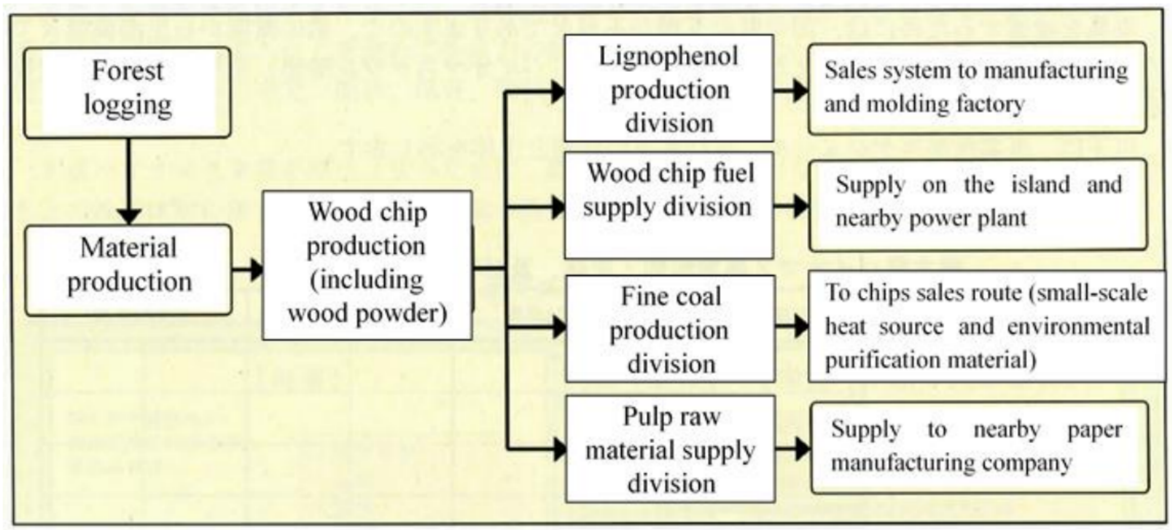
Source: Okinoshima, "Vision for Renewable Energy Promotion in Okinoshima" (2014) (隠岐の島町, 隠岐の島町再生可能エネルギー推進ビジョン, 2014).

Figure 1.3
Oki Employment Percentage by Industry



Source: Unpublished materials provided to project staff, "Oki Islands Development," Okinoshima Prefecture, received August 18, 2015.

Figure 1.4
Potential Oki Biomass Industries



Source: Unpublished materials provided to project staff, "Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received August 2017.

The Potential for Biomass on the Oki Islands

Oki's abundant biomass includes wood chips, mulch, sewage, manure, and other organic matter that can be used as renewable biofuels directly burned to create electricity or heat or converted via a variety of processes to organic chemicals. Compared to fossil fuels, biomass absorbs carbon dioxide during plant growth. Dried biomass can be burned in many combustion engines with limited modifications. However, biomass and biofuels can be less energy intensive, in terms of fewer kilocalories per gram, than conventional fossil fuels. They can also face technical market and logistical challenges.

Sustainable development of Japan's biomass resource for energy depends on understanding how forests and agricultural capacity can supply biomass while preventing overharvesting and associated ecological and economic consequences. One challenge is how to assess, on a sustainable basis, the volume of low-quality wood biomass available from forests for energy that can support long-term forest health, soil productivity, water quality, wildlife habitat, and biodiversity.[10]

Pellet stoves are one potential use of biomass. A pellet stove is a combustion engine which uses pellets (compressed wood biomass) to generate heat or electricity. Pellet fuel is a renewable, clean-burning, and cost-stable heating alternative to kerosene or conventional stove heating.[11] As forests cover 87 percent of the Oki Islands,[12] the abundance of timber and wood waste created by the timber industry presents an opportunity for wood fuel pellets to become a cost-competitive and viable option for space heating. Pellet stoves are already used to heat some hotels, schools, and homes on the Oki Islands.

Replacing fossil fuels with biomass versus fuel oil for space heating can reduce carbon emissions and other environmental impacts. Wood fuels are often referred to as "carbon neutral," as CO_2 emissions can be offset and captured by new tree growth. Although carbon dioxide is released when wood is burned, if trees are harvested and burned at the same rate of growth, no net carbon is released, as opposed to burning fossil fuels.[13] Every ton of pellets reduces CO_2 emissions by about 1.5 tons versus fuel oil.[14]

[1]"From Peninsula to Islands," Oki Islands UNESCO Global Geopark, accessed October 12, 2017, http://www.oki-geopark.jp/en/geohistory/stage4/.
[2]Masakazu Yoshioka, Takuya Hasegawa, Osamu Hirabayashi, Tokiyoshi Kaneta, Kiyokazu Kawakami, Nobuhiro Kimura, Takasumi Maruyama, Koichiro Nishikawa, Tetsunori Oshimo, André Rubbia, Satoshi Taguchi, and Masashi Tanaka, "Oki Islands Site Study," *Journal of Physics: Conference Series* 308, no. 1 (2011): 1–7.
[3]Unpublished materials provided to project staff, "Oki Islands Development," Okinoshima Prefecture, received August 18, 2015.
[4]*Renewable Energy Technology for Development in a Remote Area: Oki Islands, Japan*, report no. 187, LBJ School of Public Affairs, The University of Texas at Austin, 2016.
[5]Ibid.
[6]Ibid.
[7]Ibid.
[8]Masakazu Yoshioka, Takuya Hasegawa, Osamu Hirabayashi, Tokiyoshi Kaneta, Kiyokazu Kawakami, Nobuhiro Kimura, Takasumi Maruyama, Koichiro Nishikawa, Tetsunori Oshimo, André Rubbia, Satoshi Taguchi, and Masashi Tanaka, "Oki Islands Site Study," *Journal of Physics: Conference Series* 308, no. 1 (2011): 1–7.
[9]Ibid.
[10]"Biomass Energy: Efficiency, Scale, and Sustainability," Biomass Energy Resource Center, accessed October 4, 2017, http://www.biomasscenter.org/policy-statements/FSE-Policy.pdf.
[11]"Heating Full Life-Cycle Assessment," University of Wisconsin Green Bay, accessed November 8, 2017, http://www.pelletheat.org/assets/docs/industry-data/final-pfi-study.pdf.
[12]Unpublished PowerPoint provided to project staff, Tats Sakamoto, "Basic Views for Woody Biomass Energy," received June 3, 2017.
[13]"Heating Full Life-Cycle Assessment," University of Wisconsin Green Bay, accessed November 8, 2017, http://www.pelletheat.org/assets/docs/industry-data/final-pfi-study.pdf.
[14]"Benefits of Pellets," Pellet Fuels Institute, accessed November 8, 2017, http://www.pelletheat.org/benefits-of-pellets.

Chapter 2: Biomass Resources Availability

Oki's Green Complex (GC) project seeks to increase business activity and generate employment through the revitalization of the forestry industry. GC created a coordinating committee for the Resource Supply System to promote logging, plan forestry practices, install high performance logging machinery, and invest in the wood biomass industry. By improving the forestry working process, GC seeks to enable the Oki forestry industry to be more competitive and use waste products from the lumber industry as inexpensive and useful feedstocks. The cascading use of forest materials in a wood biomass industry can add value at each phase of the process before the resource is exhausted. Waste wood biomass created in sawmills can become the input for another industry. For example, wood biomass in the form of sawdust from a local lumber mill can be the least costly biomass input for lignophenol and energy generation. Due to the low domestic price of cedar logs, Oki industries face challenges in realizing profit at the initial stage of lumber production. Table 2.1 illustrates the revenue generated by the expected production of wood biomass from forestry activities at the levels needed to meet demand for local industries using wood biomass.

Table 2.1
Revenue from Oki Forestry

Category	Quantity
Volume of forest resources logged	30,000 tons/year
Unit selling price	4,303 yen/ton
Sales	129.09 million yen/year
Revenue from forest resources logging (unit value)	391 yen/ton
Revenue from forest resources logging	11.74 million yen/year

Source: Unpublished materials provided to project staff, "Oki Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received 2015.

Net revenue values in Table 2.2 indicate that logging alone cannot yield profit without the aid of subsidies; the loss from logging alone is 6.26 million yen. Without increasing efficiency and competitiveness for logging and timber production, Oki's forestry industry could not provide a sufficiently cheap source of wood biomass at the levels needed to supply lignophenol, wood chips, or energy production on Oki Islands. The profitability of small-scale forestry operations worldwide is in decline, especially in developed countries, such as Japan and the United States, where small lumber operations may fail to compete successfully with the lower operating costs of vertically integrated logging companies in China and Southeast Asia. There are many cascading uses for biomass available on the Oki Islands which are discussed below and in the next chapter.

Table 2.2
Revenue for Wood Biomass Industries on the Oki Islands (in millions of yen)

Category	Total	Without Subsidy
Forest resource logging	11.74	-6.26
Cellulose/lignin separation and utilization	452.46	452.46
Wood chip utilization	71.95	49.95
Total	536.14	496.14

Source: Unpublished materials provided to project staff, "Oki Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received 2015.

Table 2.3
Target Biomass Procurement (input in tons)

Category	Required Input
Biomass gasification	2,000
Wood pellet production	4,000
Lignophenol production	10,000
Total	16,000

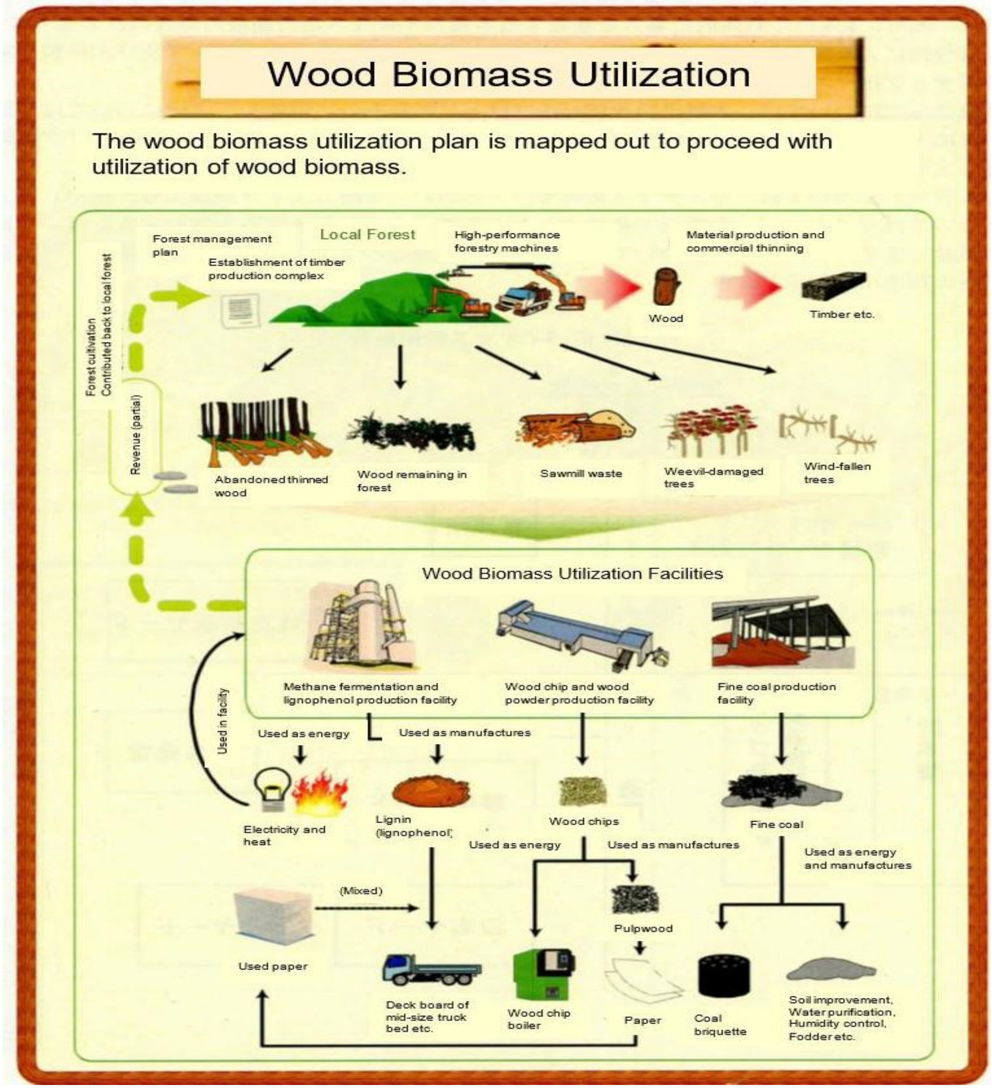
Source: Unpublished conversation with Eunosuke Fujimoto, August 29, 2017; unpublished materials provided to project staff, "Procurement Plan for the Green Complex Project," received 2017.

Table 2.4
Current Biomass Procurement (in tons)

Category	Quantity
Processed goods (tons)	5,000
Logs	15,000
Total	20,000
Total wood biomass generated as byproduct	6,000
Required input	-16,000
Deficit	-10,000
Level of processed good production needed to meet deficit	25,000

Source: Unpublished conversation with Eunosuke Fujimoto, August 29, 2017; unpublished materials provided to project staff, "Procurement Plan for the Green Complex Project," received 2017.

Figure 2.1
Wood Biomass Utilization



Source: Unpublished figure provided to project staff, "Oki Green Complex Wood Biomass Utilization Plan," Oki Islands Municipal Government, received 2015.

According to the town's plan, wood biomass produced during logging operations will be stored at a facility designed to convert it into wood chips and wood powder.[1] Wood chips can then be processed chemically to produce cellulose and lignin, which at sufficient production levels can be exported as lignophenol products. Cellulose derived from wood biomass produced during logging operations can be fermented to extract methane to be used for power generation.

Based on the tables, Dogo Island does not currently produce enough biomass to reach target procurement levels. Previous studies suggest that the amount of wood biomass available to use as inputs in local industries is approximately 18,094 cubic meters per year.[2] By adding biomass produced during logging that cannot be processed at the sawmill, total procurement could reach

23,000 cubic meters per year.[3] Local industries do not purchase the required amount of biomass material and are still working to reach target production levels.[4] Table 2.3 lists the target procurement levels for each Green Complex industry and Table 2.4 illustrates current procurement levels based on logging.

The combined total procurement for lignophenol, gasification, and wood pellets is projected to be 16,000 tons of biomass. GC proposes a biomass gasification power generator with a capacity of 45 kW, which at capacity could burn 500 tons of wood chips annually. This amount is available from the 2,000 tons of wood chips already produced annually at Woodhill Sawmill.[5] According to the procurement plan, the pellet factory, whose production is 1,000 tons per year during its first phase, can increase its production to 4,000 tons. Total procurement for the pellet factory would then be 4,000 tons in this phase. The town also plans to increase lignophenol production to 1,000 tons, which will require approximately 10,000 tons of biomass material.[6]

The Oki Islands timber industry fells 20,000 tons of timber each year; 5,000 tons are exported from the island as processed wood products and 15,000 tons as unprocessed logs. Shipping unprocessed logs is expensive, as half of those 15,000 tons is comprised of moisture content. Air between logs, even when tightly packed, is about 5 to 22 percent, meaning that about 55 to 70 percent of volume associated with the 15,000 tons of logs shipped annually from the Oki Islands has no value.[7]

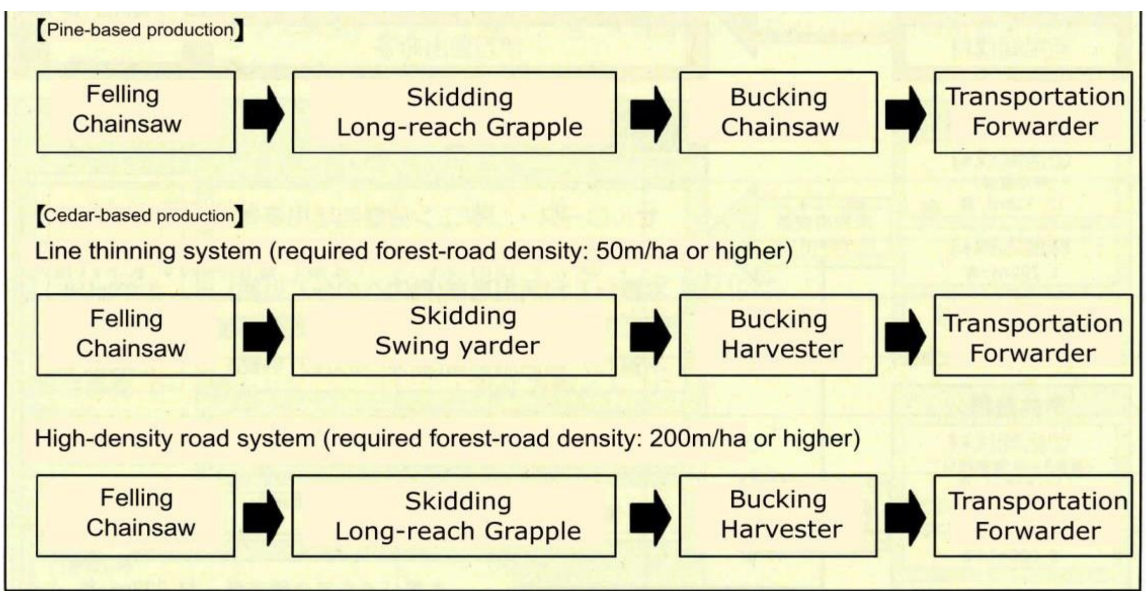
Exporting unprocessed logs compared to processed goods is both more expensive and results in less value from Oki's timber industry in addition to higher distribution costs. The high cost of shipping unprocessed logs off the island reduces profit margins and the competitiveness of the forestry industry. It is more profitable for wood to be processed on the island and exported as a finished product, producing wood biomass waste as a byproduct of production which can then be used in energy and lignophenol production. If Dogo can process the remaining 15,000 tons of wood now exported, the value-added increases and distribution costs could fall by as much as 60 to 70 percent. Approximately 6,000 tons of lumber waste could then be used as inputs to other industries, such as lignophenol, wood pellet heating, and local power generation. Based on current production levels, Dogo plans to produce an additional 10,000 tons of wood biomass material for a total of 16,000 tons. This volume would increase the amount of processed wood shipped from Oki to 25,000 tons for a total of 45,000 tons, assuming the current mix of processed lumber and uncut logs.

Some industries use waste materials generated by other industries, such as timber processing, as production inputs. This is known as cascading biomass use. The use of one industry's waste as another industry's inputs can reduce the need to develop a separate procurement system for unused biomass left on the forest floor during harvest operations. A sufficient volume of wood waste generated by trimming and harvesting implies that costs incurred during forestry activities can be reduced through cost efficiencies, allowing processed goods produced on the Oki Islands to be more competitive. Based on Dogo field research, we identified three activities wherein the Oki Islands could increase its forestry efficiency and promote an increase in the shipping of processed goods: (a) improving land title records; (b) promoting access to forest resources; and (c) pursuing technological efficiency in the forestry working process. By using the most efficient technologies and processes for harvesting and trimming trees, local forestry companies can lower costs and increase the competitiveness of logs and processed wood.

In the Satoyama forestry system, cedar trees are planted and cared for through regular thinning operations to promote healthy growth for approximately 60 years before the trees have reached the appropriate girth for harvesting.[8] Forestry thinning operations constitute half of total logging activities (see Figure 2.2). Cedars that have not reached the minimum harvest girth cannot be processed at the lumber mill; during harvesting, thin trees are typically left on the forest floor. To manage the forests, the Japanese government takes aerial photos of land plots which can be cross-referenced with local records to determine ownership. Because of the imprecise nature of this system, it is often difficult to tell where one individual's land ends and another's begins.[9]

Compounding this imprecise survey is the difficulty in finding landowners. As most forests on Dogo Island are privately owned, local forestry companies are not able to thin forest tracks without the permission of the landowners. Oki Islands Forestry Collective professionals identify cedar plots ready for thinning or harvesting by driving through the island and visually surveying the forest for harvestable plots. When mature trees are found, attempts are made to contact the owner, who can pay them to have the cedars harvested or trimmed to promote healthy growth. According to the Oki-Dogo Forest Cooperative, forestry companies are often unable locate or identify landowners.[10] Migration to the mainland is the main cause of this difficulty, and in their absence, is it difficult to determine or obtain tenure rights.[11]

Figure 2.2
Forestry Processes



Source: Unpublished materials provided to project staff, "Oki Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received 2015.

This current system creates economic inefficiencies due to the added labor costs and time attempting to determine land ownership and tenure rights. Plots of land may go untrimmed or be poorly maintained due to the inability to find owners and gain permission, resulting in trees that cannot be processed and exported.[12]

Forestry companies in Japan typically use chainsaws and manual labor during harvesting and trimming. Project staff were able to observe the working process used in tree felling operations on Dogo Island. Three two-person teams cut trees with a chainsaw before using heavy machinery for skidding and forwarding. One worker operates a cut-to-length harvester for bucking and forwarding. According to the site foreman, each logger can manually harvest approximately 5 to 6 cubic meters per day, for a total of 30 cubic meters per day for the site. Generally, each two-person team can harvest approximately 100 to 150 trees per day. It takes approximately one month to clear a typical site. There are five companies on Oki which harvest timber on the island using similar methods.[13] Although demand for Dogo's and Japanese timber could increase, it is a challenge to find capable laborers due to the declining and aging population.[14]

Mountainous terrain and damp soil create additional challenges to efficient tree harvesting and transporting. The Japanese government has subsidized some automated heavy machinery for wood harvesting. Table 2.5 lists some automated technologies that could improve harvest yields and reduce costs. Determining whether improvements in heavy machinery, technology, or working practices could reduce unit costs associated with Dogo's difficult terrain is beyond the scope of this project.

Forestry companies use cut-to-length harvesters for preparing felled trees for shipment. The Japanese government offers subsidies that amount to 50 percent of the value of such machinery.[15] On Oki's steep slopes, the current equipment is less effective for felling trees. For example, the so-called harvester (which was demonstrated at a field site the class observed) can cut and "process" (de-limb, debark, and cut to length) a tree. However, the machine cannot reach many trees on slopes and cannot operate on unstable roads because of its size, weight, and footprint, so it is used chiefly for de-limbing and cutting logs to length. There are currently two of these machines in use for the company which we visited.[16] Figure 2.3 illustrates the harvester. Figure 2.4 is a photograph of a harvester.

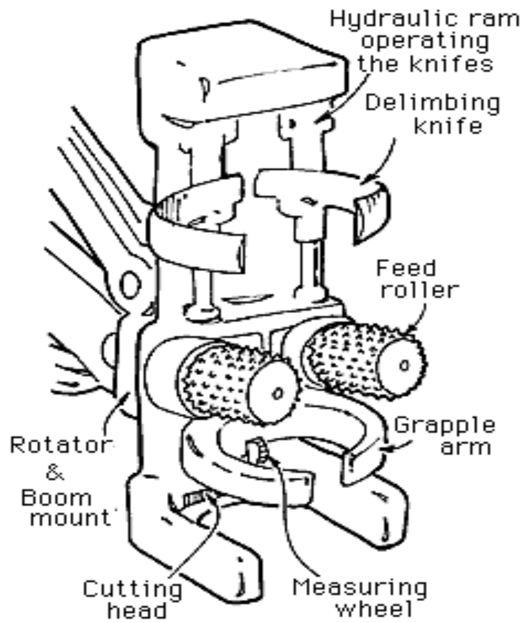
Tracked vehicles and consistent heavy traffic can cause soil compaction which can prevent roots from getting proper nutrients and inhibit healthy plant growth. Common logging practices, such as forwarding and skidding methods, drag logs across the ground to a central collection point; these processes can remove the nutrient-dense layer for the next generation of trees. If mineral soil subsequently is exposed to erosion by rainfall and surface flow, the exposed soil may not retain moisture as well, reducing the soil's nutrients for tree growth.[17] Investing in technologies and practices that minimize environmental damage could improve growth and reduce costs by preserving the soils that can grow healthy cedars.

Table 2.5
Methods of Timber Harvesting on the Oki Islands

Method 1: Manual Equipment (5–10%) *Tools*: Axe, one- or two-man-operated handsaw, machete, instruments with cutting knives *Consequences*: • Easy to carry regardless of terrain • Requires more physical work • Low productivity • Able to fell, de-limb, debark, and buck trees of all sizes (typically for personal use)
Method 2: Motor-Manual Equipment (60%)
Tools: Chainsaw *Consequences*: • Easy to carry regardless of terrain • Requires less physical work • Medium productivity • High risk of chainsaw getting stuck during operation • Able to fell, de-limb, debark, and buck trees of all sizes
Method 3: Fully Motorized Equipment (30–35%)
Tools: Harvester, feller-buncher, stroke de-limber, processor and harvester head, grapple saw *Consequences*: • Able to operate in homogeneous and even aged forests with small to medium trees • High productivity • Higher safety and comfort standards for the operator • Pre-concentration of wood makes higher performance of subsequent activities possible • Decreased wood loss, as felling cut can be made close to soil level • 24-hour work possible (with spotlight equipment and without climate influence) • High investment costs • Demand for highly qualified maintenance and spare part logistics • Soil damages, such as compaction and erosion • Difficulties in finding skilled machine operators

Source: Chart developed by Cristina Mendez, The University of Texas at Austin, based on information provided by Tran Anh Quan, Hiroshima University, from unpublished interview, timber harvesting foreman, Dogo Island, August 24, 2017.

Figure 2.3
Diagram of Harvester Mechanisms



Source: Charles R. Blinn and Matthew Smidt, "Logging for the 21st Century: Protecting the Forest Environment," University of Minnesota Extension, accessed August 26, 2017, http://www.extension.umn.edu/environment/trees-woodlands/logging-for-the-21st-century-protecting-the-forest-environment/.

Figure 2.4
Photograph of Harvester

Source: "New from Kesla at SkogsElmia – Loaders, a harvester head and a chipper," Logging-On, 2009, accessed December 1, 2017, http://www.loggingon.net/new-from-kesla-at-skogselmia-loaders-harvester-head-and-chipper_news_op_ view_id_299/.

Another challenge on Dogo is the paucity of forest roads to access timber with proper machinery. Forest roads are necessary to provide access to forest land for general management, maintenance, timber extraction, and recreation. Creating a forest road requires a large capital investment by an owner. The current forest road network is limited in length and density compared to extensive forest road networks in other nations. There are two types of Japanese road systems to access the forest: permanent roads and temporary roads. Permanent roads on Dogo make up a total length of 182,621 meters and the forest road density is 8.7 meters per hectare. This density is higher than the average density of Japanese forest roads, which is only 5 meters per hectare, and almost three times denser than the average density of Shimane Prefecture forest roads, 3.3 meters per hectare.[18] However, the Dogo road density is still far less than that of Germany (118 meters per hectare), although German forest coverage is only one-third of Oki's rate.[19] With a relatively low forest-to-road density compared to other forestry-dense economies (such as Germany), timber companies create temporary roads to harvest and thin timber. Temporary roads are used for approximately 90 percent of Oki's harvesting and thinning activities.[20]

Bucking is the process of cutting a felled tree into logs. Cut logs are used for plywood, lumber, or pulp, based on the small-end diameter of cut logs. Forestry companies on Oki are aware of the different value-loss ratios associated with different bucking practices. Significant value-loss can occur when conservative estimates are used to determine the minimum allowable small-end diameter for different log scales.[21] Marginal costs increase as a result of increased labor and time spent producing lower-value pulp logs due to errors in measuring small-end diameter. During an Oki field observation, project staff observed a significant number of felled logs with a smaller diameter than is required for use in plywood and lumber. In many forests, thin logs are downgraded to a size suitable for pulp and are sent to pulp mills for paper production. Because there is no pulp mill on Oki, when logs are downgraded to pulp, they are not moved from the site and the wood's entire potential value is lost. It is not within the scope of this study to examine the possibility of a pulp mill on Oki, but the installation of a pulp mill could help recover value lost during harvesting operations.

Mechanized harvesters consistently capture more value when used to fell and buck trees, but only when the machines are aligned with the volume calculations, whether this is in cubic meters or various board-feet log rules. Project staff were not able to observe which scaling rules were being used by the Oki harvester in operation, but Scribner scaling rules with mechanized bucking can increase productivity and reduce value-loss.[22]

Some types of feller-bunchers and harvesters can operate on steep slopes, and analysts report gains in productivity associated with proper machinery use.[23] Such machines can replace chainsaw felling and significantly increase efficiency.[24] Machinery purchases should be modified to ensure that equipment is compatible with Oki terrain. Alternately, tethering can be used to stabilize conventional machinery difficult terrain. Tethering involves using a winch and cable to hold a piece of machinery in place and allow for steep slope operation.[25]

Recommendations

Forest managers on Dogo Island survey harvestable plots by driving through the forests and evaluating individual plots by eye. This process consumes significant time and resources and relies on the experience of the surveyor in identifying plots that are ready for harvest. The use of satellites and remote sensing systems to monitor forests or identify land tracks appropriate for thinning or clearing could speed this process. As one source stated: "Remote sensing is particularly useful in studying forest change because a region's forests can be studied comprehensively and uniformly across time and space."[26]

Remote sensing methods can collect data from multiple satellites or aircraft that capture land images which can be interpreted by researchers and remote sensing software.[27] In the United States' Pacific Northwest, a remote sensing analysis quantified differences in harvest practices between federal and private foresters.[28] These findings can empower forest managers to improve forest harvest sustainability. For example, a 1992 study of map time series of Northwest US federal land discovered that after clear-cutting had ceased, private sector forests continued to be clear-cut. These data allowed for forests managers to understand forest disturbances and improve sustainability strategies. Remote sensing can promote public education by creating a visual representation of historical forest disturbances.[29] Remote sensing has been used by a commercial company to assess the quality and value of forests,[30] as remote sensing can delineate forest cover maps. A 2006 study of the feasibility of forest cover mapping found derived forest maps can be accurate using images from the Japanese Earth Satellite (JERS-1).[31] Oki is at an advantage because any data gathered from remote sensing can be used in conjunction with Japan's two forest inventory systems to provide insight for strategic forest system planning and management.[32]

Pruning and harvesting Oki timber can be challenging due to the islands' steep, mountainous terrain and wet soil. Traditional methods of harvesting may be inefficient. Staff observed the operation of a harvester at a timber-felling site. Those expensive machines could perform only some intended tasks, such as de-limbing and cutting-to-length, as extraction is only possible when the harvester is operating on level, or nearly level, terrain. Japanese and local governments ought to consider whether other forestry equipment may be better suited for tree harvesting and thinning for the Oki terrain.

Europe has been developing and testing timber harvesting equipment for mountainous regions, such as those in Germany and Switzerland (see Figure 2.5). The Integrated Processing and Control Systems for Sustainable Forest Production in Mountain Areas (SLOPE) technology innovations include radio-controlled chokers; cable skidding; and TECNO automated system. This system is meant to reduce time and increase productivity. A cable skidder operates by automatically detecting felled logs tagged with RFID tags. The skidder then releases the radio-controlled chokers to pick up timber and move it down the cable to a collection site without the use of manual laborers or heavy equipment on the ground.[33] Figure 2.6 also depicts a generic cable skidder system which can transport logs without dragging them across the ground. Aerial (helicopter) extraction, although expensive, could be used in mountainous areas if the harvest is carefully planned. These practices are cost-effective and efficient and could help maintain the Oki Islands' environmental sustainability as a UNESCO Geopark. Aerial extraction, cable skidding, or high-flotation tires can decrease damage to the soil from timber harvesting.

Another recommendation is to enhance forest planning, including road design and layout suitable for extraction and ongoing maintenance and repair of forest roads, especially after harvesting operations and periods of heavy rainfall. Some benefits include easier accessibility for forest planning and management, plantation, maintenance, timber extraction, and recreation. Other benefits are hazard protection (wildfire spread, wind-throw, disease spread, etc.) and an opportunity for biodiversity enhancement.

Through the GC project, the Oki government seeks to implement the cascading use of forest materials in various wood biomass industries to revitalize the Oki forestry industry. We identified three primary hurdles to overcome in reaching this goal: technological efficiency in the forestry working process; tenure rights on Oki; and the promotion of forestry resources accessibility. The town's plan to increase the amount of processed wood products exported from the island could lead to greater value-capture as well as increase the amount of wood biomass available to local businesses.

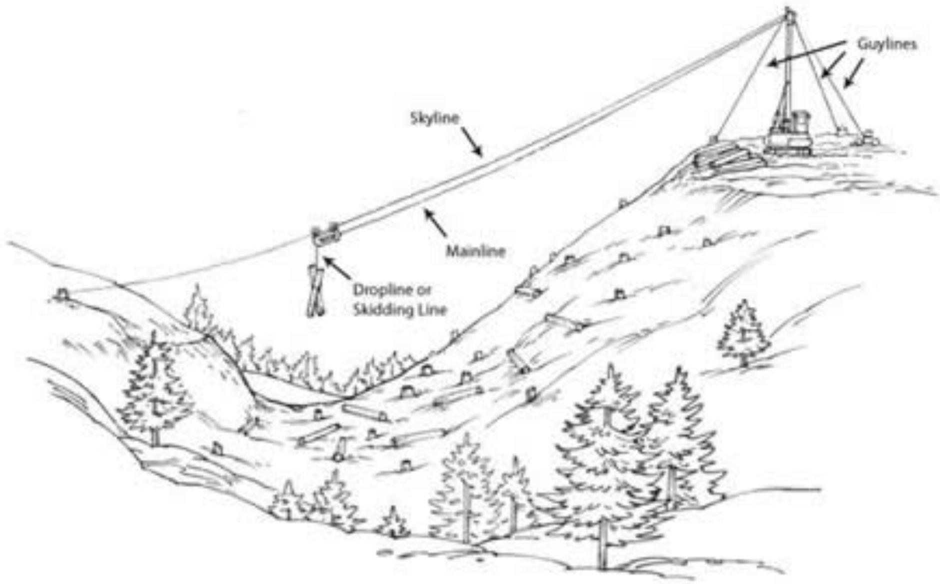
This may be possible through finding cost-cutting efficiencies in the forestry working process, including introducing machinery suited to Oki's mountainous terrain and moving away from chainsaw felling. Remote sensing systems may save the Forestry Cooperative time spent surveying land. The town may work to streamline access to privately owned forestry resources by identifying private land owners who have moved off the island. Such cost-cutting initiatives will additionally lower procurement costs for the entire GC project, resulting in greater competitiveness for lignophenol based products, wood pellets, and energy production.

The local Dogo Island's government has launched the Green Complex initiative to promote sustainable energy and make efficient use of biomass resources, a topic which will be discussed in the following chapter.

Figure 2.5
TECNO Intelligent Crane Carriage Retrieving Felled Timber

Source: "Intelligent Cable Crane Carriage," Integrated Processing and Control Systems for Sustainable Forest Production in Mountain Areas (SLOPE) Project, November 10, 2016, accessed August 14, 2017, http://www.slopeproject.eu/dissemination/slideshare/.

Figure 2.6
Diagram of a Fully Automated Retrieval and Skidding System



Source: Charles R. Blinn and Matthew Smidt, "Logging for the 21st Century: Protecting the Forest Environment," University of Minnesota Extension, accessed August 26, 2017. http://www.extension.umn.edu/environment/trees-woodlands/logging-for-the-21st-century-protecting-the-forest-environment/.

[1]Unpublished materials provided to project staff, "Oki Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received 2015.
[2]Ibid.
[3]Unpublished email provided to project staff, Eunosuke Fujimoto, "Procurement Plan for the Green Complex Project," received August 29, 2017.
[4]Ibid.
[5]Unpublished email provided to project staff, Eunosuke Fujimoto, "Procurement Plan for the Green Complex Project," received August 29, 2017.
[6]Ibid.
[7]Unpublished materials provided to project staff, "Oki Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received 2015.
[8]Unpublished interview with timber harvesting foreman, Dogo Island, August 24, 2017.
[9]Ibid.
[10]Unpublished interview with timber harvesting foreman, Dogo Island, August 24, 2017.
[11]Ibid.
[12]Unpublished interview with timber harvesting foreman, Dogo Island, August 24, 2017.
[13]Ibid.
[14]Ibid.
[15]Ibid.
[16]Ibid.
[17]Charles R. Blinn and Matthew Smidt, "Logging for the 21st Century: Protecting the Forest Environment," University of Minnesota Extension, accessed August 26, 2017, http://www.extension.umn.edu/environment/trees-woodlands/ logging-for-the-21st-century-protecting-the-forest-environment/.

[18]Sven O. Gärtner, Gunnar Hienz, Heiko Keller, and Detlev Paulsch, “Ökobilanz der kaskadierten Nutzung nachwachsender Rohstoffe am Beispiel Holz – eine Einordnung,” *uwf UmweltWirtschaftsForum* 20, no. 2–4 (December 2012): 155–64, https://doi.org/10.1007/s00550-012-0259-7.
[19]Ibid.
[20]Ibid.
[21]Kevin Boston and Glen Murphy, “Value Recovery from Two Mechanized Bucking Operations in the Southeastern United States,” *Southern Journal of Applied Forestry* 27, no. 4 (November 2003): 259–63.
[22]Ibid.
[23]Ibid.
[24]Ibid.
[25]“Meet the World’s Leading Steep Slope Innovators,” Steep Slope Lodging, accessed November 21, 2017, https://steepslopelogging.events/.
[26]“Monitoring Forests from Space: Quantifying Forest Change by Using Satellite Data,” Science Findings, https://www.fs.fed.us/pnw/sciencef/scifi89.pdf.
[27]Ibid.
[28]Ibid.
[29]DJ Peterson, Jennifer Brower, Ronald Diver, and Susan Resetar, *Forest Monitoring and Remote Sensing: A Survey of Accomplishments and Opportunities for the Future* (RAND Corporation, July 1999).
[30]Caitlin Dempsey, “Smart Tree Logging with Remote Sensing,” GIS Lounge, October 21, 2014, accessed October 2017, https://www.gislounge.com/smart-tree-logging-remote-sensing/.
[31]C Thiel, P Drezet, C Weise, S Quegan, C Schmullius, “Radar Remote Sensing for the Delineation of Forest Cover Maps and the Detection of Deforestation,” *Forestry: An International Journal of Forest Research* 79, no. 5 (December 1, 2006): 589–597, https://doi.org/10.1093/forestry/cpl036.
[32]Yasumasa Hirata, Mitsuo Matsumoto, and Toshiro Iehara, “Japanese National Forest Inventory and its Spatial Extension by Remote Sensing,” 2009, accessed October 2017, https://www.nrs.fs.fed.us/pubs/gtr/gtr_wo079/gtr_wo079_013.pdf.
[33]“Intelligent Cable Crane Carriage,” Integrated Processing and Control Systems for Sustainable Forest Production in Mountain Areas Project, November 10, 2016, accessed August 14, 2017, http://www.slopeproject.eu/dissemination/slideshare/.

Chapter 3: Biomass Resource Utilization

The Oki Islands' Green Complex (GC) project seeks to revitalize Oki's forest industry while promoting the preservation of forests through the sustainable use of wood resources. The Dogo municipality has plans to use waste biomass for multiple industries, including timber, thinned wood for commercial use, abandoned thinned wood, cut wood remaining in forests, sawmill waste, weevil-damaged trees, and windfallen trees.[1] As illustrated in Figure 3.1, the Oki government developed a plan in 2007 to use these resources within different industries. Figure 3.1 lists the volume of resources used by different industries. Note that volumes in the end-use column do not add up to the total available resource, as each industry's process reduces the volume of wood while also creating residuals, such as water.

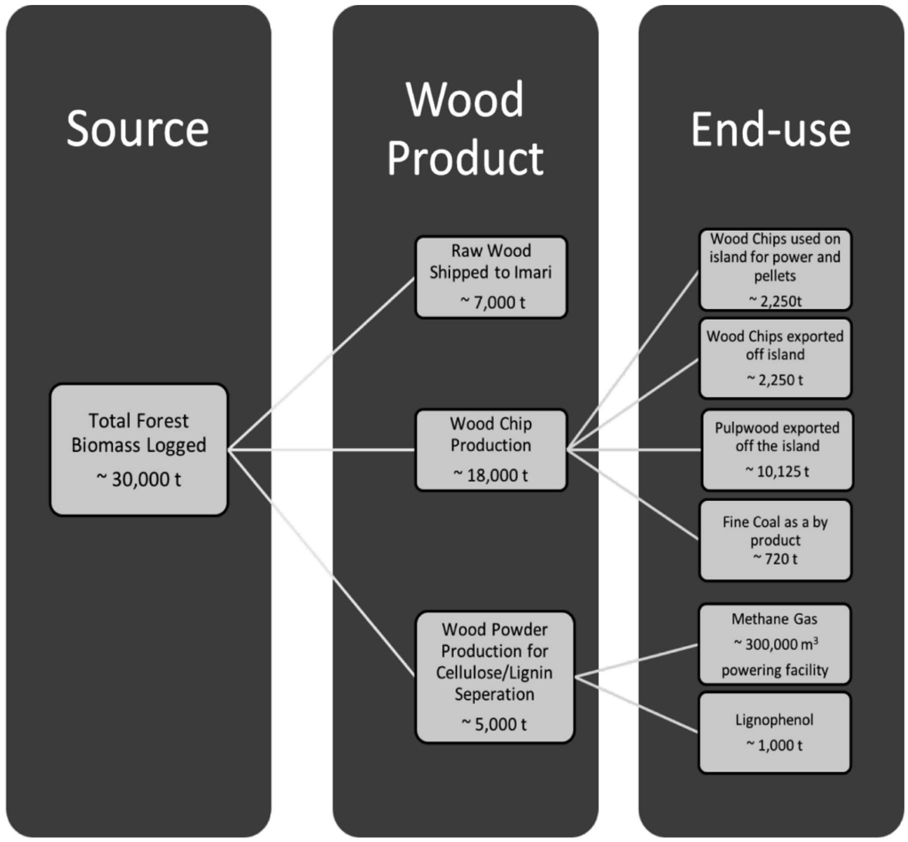
Forest biomass from Oki serves as a source of wood for export. Around 7,000 tons of raw wood are shipped to mainland Japan as timber, leaving about 23,000 tons of biomass waste. About 18,000 tons of this waste can be converted to wood chips, which can either be used on the island or exported. Around 2,250 tons of Oki's wood chips are used to create pellets or directly burned in a combined heat and power plant for electricity and heat. Another 2,250 tons of wood chips are exported as wood fuel. According to the same plan developed in 2007, around 10,125 tons of wood chips are converted to pulpwood and exported for paper production and other uses.[2]

The remaining 5,000 tons from the biomass waste can be converted to wood powder to be separated chemically into cellulose and lignin. Cellulose can be fermented to produce around 300,000 cubic meters of methane that can be burned to provide power for the Biomass Utilization Facility, as well as hot water to nearby facilities. The remaining lignin can be used to produce lignophenol and exported outside the island.

A byproduct of wood chip and powder production is the production of charcoal, termed as "fine coal" in the Oki Islands' Biomass Utilization report. Bark, the outermost layer of hardwood trees, is incinerated in a furnace and converted into 720 tons of charcoal, which is exported as an input for some manufacturing industries.

For any biomass industry to become self-supporting and sustainable, revenues will need to exceed total costs. Costs differ for each end-use of wood (see Table 3.1). There are five columns in the table; each column shows the associated procurement expenses to reach the desired end product. The five industries in the columns are cellulose/lignin production, wood chip production broken down into direct use on the island and export, pulpwood production, and charcoal production. Per unit costs for any of the products range between 5,625 and 8,136 yen/ton, with pulpwood having the highest per unit production cost and charcoal having the lowest.

Figure 3.1
Oki Islands Wood Biomass Utilization Plan



Source: Illustration developed by Samer Atshan, The University of Texas at Austin, based on unpublished materials provided to project staff, "Oki Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received August 2017.

The pulpwood's high production cost reflects a significant transportation cost: 1,500 yen/ton to export pulpwood off the island. Marine transport applies to two other export industries, off-island wood chips and charcoal. Note that for wood chips, the marine transportation costs (1,500 yen/ton) exceed production expenses (1,333 yen/ton), which includes subsidized facility expenses and personnel expenses.[3] Wood chips have lower logging expense versus other uses, which reduces total costs in comparison to the other products. These costs occur because around half the procured wood for woodchip export comes from sawmill waste and weevil-damaged trees, which are cheaper to log.[4] The process to produce wood powder for cellulose/lignin separation adds an additional 833 yen/ton expense to move from wood chips to wood powder. The total for lignin production is therefore 7,470 yen/ton, which makes it the second priciest process. Four workers operate the Biomass Facility that coproduces the wood chips, wood powder, and charcoal. The most appropriate allocation of labor costs would be to wood chip production at 1,333 yen/ton, which is not listed as a cost under charcoal. This is possibly because charcoal is a "free" byproduct, or residual, of the production of wood chips.

Table 3.1
Costs Associated with Oki Biomass Industries (in yen/ton)

Category (Unit: yen/t)	Cellulose/lignin separation and utilization	Wood chip utilization (supply on the island)	Wood chip utilization (supply off the island)	Wood chip utilization (pulpwood supply)	Fine Coal production
Forest resources logging expenses	4,303	4,303	2,710(*)	4,303	-
Wood chip production expenses	1,333	1,333	1,333	1,333	-
Wood powder production expenses	833	-	-	-	-
Fine coal production expenses	-	-	-	-	3,125
Energy etc.	500	500	500	500	500
Logistic expenses (on the island)	500	500	500	500	500
Marine transportation expenses (off the island)	-	-	1,500	1,500	1,500
Total	7,470	6,636	6,543	8,136	5,625

Source: Unpublished materials provided to project staff, "Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received August 2017.

Each industry has its own pattern of revenue. Equation 3-1 shows that revenue per ton for a certain product is defined by the difference between market price and the cost of production. Net revenues are then calculated by multiplying the revenue per ton in Equation 3-1 and the volume of sales for a product (see Equation 3-2). Table 3.2 lists the total volume of sales for each product, the product price in yen/ton, the production expense in yen/ton, the net revenue for each product in yen/ton, and the total net revenues for each product in million yen based on available information.

Revenue per ton [yen/ton] = market price [yen/t] - cost per ton [yen/t] (Eq. 3-1)

Net revenue [million yen] = revenue per ton [yen/t] * volume of sales [t] (Eq. 3-2)

Cellulose/lignin separation and utilization is profitable, as it yields 28.24 million yen from 3,750 tons of wood powder which is used to create methane and lignophenol products. Based on the Oki government's market research in coordination with Mie University, 3,750 tons of wood powder can create 1,000 tons of lignophenol (after producing methane) that can be used as deck boards and pallets on mid- and large-size truck beds. Selling the lignophenol at a price of 1,250 yen/kg, the industry can make 452.46 million yen in profit.[5]

The unit price for wood chips differs when sold on the island (10,000 yen/ton) versus as export sold off the island (6,600 yen/ton). This significant difference affects the profitability of the two processes. The net revenue of exporting wood chips off Oki is just 57 yen/ton leading to profit equal to 130,000 thousand yen. These values reflect both high production expenses and high marine transportation expense (1,500 yen/ton) and the low selling price off the island (6,600 yen/ton).

Table 3.2
Revenues Associated with Oki Biomass Industries

Category	Cellulose/lignin separation and utilization	Wood chip utilization (supply on the island)	Wood chip utilization (supply off the island)	Wood chip utilization (pulpwood supply)	Fine Coal production	Total
Volume of sales (t)	3,750	2,250	2,250 (*)	10,125	720	19,095
Unit selling price (yen/t)	15,000 *JST survey	10,000 *Unit price set by domestic trading companies	6,600 *Unit price set by domestic power generation companies	10,458 *Unit price set by domestic paper manufacturing companies	23,000 *Unit price set by domestic manufacturers	-
Unit price of raw material (yen/t)	7,470	6,636	6,543	8,136	5,625	-
Revenue (per ton) (yen/t)	7,530	3,364	57	2,321	17,375	-
Revenue (million yen)	28.24	7.57	0.13	23.5	12.51	71.95

Source: Unpublished materials provided to project staff, "Green Complex Wood Biomass Utilization Plan," p. 8, Okinoshima Prefecture, received August 2017.

The net revenue of using wood chips on the island for power and pellets is 3,364 yen/ton, yielding a total revenue equal to 7.57 million yen. In other words, selling wood chips as exports produces less profit versus using wood chips on the island.

The net revenue of exporting pulpwood created from wood chips is 2,321 yen/ton, which is less than the net revenue of selling wood chips on the island (3,364 yen/ton). This sector creates 23.5 million yen in net revenues from 10,125 tons exported as pulpwood, whereas only 2,250 tons are sold within the island. Charcoal would be profitable at 23,000 yen/ton, however, although only a small amount of this byproduct is available.

Due to higher costs of exporting wood chips and pulpwood driven by transportation costs, one inference is that the Green Complex project could be more profitable if products were used on the island rather than exported. Wood chips could be used on Oki either for more wood powder for lignophenol production or as wood chip supply for power generation on the island. As discussed above, although lignophenol and local wood chips are more profitable products, they account for only 6,000 tons out of the total 19,095 tons of procured wood waste. Oki would benefit from utilizing as local production the 2,250 tons of wood chips exported off the island which produce little profit. However, there are three barriers to increased use of wood chips on Oki, such as an uncertainty about the price stability of local wood chips on Oki; a limited capacity for producing wood chips; and uncertainty of the value-added for biomass power generation.

One issue in the revenue projections is their reliability and sustainability. The net revenue for locally used wood chips (see Table 3.2) might vary if sold as power generated to the local electric company. Calculations in the Biomass Utilization report show that the 2,250 tons of locally used wood chips can generate 6.8 million kWh of energy. If sold at a feed-in-tariff rate equal to 32 yen/kWh, the total revenue from electricity would be 217 million yen in revenue. Selling wood chips on the island (see Table 3.2) creates only 22.5 million in revenues (2,250 *

10,000 yen/ton). It is not clear why this difference exists in the table between 217 million yen and 22.5 million yen.

There is not enough production capacity of wood chips for increased lignophenol production or power generation. The current installed capacity for burning of wood chips on the island is 45 kW, but the power plant is operating at very low capacity due to maintenance challenges.[6] This means that Oki seems to be exporting wood chips at a reduced profit because the market for both industries has yet to develop.

It is not clear whether it would be more profitable to export the partially profitable pulpwood (10,125 tons), even if the net revenue of sales to power generation is higher. It is beyond the scope of this report to compare the macroeconomic impact of exporting wood chips compared to subsidizing local energy costs.

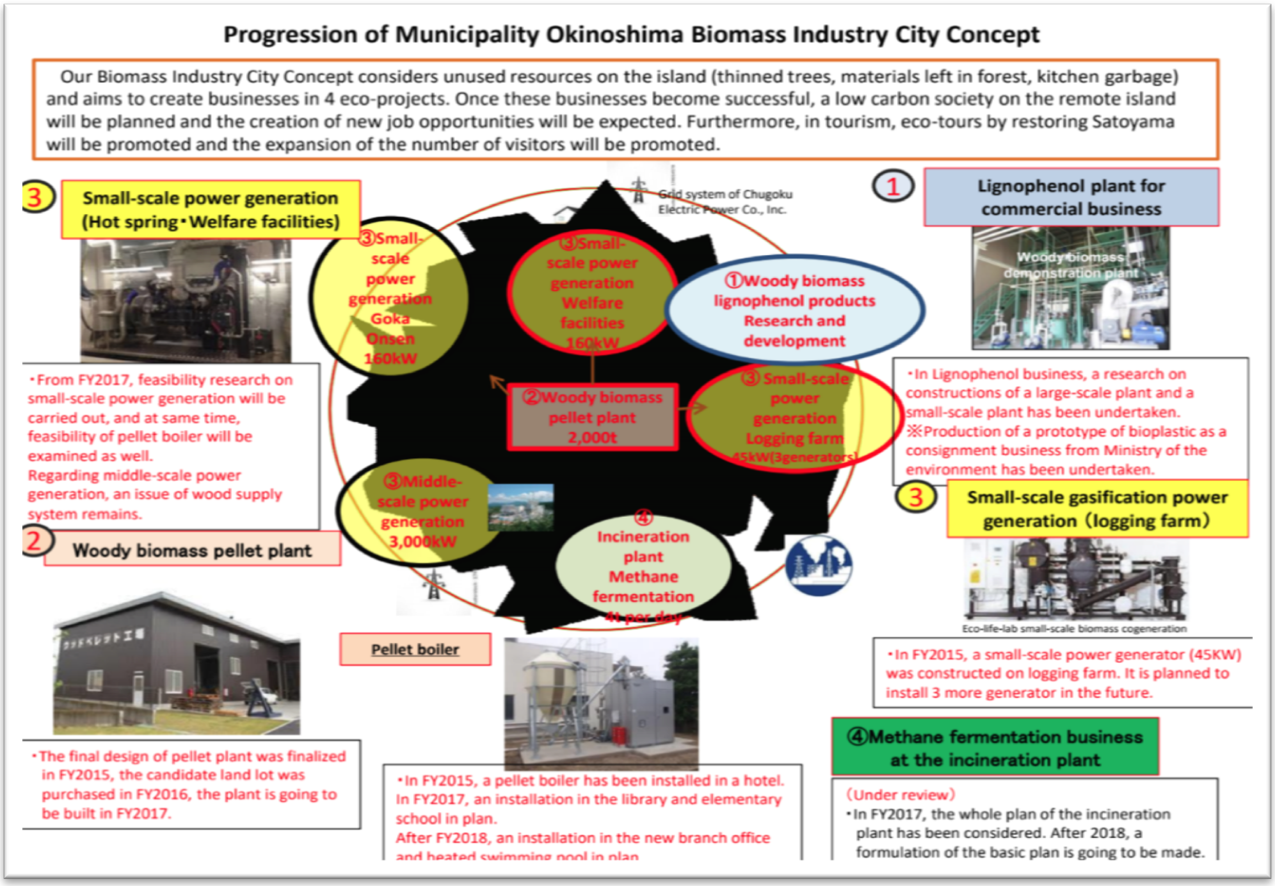
The local Oki government has recently decided to expand energy production on the islands through several small-scale and mid-scale wood chip power plants, possibly due to the reasons listed in the revenue analysis discussed above. Figure 3.2 illustrates recent power generation plans on the island. The current plan for Oki is to build two additional 160 kWh biomass power plants, more pellet boilers, a four-ton methane fermentation plant, and eventually a 3 MW power generation facility. One challenge is the economic feasibility of those plans as well as the Oki wood supply. The following sections analyze the economic feasibility of building a 3 MW biomass plant.

Evaluation of a Proposed Wood Biomass Power Plant

This section seeks to evaluate the economic feasibility of a biomass power plant and to determine an appropriate plant capacity based on cost and revenue analysis and wood supply. According to the Dogo municipality, there are 23,000 t/year of available waste wood biomass.[7] In the interest of simplifying the analysis and providing an idealized case scenario for the economic feasibility of the plant due to economies of scale, this analysis assumes that the total amount of biomass could be burned in the power plant. If a wood-burning power plant is built on Oki, it will require a high investment cost and burning more wood may allow users to achieve higher marginal returns.

The economic feasibility analysis takes the time value of money into account. Costs associated with building and operating the power plant are discounted by the years in which they occur. Revenues from selling the generated power at the assumed tariff rate are determined and discounted by the years in which they occur. The net present value measures the project's economic feasibility by measuring whether revenue from power generation will exceed input costs.[8] Table 3.3 lists the costs associated with the construction and operation of a power plant.

Figure 3.2
Oki Islands Future Wood Biomass Power Generation Expansion



Source: Unpublished materials provided to project staff, "Effort of Okinoshima Town as a Whole," received August 2017.

Table 3.3
Power Plant Costs

Costs	Cost Components
Labor costs	Wood production workers, personal expenses per person, and maintenance
Capital costs	Warehouses, (combined heat and power) plant, boiler, electricity transmission, district heating, and cooling
Operating costs	Price to dispose of the plant at the last year including transportation cost
Unit costs	Costs of wood biomass procurement and other variable input costs

Source: Table developed by project staff, The University of Texas at Austin, 2017.

To determine the costs, a model biomass power plant in Japan was evaluated based on information provided by the Japanese Agency on Natural Resources.[9] Figure 3.3 is a schematic of the modeling done to calculate the available capacity on the Oki Islands based on the exemplar. In the Japanese exemplar model, a 5.7 MW biomass power plant requires 60,000 tons/year of wood biomass. Given that the maximum available fuel amount within Oki Islands is now 23,000 tons/year, one way to estimate the maximum power generation capacity and associated costs is to use linear calculations. Based on the calculations, 23,000 tons/year can be burned within an installation capacity of 2.185 MW on Oki Island. One other inference from this analysis is that the required energy to cover Oki's consumption requires installation capacity of 4.34 MW that burns around 45,684 tons/year, based on the Oki population and average household energy demand. This means that the available 23,000 tons/year of biomass would not provide all of Oki's demand for energy.

This section estimates the revenue options for a 2.185 MW power plant. One option is baseload power; the burning wood becomes the main energy source for the island, based on an assumption that the power plant runs at an 87 percent capacity factor. Other fuels become supplemental sources that are used in response to on-demand fluctuations. Another case is as a variable-load source; burning wood supplements fossil fuels or other primary energy sources based on demand fluctuation. Biomass would be needed at times of the day where the load peaks due to high power usage, typically in the early morning hours or afternoon. In the variable-load case, it would be appropriate to assume a power plant capacity factor of 30 percent. The revenue is computed in Equation 3.3 is based on many components and the feed-in-tariff (FIT) value.

$$\text{Revenue(JPY)} = \text{generation capacity} * \text{FIT} * \text{hours/day} * \text{days/year} * \text{capacity factor} \quad \text{(Eq. 3-1)}$$

Figure 3.3
Oki Islands Future Wood Biomass Generation Costs

Model case in Japan

Plant Capacity	5,700	kW
Capital Costs	398,000	JPY / kW
Disposal fee	19,900	JPY / kW
Operating and Labor Costs	27,000	JPY / kW
Fuel amount	60,000	t / year

Demand/ individual: 2,533kWh / (people・year)

Capacity to Cover Oki Island Demand

Population in Oki Island	15,000	People
Plant Capacity	4.34	MW
Capital Costs	1,727,320,000	JPY
Disposal fee	86,366,000	JPY
Operating and Labor Costs	117,180,000	JPY / year
Fuel amount	45,684	t
Fuel cost	60,918,901	JPY / year
Lifetime	15	years

Required Capacity based on Available Biomass Amount on Oki

Fuel amount	23,000	t / year
Fuel energy	0.095	kW / t
Fuel cost	30,670,000	JPY / year
Available Plant Capacity	2.185	MW
Capital Costs	869,630,000	JPY
Disposal fee	43,481,500	JPY
Operating and Labor costs	58,995,000	JPY / year
Lifetime	15	years

Since the amount of wood biomass is only **23,000 t/year**, it is impossible to cover the power consumption within the island with a 2.185 MW power plant only.

Source: Chart developed by project staff, The University of Texas at Austin, 2017.

Table 3.4
Components of a Power Plant Revenue Equation

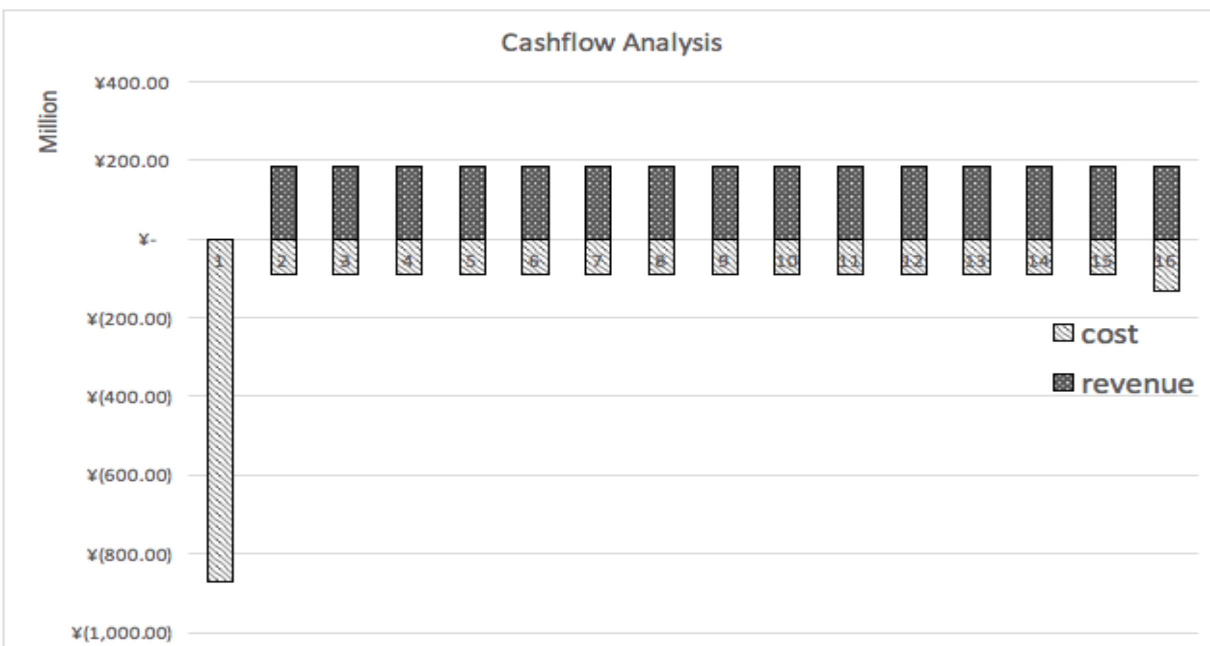
Generation Capacity: Maximum electric output power plant can produce[10]	2.185 MW
FIT (Feed-in Tariff): Feed-in-tariff rate is the regulated amount power generation can be sold at to the local energy company	32 JPY/kWh[11]
Capacity Factor: The net capacity factor is the ratio of an actual electrical energy output over a given period to the maximum possible electrical energy output over the same amount of time	Base-load Senario: 87% Variable-load Senario: 30%

Source: Table developed by project staff, The University of Texas at Austin, 2017.

A cash flow analysis is one method to assess the financial feasibility of the project. Figure 3.5 illustrates the cash flow analysis based on the cost and revenue analysis. A cash flow is defined by the difference in cash available to the project at the beginning and at the end of the period. In the first year, the costs are mostly capital expenses, such as the costs associated with buying equipment. In that year, the initial investment expense makes up the bulk of the total costs, particularly to install the combined heat and power engine, a boiler, required electric transmission and equipment, and a heat exchanger. Between years 2 and 15, the cash flow shows a steady cost which comprises fuel, operating, and labor expenses. A disposal fee is included in the final year. Figure 3.4 illustrates these costs on the negative side of the y-axis. Revenues are assumed to be constant every year for the project's life cycle, based on selling all power generated to the island. Revenues are illustrated on the positive side of the y-axis in Figure 3.4.

The net present value (NPV) of the project can be computed from the difference between the present value of costs and revenues in the cash flow, or the cumulative profitability over time. A positive NPV indicates anticipated revenues exceed anticipated costs. NPV calculation depends on an assumed interest rate which represents the discounted value of a yen next year versus the value of a yen today. Table 3.5 compares the results of using three interest rate scenarios at 1 percent, 5 percent, and 10 percent for each of the two capacity factor scenarios. At 87 percent capacity factor, the three different discount rates produce positive NPVs. At a 30 percent capacity factor, the NPV is positive only at 1 percent and 5 percent discount rates. This means that in the variable-load scenario, the project is not profitable at a 10 percent discount rate.

Figure 3.4
Oki Power Plant Cash Flow Analysis – Baseload Scenario



Source: Illustration developed by project staff, 2017.

Table 3.5 below shows the calculations for the six different scenarios. The cells in grey are the headers for the net present values at the three interest rates. The cells in black show the net present value of the power plants for each of the six scenarios. For instance, point A illustrates the net present value of the power plant, running at an 87 percent capacity factor while the

Japanese interest rate is around 1 percent. Point B shows the net present value at a 30 percent capacity factor and assuming a discount rate of 10 percent.

Internal Rate of Return

Another method to assess project feasibility is to determine the internal rate of return (IRR) associated with the cash flow. The IRR is the discount rate that makes the net present value of the cash flows equal to zero. The higher the IRR, the more desirable it is to undertake the project.[12] Figure 3.5 shows that the IRR is the point at which the curve meets the axis, around 6.5 percent. This x-axis represents the interest rates at different net present values. This figure illustrates that the project is profitable if interest rates stay below 6.5 percent. For example, Figure 3.6 illustrates that since 1995 the Japanese government's public discount rate has been less than 1 percent.[13] As long as the project's IRR is greater than the public discount rate, the project is feasible and can be attractive to investors.

The biomass power plant is an economic investment in which revenue exceeds costs under diverse assumptions. From an economic perspective, it makes sense to construct the power plant even assuming different utilization factors (87% versus 30%). The cost, revenue, cash flow, and net present value (NPV) analysis show that feasibility decreases as public discount rate increases. The project's feasibility decreases as the capacity factor decreases. As this analysis purposely uses a simple model, results reliability could be enhanced if the analysis included estimates of some uncertain values, such as variable fuel cost, subsidies, variable feed-in-tariffs, or variable fuel availability. Such an analysis is beyond the scope of this study.

The maximum installation capacity is based on 23,000 tons/year of current available resources yielding a capacity of 2.185 MW. Of course, it is not a realistic assumption that all 23,000 tons/year will go to power generation on the Oki Islands. Based on the current resource availability in Table 3.2, the available amount of wood chips for local use is 2,250 tons/year. The exported wood chips could be used for local power generation instead of export, a comment made previously in a Chapter 2 analysis. In that scenario, the total amount of wood chips available becomes the combination of imported wood chips (2,250 tons), exported wood chips (2,250 tons), and wood chips used as export for pulpwood (10,125 tons). The sum of these amounts is 14,625 tons/year which is a more realistic assumption for wood biomass available for power generation. The analysis above assumed that 23,000 tons/year of biomass can fuel a power plant with 2.185 MW installation capacity. At the current available resources of 14,625 tons/year, a 3 MW power plant is too large because there is not enough wood biomass to burn.

Table 3.5
Power Plant NPV Calculations for Baseline and Variable Loads

Baseload: 87% Capacity Factor

2185kW (fuel: 23,000t/year)				1%	5%	10%
year	revenue	cost	Net Real Value	Net PV		
0	¥0.00	¥869,630,000.00	(¥869,630,000.00)	(¥869,630,000.00)	(¥869,630,000.00)	(¥869,630,000.00)
1	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥438,821,093.07	¥422,104,099.05	¥402,917,549.09
2	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥434,476,329.77	¥ 402,003,903.85	¥ 366,288,680.99
3	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥430,174,583.93	¥ 382,860,860.81	¥ 332,989,709.99
4	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥425,915,429.64	¥ 364,629,391.25	¥ 302,717,918.17
5	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥421,698,445.18	¥ 347,266,086.91	¥ 275,198,107.43
6	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥417,523,213.05	¥ 330,729,606.58	¥ 250,180,097.67
7	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥413,389,319.85	¥ 314,980,577.69	¥ 227,436,452.42
8	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥409,296,356.29	¥ 299,981,502.56	¥ 206,760,411.29
9	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥405,243,917.12	¥ 285,696,669.11	¥ 187,964,010.27
10	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥401,231,601.11	¥ 272,092,065.82	¥ 170,876,372.97
11	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥397,259,011.00	¥ 259,135,300.78	¥ 155,342,157.25
12	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥393,325,753.47	¥ 246,795,524.55	¥ 141,220,142.95
13	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥389,431,439.07	¥ 235,043,356.72	¥ 128,381,948.14
14	¥532,874,304.00	¥89,665,000.00	¥443,209,304.00	¥385,575,682.25	¥ 223,850,815.92	¥ 116,710,861.94
15	¥532,874,304.00	¥133,146,500.00	¥399,727,804.00	¥344,305,334.05	¥ 192,275,908.31	¥ 95,691,658.19
total	¥7,993,114,560.00	¥2,258,086,500.00	¥5,735,028,060.00	¥ 5,238,037,508.87	¥ 3,709,815,669.91	¥ 2,491,046,078.76

A

Variable Load: 30% Capacity Factor

2185kW (fuel: 23,000t/year)				1%	5%	7%	10%
year	revenue	cost	Net Real Value	Net PV			
0	¥0.00	¥869,630,000.00	(¥869,630,000.00)	(¥869,630,000.00)	(¥869,630,000.00)	(¥869,630,000.00)	(¥869,630,000.00)
1	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥93,153,227.72	¥89,604,533.33	¥87,929,682.24	¥85,531,600.00
2	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥92,230,918.54	¥ 85,337,650.79	¥82,177,273.12	¥ 77,756,000.00
3	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥91,317,741.13	¥ 81,273,953.14	¥76,801,189.84	¥ 70,687,272.73
4	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥90,413,605.08	¥ 77,403,764.89	¥71,776,812.93	¥ 64,261,157.02
5	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥89,518,420.87	¥ 73,717,871.33	¥67,081,133.58	¥ 58,419,233.66
6	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥88,632,099.87	¥ 70,207,496.50	¥62,692,648.21	¥ 53,108,394.24
7	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥87,754,554.32	¥ 66,864,282.38	¥58,591,260.01	¥ 48,280,358.40
8	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥86,885,697.35	¥ 63,680,268.94	¥54,758,186.92	¥ 43,891,234.91
9	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥86,025,442.92	¥ 60,647,875.18	¥51,175,875.63	¥ 39,901,122.64
10	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥85,173,705.86	¥ 57,759,881.12	¥47,827,921.15	¥ 36,273,747.86
11	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥84,330,401.84	¥ 55,009,410.59	¥44,698,991.73	¥ 32,976,134.41
12	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥83,495,447.37	¥ 52,389,914.85	¥41,774,758.62	¥ 29,978,304.01
13	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥82,668,759.77	¥ 49,895,157.00	¥39,041,830.49	¥ 27,253,003.65
14	¥183,749,760.00	¥89,665,000.00	¥94,084,760.00	¥81,850,257.20	¥ 47,519,197.14	¥36,487,692.04	¥ 24,775,457.86
15	¥183,749,760.00	¥133,146,500.00	¥50,603,260.00	¥43,587,091.43	¥ 24,341,033.28	¥18,340,950.17	¥ 12,114,018.12
total	¥2,756,246,400.00	¥2,258,086,500.00	¥498,159,900.00	¥ 397,407,371.27	¥ 86,022,290.45	-¥ 28,473,793.33	-¥ 164,422,960.50

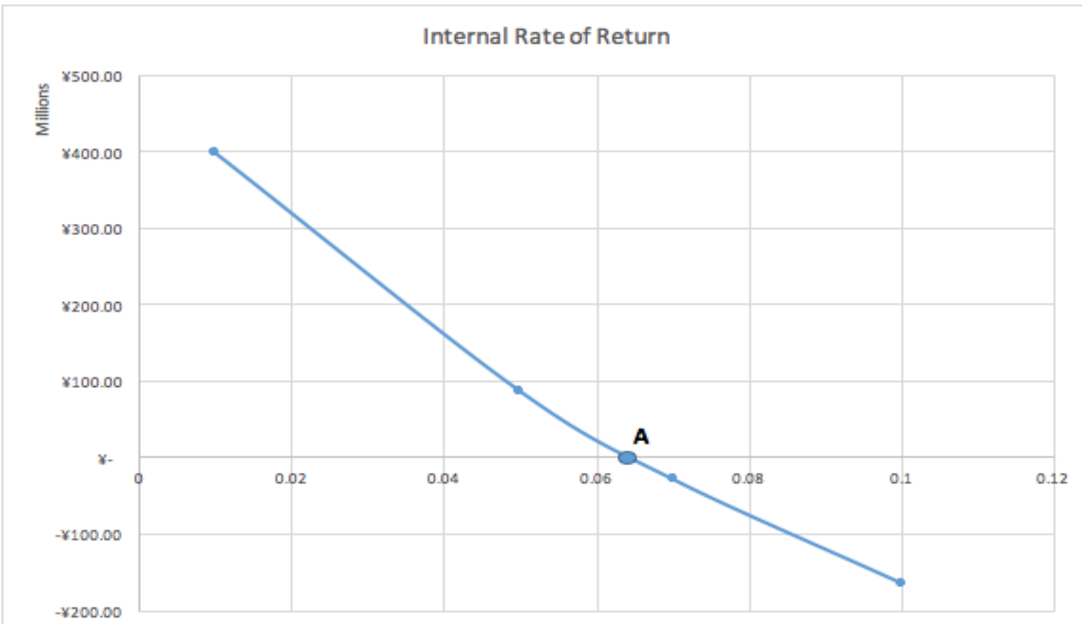
B

Source: Illustrations developed by project staff, The University of Texas at Austin, 2017.

Based on these analyses, the Oki government might want to consider a biomass power plant of around 1 MW or 2 MW capacity. The feasibility for that plant is expected to be lower since a lower capacity factor decreases the net present value due to lower economies of scale. It could be argued that Oki plans to increase its procurement of wood biomass in the future so that a higher amount of wood chips will be available for the power plant.

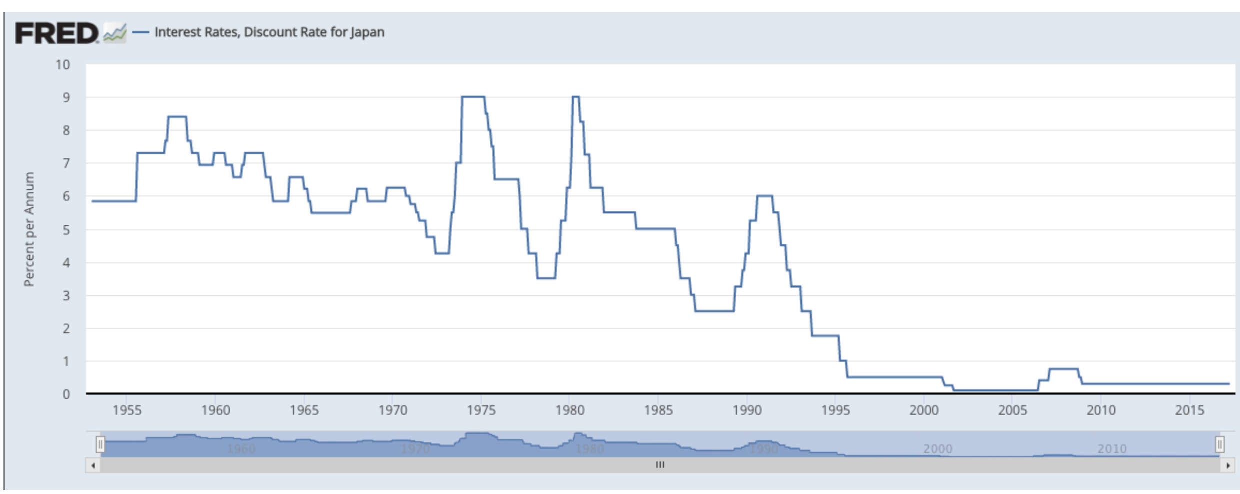
The next chapter discusses another form of power generation from wood chips: pellet stoves. The chapter is an evaluation of the subsidy program Oki runs that encourages more residents to own pellet stoves in hopes of creating a local market for the wood pellets produced from wood chips.

Figure 3.5
Power Plant Internal Rate of Return Calculation for 30% Capacity Factor



Source: Illustration developed by project staff, The University of Texas at Austin, 2017.

Figure 3.6
Japanese Public Discount Rates between 1955 and 2016



Source: "Interest Rates, Discount Rates for Japan," Economic Research Federal Reserve Bank of St. Louis, 2016, https://fred.stlouisfed.org/series/INTDSRJPM193N/.

[1]Unpublished materials provided to project staff, Island Staff, "Green Complex Wood Biomass Utilization Plan from Oki," received August 2017.
[2]Ibid.
[3]Ibid.
[4]Ibid.
[5]Ibid.
[6]Unpublished materials provided to project staff from Oki Island staff, "Effort of Okinoshima Town as a Whole," received August 2017.
[7]Ibid.
[8]"A Refresher on Net Present Value," Harvard Business Review, November 19, 2014, https://hbr.org/2014/11/a-refresher-on-net-present-value.
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[12]"A Refresher on Internal Rate of Return," Harvard Business Review, March 17, 2016, https://hbr.org/2016/03/a-refresher-on-internal-rate-of-return.
[13]"Interest Rates, Discount Rates for Japan," Economic Research Federal Reserve Bank of St. Louis, 2016, https://fred.stlouisfed.org/series/INTDSRJPM193N/.

Chapter 4: Pellet Stove Subsidies

The Dogo Island municipality currently provides direct cash subsidies to encourage residents to convert fuel oil, kerosene, wood, or electric home stoves to a pellet stove as part of the Green Complex (GC) project. The municipal government provides a financial subsidy of 300,000 yen to ten customers a year to pay for up to two-thirds of the costs of installing a pellet stove for an individual entity, such as a household or business.[1] Governments in Japan can provide different forms of intervention to encourage a household to switch to renewable forms of energy (see Table 4.1). A direct subsidy is a payment of cash; the cash can be in the form of a grant to a family or business. The municipality could also provide an indirect subsidy, such as a tax credit or government assumption of risk (e.g. loan guarantees), which can support either a household or business. The municipality could create a financial penalty as a disincentive to nonrenewable energy sources, which can encourage adoption of alternative forms of energy. Examples of disincentives include increased taxes, penalties, or fees for petroleum consumption. The municipality could impose direct user fees or taxes as subsidies, such as local revenue bonds. Dogo has chosen to administer direct cash subsidies rather than alternative forms of subsidies.

Table 4.1
Options for Japanese Government Subsidies

Direct Subsidies	Cash subsidies (grants)
	Stock purchases (higher value of stock)
Indirect Subsidies	Tax concessions (tax credits)
	Assumption of risk (loan guarantees)
Non-subsidies	Taxes and penalties for non-compliance (carbon tax)
	Revenue bonds (tobacco bonds)

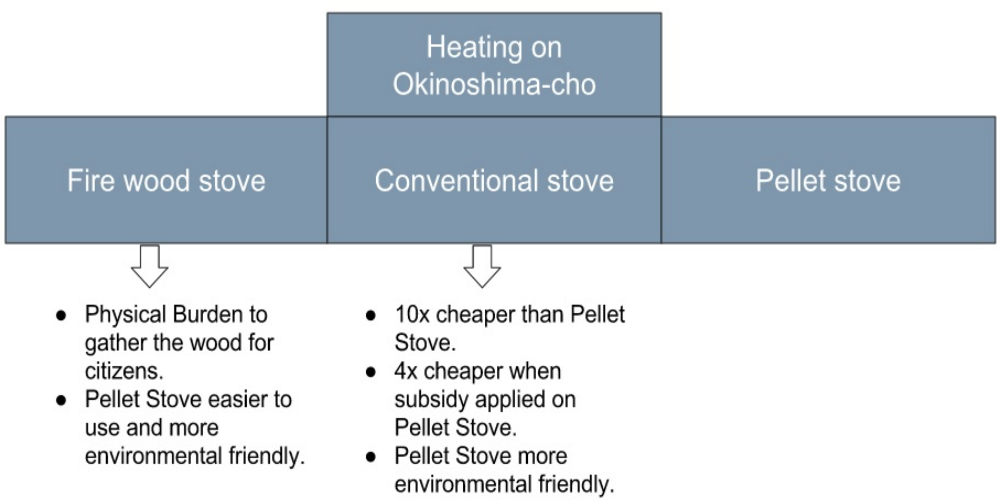
Source: Ivetta Gerasimchuk, Peter Wooders, Laura Merrill, Lourdes Sanchez, Lucy Kitson, “A Guidebook to Reviews of Fossil Fuel Subsidies: From Self-Reports to Peer Learning,” International Institute for Sustainable Development (2017): http://www.iisd.org/sites/default/files/publications/guidebook-reviews-fossil-fuels-subsidies.pdf.

According to Dogo Island municipal authorities, the major home heating options include conventional stoves (electric or gas fueled) or firewood stoves. Conventional stoves tend to be fueled by petroleum products rather than electricity, producing more air pollution. Conventional stoves are cheaper than pellet stoves; purchasing a conventional stove is one-tenth the cost of a pellet stove and four times cheaper even after a subsidy.[2] A wood pellet stove can be easier to use than a firewood stove because customers use small pellets versus logs that must be cut and moved; pellets involve a smaller physical burden, particularly for elderly residents. Wood pellet stoves not only allow households accustomed to firewood stoves to maintain independence from electric stoves but also represent a more environmentally-friendly alternative (see Figure 4.1).[3]

Figure 4.2 assesses some strengths, weaknesses, opportunities, and threats associated with the Dogo Island pellet stove subsidy. Pellet stoves have some advantages over conventional stoves and wood stoves currently used on the island, as they may be more environmentally friendly, operate at higher energy use efficiency, and can be serviced more easily. Pellet stoves have some comparative weaknesses: they have a higher per unit cost to operate relative to other heating technologies, and they may be more difficult to maintain. These weaknesses undermine the public's attraction for pellet stoves.

We found two case studies, one in Germany and the other in Japan, that compare pellet stoves with other stove alternatives. Germany's strong forestry industry produces large numbers of pellet stoves and wood pellets. Pellet installations in Germany between 2008 until the end of 2011 grew to 50,000 installations after the implementation of a subsidy. In 2010, the share of biomass heat generator sales was only 3.1 percent versus the overall sales volume of other heat generators (oil and gas heat generators, heat pumps, and other biomass). The sales of pellet stoves were below expectations as other heating and energy generation options remained more popular. The main lesson from the German study is that subsidies alone do not provide a sufficient incentive to motivate people to adopt pellet stoves, particularly if more attractive alternatives compete.[4]

Figure 4.1
Comparison of Current Heating Options Available on Dogo Island



Source: Illustration developed by project staff, based on unpublished interview with an Oki, municipal officer, Dogo Island, August 24, 2017, and on unpublished information provided by Oki staff.

Figure 4.2
SWOT Analysis of Pellet Stove Subsidy

Source: Illustration developed by project staff, based on unpublished interview with municipal officer, Dogo Island, August 24, 2017.

Hamamatsu City, Japan, operates a successful subsidy program for the adoption of pellet stoves. Its government subsidy covers less than 30 percent of the costs of a pellet stove, with a maximum expense of a 50,000 yen per stove substitution. Even with such a modest cost subsidy, the sales volume of wood pellets grew from 27,870 kilograms to 112,963 kilograms from 2005 to 2011.[5] Growth in wood pellet sales reflected the increased number of devices using pellets as fuel for heating households and businesses.[6] One difference between Dogo Island and Hamamatsu is the intensity of public involvement. The Hamamatsu government promotes its wood pellet subsidy with brochures and a guidebook developed in cooperation with students at the Hamamatsu School of Design.[7]

On Dogo Island, a typical pellet stove will cost 500,000 yen, which includes 300,000 yen for the pellet stove itself and 200,000 yen for installation.[8] The municipality offers a 15-year subsidy covering 60 percent of the expenses or up to 300,000 yen. The subsidy targets residents, organizations or corporations having an address in the Oki Islands. However, Dogo has a limited budget that can subsidize only ten entities per year. The process to apply for the subsidy involves submitting forms to the Agriculture, Forestry, and Fisheries Division on the Oki Islands.[9]

One barrier to the use of subsidies is an overly complex application process. For example, applicants are required to identify a construction company for the installation of the stove on the current municipality website. If the municipality could identify a set of construction companies willing to install the stoves at a standard or even discounted price, such public-private cooperation could save money and assure quality.

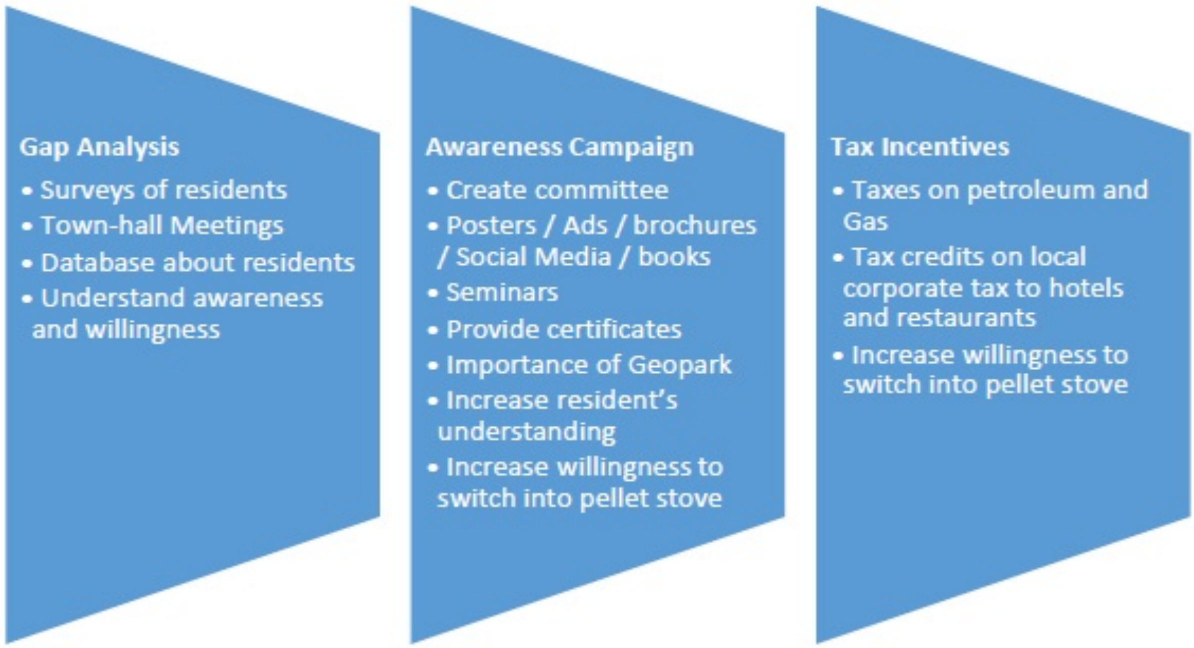
A second barrier to the success of the subsidy program is its small size; the municipality budget subsidizes only ten stove substitutions per year, which will have a negligible consequence on the pattern of home heating on Dogo Island. The current subsidy program does not ask users to do anything for a subsidy. The city could pair the subsidy with monitoring and evaluation; any entity offered a subsidy could be required to evaluate pellet stove use. If customers were to share useful data with the municipality, the process would generate evidence on the reliability of pellet stove use. If pellet stoves are efficient and satisfactory, then the evidence can be used to motivate more residents to use pellet stoves and encourage investment. If stove performance is problematic and shows pellet stoves are inefficient, then the municipality could end the subsidy and invest money in other initiatives. A gap analysis revealed that the municipality has never collected data and information on customer stove preferences. If the municipality were to conduct a survey of Dogo Island residents to determine their needs and demands, they might focus outreach more effectively. For example, the municipality could hold town hall meetings to understand local household heating needs.

The Hamamatsu City case study illustrates the value of an awareness campaign. Based on the low level of public interest in pellet stoves on Dogo Island, a subsidy alone may not be enough, so an awareness campaign could help encourage the adoption of pellet stoves. The Oki municipality could create a committee to publicize benefits of pellet stoves by creating posters, brochures, social media pages, and books as well by organizing seminars to promote forestry and biomass energy. The municipality could also provide certificates for businesses, including hotels and restaurants, if they choose to burn biomass. Tax incentives and penalties could encourage also residents on Dogo Island to switch to biomass energy technologies. Local authorities could tax petroleum and gas while providing tax credits to local businesses that use pellet stoves and boilers.

The pellet stove subsidy is based on two assumptions. If prices are competitive, more residents ought to prefer pellet stoves to other heating systems. If more residents were to use pellet stoves, heating costs would fall. More users of pellet stoves would create a market niche, increasing demand for pellets and reducing costs. A larger number of users could potentially create an opportunity for vendors to innovate, increase efficiency, and lower costs. Greater efficiency and lower costs could convince more residents to install pellet stoves instead of other heating systems.

In summary, even with such a large subsidy, the public appears to be unaware of the Dogo subsidy program.[10] One factor is the lack of transparency in prices. For example, if the municipality could preapprove vendors willing to install pellet stoves for a fixed price with guaranteed quality and reliability, customers would face less uncertainties. If the municipality were to require the subsidy recipient to monitor and report the performance of the pellet stove, including its performance as a heating utility to the customer's satisfaction, new customers could have more information about the stove's reliability.

Figure 4.3
Additional Programs for Promoting Pellet Stoves



Source: Illustration developed by Ghida Ismail, Demetrius Martinez, Mohammad Awad Hajjaj, Kentaro Yoshioka, and Yoshinori Onishi.

If the municipality were to conduct a survey of Dogo Island residents to determine their potential needs for replacement of home heating, there might be less uncertainty as to whether there is demand for the subsidy. If the municipality were to launch a public relations campaign to encourage the replacement of oil and electric fueled stoves with pellet stoves, more residents or organizations might become interested in pellet stoves. A tax incentive could encourage some users to switch to pellet stoves.

[1]Unpublished interview, municipal officer, Dogo Island, August 24, 2017.
[2]Bertha Maya Sopha and Geir Skjevrak, "Wood-Pellet Heating in Norway: Early Adopters' Satisfaction and Problems That Have Been Experienced," *Sustainability* 4, no. 6 (May 1, 2012): 1089–1103.
[3]"Compare 2018 Gas Fireplace vs Pellet Stove Average Costs - Pros versus Cons," KompareIt, accessed February 6, 2018, https://www.kompareit.com/homeandgarden/hvac-compare-gas-fireplace-vs-pellet-stove.html.
[4]"Pellet Stoves in Germany 2016: Barriers and Opportunities," Biomass Energy German Biofuel Portal, 2016, accessed August 24, 2017, http://biomassa.de/news-pellet-stoves-in-germany-2016-barriers-and-opport-32.html.
[5]"Use of Wood Pellets in Japan/Asia Biomass Energy Cooperation Promotion Office - Asia Biomass Office," February 3, 2015, https://www.asiabiomass.jp/english/topics/1309_02.html.
[6]"浜松市，天竜の森×デザインプロジェクト," "Pellet Stoves Purchase Subsidy," accessed August 2017, https://www.city.hamamatsu.shizuoka.jp/sangyo/shinko/nogyo/nogyo/pellet/jouseikin.html.
[7]Ibid.

[8]Unpublished interview, municipal officer, Dogo Island, August 24, 2017.
[9]Oki Islands-cho official webpage about subsidy translated into English, Oki Islands Municipality, accessed August 24, 2017.
[10]Unpublished materials provided to project staff, "Community Survey Questionnaire for Oki Islands," received August 24, 2017. See Chapter 7.

Chapter 5: Other Options for Economic Revitalization

This chapter presents some innovative investments beyond forestry that can contribute to the Oki Islands' economic revitalization. One section of this chapter describes Dogo Island tourism and provides recommendations for increasing tourism. A second section examines the feasibility of creating new industries around non-forestry resources available on Dogo. A third section explores the possibility of creating a forestry research center on Dogo which could incubate new biomass-based products and technologies. A fourth section discusses the potential for Dogo to increase its resident population by leveraging its natural characteristics to attract telecommuters.

Dogo Island Tourism

Dogo Island has many features that ought to make it an attractive tourist destination. Its diverse topography (mountains, rivers, forests, and beaches) makes it a destination for outdoor activities ranging from hiking and biking to kayaking and scuba diving. The islands have been designated as a UNESCO Global Geopark in recognition of their natural beauty and unique geological history. Dogo is considered a sacred island and is home to many monuments and shrines. Festivals such as the New Year's Bull Sumo Tournament attract visitors.

The decrease in Dogo's resident population, as well as a decline in business activity and transit options between Dogo and the Japanese mainland, have contributed to the tourism decline. During the last four decades, tour groups consisting primarily of older travelers made up a large portion of tourist visits to Dogo.[1] Decreasing international airfares have made travel abroad from Japan comparatively more affordable, leading to a sharp decline in the popularity of tour group trips to locations all over Japan, including Dogo.[2] Though the Oki Islands Tourism Association has promoted Dogo tourism, there are opportunities to improve tourism promotion and branding, as listed in Table 5.1.

Public awareness within Japan of the Oki Islands as a desirable tourist destination is low. [3] Marketing efforts by tourism offices on each of the four inhabited islands have been somewhat uncoordinated over the last several years.[4] Although general information about all four inhabited islands (Dogo, Nishinoshima, Nakanoshima, and Chiburijima) is available on the Oki Islands Tourism Association website (http://www.travel-oki-islands.net), more detailed information for each island is provided on four separate web pages. Information about Nishinoshima is available in both Japanese and English. Information about Dogo, Nakanoshima, and Chiburijima is available in Japanese only. The Nishinoshima tourism office alone employs staff fluent in English.[5]

Transportation options on Dogo include taxis, rental cars, public buses, bicycles for rent, and foot travel. While taxis and rental cars are a fast and convenient way to get around, the local prices are too high for some visitors.[6] Dogo's public buses are less costly, but service is infrequent. Bus schedules are available in Japanese only and can be found solely at the Dogo tourism office. The only bicycle rental station is located at the tourism office.[7]

Table 5.1
Recommendations for Improving Oki Tourism

Goal	Recommendation
Increase tourist awareness	• Coordinate islands' tourism marketing, websites, and social media presence • Provide information in English as well as Japanese online and employ English-speaking staff at tourism offices • Increase marketing via social media (Facebook, Line, Twitter, Instagram, etc.)
Reduce travel cost	• Subsidize cost of ferry travel via an increased hotel or other tax
Improve transportation on Dogo	• Increase bus route frequency • Publish bus schedule online in Japanese and English • Encourage use of ride-sharing platforms
Increase Dogo entertainment	• Encourage development of entertainment venues (restaurants, bars, and clubs) that stay open late
Reduce hotel costs	• Encourage development of hotels that cater to budget– and middle-income visitors

Source: Table developed by project staff, 2017.

Dogo offers a variety of restaurants and bars, although the majority do not stay open well into the evening. Of the nine featured dining venues on the Oki Islands Tourism Association website, only two operate after 8:00 p.m.[8] Most of these restaurants and bars offer menus in Japanese only.[9] Dogo offers numerous accommodations, the majority of which are too expensive for budget travelers.[10]

One example of how to enhance tourism through marketing and branding comes from Costa Rica. An American country located between Nicaragua and Panama and bordered on the east by the Caribbean Sea and on the west by the Pacific Ocean, Costa Rica has a population of about five million and a land area of about 50,000 square kilometers. Costa Rica has many natural features that make it an attractive tourist destination. Over 50 percent of Costa Rica's land area is forested. Numerous beaches lie along its 1290 kilometers of coastline. It is home to a wide variety of flora and fauna: although it comprises just 0.03 percent of the world's landmass, it contains 5 percent of the world's biodiversity.[11] Over the last 30 years, Costa Rica has leveraged its natural environment to build a thriving tourism industry. Ecotourism (tourism where visitors put an emphasis on visiting unspoiled natural places and on disturbing the natural environment as little as possible) has been a key driver of tourism; the number of annual visitors has grown from

329,000 annual visitors in 1988 to 2.66 million in 2015.[12] Though Costa Rica's natural endowments are the anchor of its tourist industry, joint government and private initiatives have been instrumental to its continued success. Table 5.2 describes four of these initiatives: protection of natural areas, tourism promotion, availability of adventure activities, and certification for sustainability.

Table 5.2
Factors Contributing to Costa Rica's Tourism Success

Protected Natural Areas Approximately one quarter of Costa Rica's land area is protected, either in national parks or other (mostly privately owned) protected land areas. In addition to protecting biodiversity, these protected areas are a major draw for tourists. A 2005 survey showed that over 60 percent of tourists visited national parks.[13]	**Tourism Promotion** The Costa Rican government began to heavily invest in tourism in the 1980s. It increased funding for its tourism industry, the Costa Rican Tourism Institute (ICT), by raising hotel room and airline ticket taxes. It passed legislation that provided incentives for hotels, travel agencies, and transportation companies.[14]
Certification for Sustainable Tourism Costa Rica developed a Certification for Sustainable Tourism (CST) in the mid-1990s to certify hotels' interaction with natural and cultural resources, influence on the quality of life within local communities, and economic contribution to national development. The CST program has encouraged development of eco lodges[15] to provide environmentally friendly accommodation. These are typically built using sustainable materials and often powered by renewable power sources, such as wind and solar. Proceeds from eco lodges are often used to fund environmental preservation and education.	**Adventure Activities** A wide range of adventure activities has helped to draw visitors. Zip lining, mountain biking, bungee jumping, and periodically held endurance races are among them. According to the Costa Rican Tourism Board, more than 50 percent of all visitors now come for adventure activities.[16]

Sources: See references in Table 5.2.

Forestry Certification and Forestry Research

The abundance and quality of forest cover on the Oki Islands provides natural resources for developing a wide range of wood products. Forest certification represents one path to increase the value of these products, while also enhancing environmental protection and sustainability. Forest certification is a tool for forest monitoring as well as labeling and tracking wood, pulp products, timber, and non-timber forest products while also considering metrics of economic and social well-being. Forest certification can occur under a framework of forest so-called best management practices, as developed by a variety of international forestry organizations, including the Forest Stewardship Council (FSC), regarded as the most rigorous forest certification organization by the World Wide Fund for Nature (WWF).[17] In many nations, forest certification confers two key economic benefits: higher prices for goods sourced from certified areas and greater access to markets for those goods. Higher prices can be obtained because consumers place value on the sustainable management of forests and the ethical treatment of workers. Market access may be increased because some governments and companies prefer forest certified products. For example, the Green Building Council's LEED program in the US provides incentives for using certified materials.[18]

To take advantage of Dogo's abundant forests and natural beauty and Shimane Prefecture's commitment to developing biomass-based industries, Dogo could serve as a suitable location for a forestry and forest resources research center. The Forest Products Laboratory (FPL), a national research laboratory of the United States Forest Service, serves as a model. The FPL conducts research in many areas relevant to Dogo, including finding uses for underutilized wood biomass, converting wood to useful chemicals, developing wood composites, biotechnology, and more. The FPL provides technical support to manufacturing, marketing, and recycling for wood-based products.[19] The FPL's goal of contributing to "conservation and productivity of the forest resource, thereby sustaining forests, the economy, and quality of life"[20] aligns well with the overall objective of the Green Complex (GC) project. The Forest Products laboratory has contributed to breakthroughs that have benefited society at large, such as advances in conserving forest resources and improvements in construction materials, recycling, and packaging.[21] A forest products research and education center on Dogo could bring members of government, industry, and academia together to develop new wood-based products and technologies. It could involve local community members, including students, in the GC project by providing a center for forestry education. A forest products research and education center (similar to the FPL) could attract leading researchers, entrepreneurs, and business people from all over Japan to Dogo and increase the number of permanent residents.

Akiya (Abandoned Homes) Opportunities

Japan has a decreasing population. Even as major cities continue to see population growth and high housing prices, rural areas as close as 10 miles away from urban centers are experiencing a growing problem of abandoned homes (Akiya).[22] The issue of abandoned homes reflects a severe shortage of home buyers in nonurban areas. Homeowners either do not want to or cannot maintain their property given a low likelihood of selling the property. This results in a blight of dilapidated homes in exurban and rural areas. Dilapidated buildings can pose fire hazards, attract vagabonds, squatters, and vermin and reduce the value of nearby properties.

Japanese tax policy levies a 600 percent multiplier to property taxes on undeveloped land.[23] If a parcel of residentially zoned land does not have a home on it, then the multiplier is applied. Thus, there is a strong incentive to build new homes, even if there is not sufficient demand. Once a home is built, there is no incentive to tear it down, even if it will never be sold and is no longer suitable for human habitation.

In 2015, Japan passed the "Special measures for promoting measures such as vacancies" law.[24] This law makes it easier for municipalities to address the issue of abandoned homes by allowing them to require the owner of an abandoned home to either maintain the property or demolish it. If no living inheritor to the property can be found, then the municipality may take possession of the dwelling and any attached land, subsequent to adequate notice through several measures.[25]

Many municipalities have created inventive uses for abandoned properties. Some have sold vacant land to new residents at a steep discount to encourage immigration. Other communities have converted buildings into community centers, office spaces, daycare centers, or eldercare facilities. Of particular use to the Oki District might be the conversion of abandoned periphery homes into state-managed forestland to support the GC project.

Oki could use Japan's new Akiya law to generate new revenues and attract residents to the Oki Islands. There is a disparity between living costs in Japan's developed cities and Oki. Due to the number of abandoned homes on the Oki Islands, it might be possible to reclaim large enough plots to create large blocks of land which can be used as incentives for medium-sized businesses on which to build a campus or data center. Large eldercare facilities might find the Oki Islands an attractive option for new facilities. People who work exclusively via the Internet could also be attracted with such incentives.

Educational Reform

Oki is facing a depressing picture of rural depopulation and youth emigration.[26] Although this existential problem is threatening communities across the length and breadth of the archipelago, there are some positive examples of towns and villages that have bucked the trend by challenging the status quo. These towns can offer lessons to other small communities struggling to staunch the flow of young people to mainland cities.

The town of Ama offers an example. Ama (population 2,363), which covers the whole of Nakanoshima, is one of the Oki Islands off the coast of Shimane Prefecture.[27] Nakanoshima is one of three small islands that form the Dozen group, which is dwarfed by the neighboring island of Dogo. Together, Dogo and the Dozen make up the Oki Islands.[28] Centuries ago, members of the Japanese royal family banished from court were exiled to Dozen.[29] The islands are not fully self-sufficient, so islanders often had to rely on their own ingenuity as well as the Dozen's rich natural resources to survive. In the past few decades, migration to the mainland and a low birth rate have reduced the island's population. Prior to 2007, the local economy of Ama grappled with a huge budget deficit. The prefectural government considered closing the local high school because of low enrollment.[30]

Ama set up the Miryokuka Project to coordinate ongoing efforts to restructure its economy and education system.[31] The project's priorities were to stabilize the student population and improve the quality of high school instruction. In 2007 and 2008, Ama staff conducted meetings with local residents to increase awareness of the school's dire situation and to raise support.[32] Parents were urged to send their children to the school. Requests were made to the prefectural board of education to allocate more teachers to Ama. Before the request, the number of teaching and nonteaching staff had dropped from 27 to 18 in three years.[33] Since 2008, staff numbers have rebounded to 33.[34] Courses such as regional studies (*chiiki-gaku*) and career planning (*yume-tankyū*) were added to the curriculum, thanks to the efforts of You Iwamoto, head of the Miryokuka team.

The Oki Dozen Learning Center (the Center) was established up to complement the school's efforts to prepare students for national exams and future careers. Students are presented with problems facing the Dozen. Staff work with students to identify creative, feasible solutions to such problems.[35] The staff at the center, including the director, Shogo Toyota, envisages that such efforts may lead to students choosing careers that benefit the island's sustainability. The Center organizes weekly career seminars for students dubbed *yume zemi*, or "dream seminars." The Center's staff guides students to achieve short– and medium-term goals, such as gaining admission to a good university or training college, working in internships or jobs, and seeking employment and overseas volunteer opportunities.

The town's mayor, Michio Yamauchi, spearheaded administrative and fiscal reforms in 2007 (the Miryokuka Project) that resulted in a turnaround in the town's finances from a deficit to a surplus.[36] Leading by example in his pursuit of fiscal discipline, the mayor cut his salary in half.[37] Other executives and town hall workers cut their salaries by various degrees, with lower-income earners cutting their salaries by smaller percentages than high earners.[38] The citizenry joined in, forgoing subsidies for local transportation. Dozen staff studied the feasibility of establishing businesses that would utilize local resources, which has resulted in a few public-private partnership ventures, such as a sea cucumber (*namako*) processing factory. The partnership involves a lease of the building and equipment by the town hall; the private sector provides technical expertise and managerial competence for an "I-turn." (Loosely defined, an I-turn is a worker on the island whose hometown is on the mainland. A person who originated from the islands and has returned to work there is known as a "U-turn.") According to manager Masaya Miyazaki, the factory exports a significant portion of its products to China.[39]

Ama town's administrative, fiscal, and educational reforms have caught the attention of Japanese educators, academics, politicians, and the media.[40] Both developed and developing countries struggle to sustain rural life due to rural-urban migration, aging populations, the side effects of outsourced production, poor or deteriorating infrastructure, and, most commonly, a central government that does not invest in rural development. Ama's experience could serve as a template for facilitating new urban-rural migration. Partnerships like that between the town hall and factory manager could be forged to bring in "I-turns" able to make use of local resources.[41] Such efforts can create employment, make the community more self-reliant and arrest—and possibly even reverse—rural-urban migration. National and local governments counting on austerity measures to help revive their economies may find it helpful to study the success of fiscal reforms in Ama. Educational reforms in Ama can be replicated in other communities irrespective of their level of development. These ideas include creating courses that raise students' awareness of local resources and how these can be utilized in business; organizing career guidance classes and seminars running a local learning center or cram school.

Sustainable island or rural development is not the sole responsibility of national or regional governments. Ama is demonstrating that a sustainable future can be achieved when a community defines development goals and pursues them wholeheartedly by using local resources and partnerships.[42] Ama is an example of how the Oki Islands could rely on their natural human resources to improve their economic resources and their way of life.

[1]Unpublished materials provided to project staff, Nishinoshima Tourism Office employee, received August 2017.
[2]Ibid.
[3]Ibid.
[4]Ibid.
[5]Ibid.
[6]Observation of study participants during Oki Islands onsite training, August 21–25, 2017.
[7]"Welcome to the Oki Islands!" Oki Islands Tourism Association, accessed November 20, 2017, http://www.travel-oki-islands.net/index.html.
[8]"Dogo Island," Oki Islands Tourism Association, accessed November 20, 2017, http://www.travel-oki-islands.net/index.html.
[9]Observation of study participants during Oki Islands onsite training, August 21–25, 2017.
[10]Ibid.
[11]Martha Honey, *Ecotourism and Sustainable Development: Who Owns Paradise?* Second Edition (Washington, DC: Island Press, 2008).
[12]"Informes Estadísticos," Instituto Costarricense de Turismo, accessed November 20, 2017, http://www.ict.go.cr/es/estadisticas/informes-estadisticos.html.
[13]Martha Honey, *Ecotourism and Sustainable Development: Who Owns Paradise?* Second Edition (Washington, DC: Island Press, 2008).
[14]Ibid.
[15]Ibid.
[16]Sergio Arce, "Ecoturismo y turismo médico, otros 'clusters'," *La Nacion*, 2011.
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[18]"Building Product Disclosure and Optimization - Sourcing of Raw Materials," Leadership in Energy and Environmental Design, accessed November 30, 2017, https://www.usgbc.org/credits/new-construction-core-and-shell-schools-new-construction-retail-new-construction-healthca-23/.
[19]"FPL's Mission and Strategic Plan," Forest Products Laboratory, 2010, accessed November 30, 2017, https://www.fpl.fs.fed.us/research/research_emphasis_areas/.
[20]Ibid.
[21]"Fast Facts," Forest Products Laboratory, accessed November 25, 2017, https://www.fpl.fs.fed.us/about/index.shtml.
[22]Phillip Brasor and Masako Tsubuku, "Abandoned Buildings Still House Problems," The Japan Times, accessed November 22, 2017, https://www.japantimes.co.jp/community/2016/12/03/how-tos/abandoned-buildings-still-house-problems/.
[23]Miki Seko and Kazuto Sumita, "Effects of Government Policies on Residential Mobility in Japan: Income Tax Deduction System and the Rental Act," *Journal of Housing Economics*, Special Issue on Macroeconomics and Housing 16, no. 2 (June 1, 2007): 167–188, https://doi.org/10.1016/j.jhe.2007.06.001.
[24]"Special Measures for Promoting Measures such as Vacancies," accessed November 22, 2017, http://www.shugiin.go.jp/internet/itdb_gian.nsf/html/gian/honbun/houan/g18701011.htm/.
[25]Unpublished materials provided to project staff, "Oki Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received 2015.
[26]Imazato Santoshi, "Under Two Globalizations: Progress in Social and Cultural Geography of Japanese Rural Areas," accessed November 23, 2017, https://www.jstage.jst.go.jp/article/grj2002/81/5/81_5_323/_pdf.
[27]"Pursuing Local Economy and Well-Being in Ama Town, Shimane Prefecture," Japan For Sustainability, April 30, 2014, accessed November 11, 2017, https://www.japanfs.org/en/news/archives/news_id034869.html.
[28]Ibid.
[29]Kase Hideaki, "The Greater East Asian War: How Japan Changed the World," accessed December 1, 2017, http://www.sdh-fact.com/book-article/652/.
[30]"Pursuing Local Economy and Well-Being in Ama Town, Shimane Prefecture," Japan For Sustainability, April 30, 2014, accessed November 11, 2017, https://www.japanfs.org/en/news/archives/news_id034869.html.

[31]Joseph Quarshie, "Improving the Quality of High School Education in Rural Japan: The Case of Oki Dozen High School Miryokuka Project," accessed November 1, 2017, http://www.apu.ac.jp/rcaps/uploads/fckeditor/Conference/2014APConferencePictures/All_APC_Abstracts.pdf.
[32]Unpublished email provided to project staff, You Iwamoto, "Miryokuka Project Questions for Graduate School Research," received October 31, 2017.
[33]Ibid.
[34]Ibid.
[35]Joseph Quarshie, "Improving the Quality of High School Education in Rural Japan: The Case of Oki Dozen High School Miryokuka Project," accessed November 1, 2017, http://www.apu.ac.jp/rcaps/uploads/fckeditor/Conference/2014APConferencePictures/All_APC_Abstracts.pdf.
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[37]Ibid.
[38]Joseph Quarshie, "Improving the Quality of High School Education in Rural Japan: The Case of Oki Dozen High School Miryokuka Project," accessed November 1, 2017, http://www.apu.ac.jp/rcaps/uploads/fckeditor/Conference/2014APConferencePictures/All_APC_Abstracts.pdf.
[39]Ibid.
[40]"Pursuing Local Economy and Well-Being in Ama Town, Shimane Prefecture," Japan For Sustainability, April 30, 2014, accessed November 11, 2017, https://www.japanfs.org/en/news/archives/news_id034869.html.
[41]Unpublished email provided to project staff, You Iwamoto, "Miryokuka Project Questions for Graduate School Research," received October 31, 2017.
[42]Imazato Santoshi, "Under Two Globalizations: Progress in Social and Cultural Geography of Japanese Rural Areas," accessed November 23, 2017, https://www.jstage.jst.go.jp/article/grj2002/81/5/81_5_323/_pdf.

Chapter 6: Economic Impact

An Oki investment in either biomass industries or tourism would affect its economy. This chapter estimates the economic consequences of investment in both sectors using a method called "input-output analysis." The analysis is based on other sectors such as Impacts for Planning (IMPLAN)[1] software that can estimate how changes in demand in one economic sector, such as forestry or hotels and restaurants, influence other sectors and the regional economy.

Input-output[2] models estimate three types of economic effect: direct, indirect, and induced. Increasing the demand and production of biomass on the Oki Islands has direct effects on other coefficients in the rest of the local economy. For example, any yen of investment in forestry directly produces employment and improves facilities. Each yen of investment in one industry also creates indirect effects; an added yen in biomass production creates investment in industries that provide inputs into biomass, such as chemical products, equipment, transportation, electricity, and gas (see Table 6.2). Each investment in forestry or tourism also creates so-called induced effects, such as the hiring of new employees and their spending. The input-output model estimates the total economic impact by combining direct, indirect, and induced effects.

This analysis is based on a pre-developed input-output model of the Japanese national economy for the year 2011. The software was provided to project staff by the firm that owns IMPLAN software.[3] A national Japan model (versus one for the region) is not ideal, but there is no local model or data for the Oki Islands or Shimane Prefecture. For the purpose of the report, a required assumption is that the Oki Islands economy will mimic the behavior of the national Japanese economy and that data from Japan's 2011 economic patterns are appropriate for use in 2017. This approach allows us to use Japanese national input-output model coefficients for a local case study and 2011 coefficients in a 2017 application.

The revitalization of Oki biomass industries will increase biomass production, earnings, and employment. As the biomass industry requires input from other industries, any forest investments enhance activities of other industries. There are two steps in the economic impact of the investment in the biomass industries, one step is identification of the additional demand in the forestry sector generated by the wood biomass utilization facilities using IMPLAN to estimate changes to Oki's economy. The analysis assumes the implementation of Oki Islands Wood Biomass Utilization Plan of the Green Complex (GC) project.[4] The plan includes new forest resources logging, wood chip utilization, charcoal production, and cellulose/lignin separation and utilization. Table 6.1 lists the total revenue from the investment.

Table 6.1
Yearly Revenue Summary

Category	Total Revenue (million yen)
Forest resources logging	11.74
Cellulose/lignin separation and utilization	452.6
Wood chip utilization	71.95
Total	536.14

Source: Unpublished materials provided to project staff, "Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received August 2017.

The total incremental revenue is an additional 536.14 million yen yearly to the forestry sector. This sum represents the direct impacts of wood biomass production. To estimate the change on the total Oki Islands economy, IMPLAN allows a user to estimate the marginal economic effects on other economic sectors. Multipliers can be used to estimate the regional economy-wide effects from the biomass sector investment. Table 6.2 lists the direct, indirect, plus induced economic changes based on direct economic change. IMPLAN's Type SAM (Social Accounting Matrix) multiplier is 1.82, which means that a one-million-yen direct increase in the revenue of the wood biomass production can generate 1.82 million yen in total economic activity in Oki. The indirect and induced multipliers, 0.53 and 0.29 respectively, reveal that an initial increase of 1 million yen in the revenues of wood biomass produces an indirect economic impact valued at 530,000 yen, and an induced economic impact of 290,000 yen.

An investment in the Oki Islands tourism sector would directly affect hotels and restaurants. As hotels and restaurants require input from other industries. A yen invested in tourism generates construction and requires energy. To compare on a consistent basis investment in biomass versus tourism it is appropriate to assume that more new investments in the hotel and restaurant sector would be equal to investment in new biomass: 536.14 million yen. The Type SAM multiplier for Hotels and Restaurants in Table 6.2 is 1.79, which means that a one-million-yen direct increase in the revenue of hotels and restaurants production can generate 1.79 million yen in total economic activity on the Oki Islands. The indirect and induced multipliers, 0.52 and 0.28 respectively, reveal that an initial increase of one million yen in the revenues of hotels and restaurants produces an indirect economic impact valued at 520,000 yen, and an induced economic impact of 280,000 yen. The IMPLAN software estimates an approximate yearly increase of 959.69 million yen in total economic activity on the Oki Islands, which includes an indirect economic impact of 278.79 million yen and induced impacts valued at 150.12 million yen. Investing in the biomass industry yields more benefits than an equal investment in the tourism sector: 1.67 percent more in total in credential economic activity.

Table 6.2
IMPLAN Results

Description	Direct Effects	Indirect Effects	Induced Effects	Total	Type I Multiplier	Type SAM Multiplier
Agriculture, hunting, forestry, and fishing	1.00	0.53	0.29	1.82	1.53	1.82
Mining and quarrying	1.00	0.52	0.37	1.89	1.52	1.89
Food products, beverages, and tobacco	1.00	0.51	0.24	1.75	1.51	1.75
Textiles, textile products, leather, and footwear	1.00	0.48	0.49	1.98	1.48	1.98
Wood and products of wood and cork	1.00	0.53	0.32	1.85	1.53	1.85
Pulp, paper, paper products, printing, and publishing	1.00	0.90	0.43	2.34	1.90	2.34
Coke, refined petroleum products, and nuclear fuel	1.00	0.21	0.07	1.27	1.21	1.27
Chemicals and chemical products	1.00	0.77	0.23	2.00	1.77	2.00
Rubber and plastics products	1.00	0.85	0.34	2.19	1.85	2.19
Other non-metallic mineral products	1.00	0.48	0.35	1.82	1.48	1.82
Basic metals	1.00	0.68	0.24	1.92	1.68	1.92
Fabricated metal products	1.00	0.60	0.46	2.06	1.60	2.06
Machinery and equipment	1.00	0.83	0.43	2.26	1.83	2.26
Computer, electronic, and optical equipment	1.00	0.66	0.46	2.12	1.66	2.12
Electrical machinery and apparatus	1.00	0.63	0.44	2.07	1.63	2.07
Motor vehicles, trailers, and semi-trailers	1.00	0.97	0.35	2.32	1.97	2.32
Other transport equipment	1.00	0.61	0.33	1.94	1.61	1.94
Manufacturing; recycling	1.00	0.74	0.38	2.12	1.74	2.12
Electricity, gas, and water supply	1.00	0.27	0.18	1.45	1.27	1.45
Construction	1.00	0.48	0.50	1.99	1.48	1.99

Wholesale and retail trade; repairs	1.00	0.36	0.43	1.80	1.36	1.80
Hotels and restaurants	1.00	0.52	0.28	1.79	1.52	1.79
Transport and storage	1.00	0.43	0.53	1.96	1.43	1.96
Post and telecommunications	1.00	0.51	0.23	1.74	1.51	1.74
Financial services	1.00	0.39	0.45	1.84	1.39	1.84
Real estate activities	1.00	0.19	0.10	1.30	1.19	1.30
Renting of machinery and equipment	1.00	0.27	0.20	1.47	1.27	1.47
Computer and related activities	1.00	0.45	0.40	1.86	1.45	1.86
Research, development, and retail	1.00	0.41	0.62	2.04	1.41	2.04
Public administration and defense; compulsory social security	1.00	0.34	0.51	1.85	1.34	1.85
Education	1.00	0.21	0.77	1.99	1.21	1.99
Health and social work	1.00	0.41	0.49	1.90	1.41	1.90
Other community, social, and personal services	1.00	0.32	0.49	1.81	1.32	1.81
Private households with employed persons	0.00	0.00	0.00	0.00	0.00	0.00
Intermediate taxes on products	1.00	0.00	0.00	1.00	1.00	1.00

Source: Table developed by project staff, 2017.

[1]IMPLAN software, http://www.implan.com/.
[2]John F. McDonald and Daniel McMillen, *Urban Economics and Real Estate: Theory and Policy* (New Jersey: Wiley-Blackwell, 2006), 439–443.
[3]IMPLAN software, accessible at http://www.implan.com/.
[4]Unpublished materials provided to project staff, "Green Complex Wood Biomass Utilization Plan," Okinoshima Prefecture, received August 2017.

Chapter 7: Consensus Building: The Survey

One task in this project is to understand the public's perception and involvement in the Green Complex (GC) project. Local citizens are both stakeholders and consumers of biomass energy. Obtaining public approval and involvement can assist the project's likelihood for success. A survey, discussed below, collected information on the public's knowledge and involvement with the project.

The students from Hiroshima, Doshisha, and Texas universities applied a purposive sampling technique to evaluate public perceptions of the GC project. Municipal authorities distributed questionnaires from August 5 through August 24, 2017, among 53 residents of the Oki Islands who responded: 34 percent were female, 68 percent of respondents were over 40 years old, and 98 percent of respondents had lived on the island for over 20 years. There are limitations in the survey. Due to time restrictions, research staff could not conduct the survey, so municipal authorities administered the survey to Dogo Island citizens. Sampling reflected targeted distribution, as 96 percent of respondents were government officials and only one is self-employed. The survey responses depended on the willingness of participants to answer questions. Based on the 53 questionnaires that were distributed and collected, nearly all (98 percent) local residents agreed that forest resources should be utilized. Almost half of Oki residents reported that they do not believe public involvement can contribute to revitalization. Although the majority of respondents were municipal officers, the majority of respondents were unaware of the GC project. For example, 21 percent of respondents did not know critical project details and 53 percent had only heard of the project's name. Despite the fact that many participants are municipal officers, 55 percent of respondents reported that they do not want to participate in the GC project. If government officials were unaware of the project, it is less likely that local residents are aware of the project. This result may reflect limited access to information about the project.

Many respondents (59 percent) stated that the Oki forestry industry brings prosperity to local people. Respondents were split on whether the forestry industry on Oki cares about the management of forest resources (46 percent of respondents agree and 46 percent disagree). A majority agreed that forestry on Oki would benefit from the involvement of private industry, while 34 percent of respondents disagreed with that opinion. Most respondents (66 percent) strongly agreed or agreed that a new wood processing plant and biomass facilities would affect the forestry industry on the Oki Islands positively and that the forestry industry would be more prosperous with investment from the GC project. Most survey respondents reported that forest resources should be utilized. Although many of the respondents are governmental officers, most (72 percent) are unaware of the GC project and a majority (55 percent) do not want to participate in the project. They also do not think the project is important for them. Younger people reported a lower priority to participate in this project, which could imply a generational divide for those who want to be involved with the GC project. Figures 7.1 to 7.6 show key results of the survey. Additional results are listed in Appendix A. Appendix B lists all the survey questions.

Based on the survey results, Oki could enhance the likelihood of the GC project's success by increasing public involvement. The survey found a lack of knowledge about the GC project. Enhancing awareness and involvement could improve outcomes for the GC project, as indicated by the success stories of other communities (discussed elsewhere in the report).

Public involvement could help the success of the GC project by incorporating information from persons who are both customers and participants in the forest resource sector. By establishing a public engagement strategy, government officials, staff, and citizens can enhance citizen engagement and develop a plan with greater stakeholder involvement that may be more likely to be implemented.[1] By incorporating citizen input, sustainability is catalyzed as citizens become active agents rather than passive recipients.[2] By gathering and incorporating citizen input, Oki could increase the likelihood that the GC project will remain relevant, adaptive, and reflective of community needs. If the GC project wanted better customer information, they could conduct their own survey; it is likely that the project could reconfigure questions and seek a larger number of respondents. A survey reconfiguration could help the GC project align its initiatives with community needs.

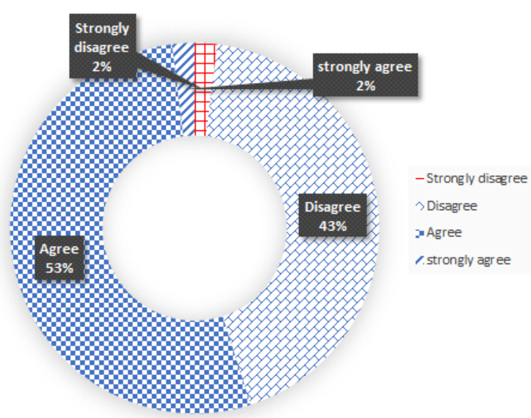
The Green Complex Promotion Council Working Group (the GC Group) has focused on public relations and information dissemination.[3] The GC Group is tasked with developing a periodical and workshops for citizens. The GC Group is a body that already exists with a diverse membership of stakeholders.[4] A strategic marketing plan for the GC project could increase public awareness and enhance municipal development. Table 7.1 lists recommendations to increase public involvement, as discussed in the section below. If the Dogo government assesses community needs and creates a strategic plan, they could execute those plans. For example, the Year of the Forest is part of worldwide celebrations. A celebration of Oki's forests could increase public awareness, provide a space to engage citizens, and generate revenue for the local community. Other communities have implemented festivals or events to produce revenue and create public awareness. For example, Woodfest Country Shows in Wales last for two days and include two crafts and various timber sports. At the end of the event, artwork is auctioned off.[5] Other cases include the International Woodcarving and Arts Festival as well as the Smoky Mountain Woodcarving Festival in the United States.[6] All these events promote regional pride and increase public awareness regarding forestry.

Table 7.1
Recommendations for a Public Involvement Campaign

Recommendation 1: Conduct Survey
Increase the number of respondents Increase the number of respondents outside of municipal employees Include questions such as: • Have you considered purchasing a pellet stove for your home? • Have you heard about the municipality's pellet stove subsidy? • What efforts does your community make to support sustainability of the forests? • How should the municipality increase public education and awareness about Oki's forest?
Recommendation 2: Develop a Marketory Strategy
Organize the Green Complex's stakeholders to develop clear internal marketing Develop a marketing strategy with promotional products including: • Logo • Infographic outlining the GC project's initiatives • Short video illustrating the initiative's work • Display of products at the GC project's partner sites

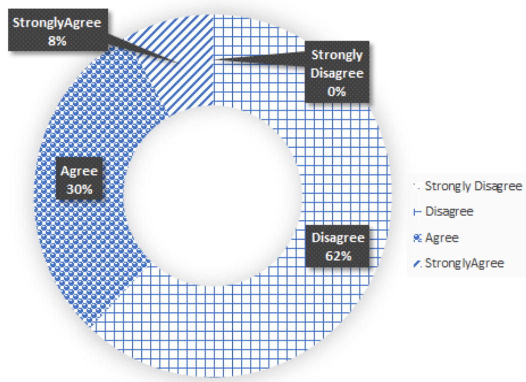
Source: Chart developed by Cristina Mendez, The University of Texas at Austin, November 2017.

Figure 7.1
Is Public Involvement Important for the Revitalization of the Oki Islands?



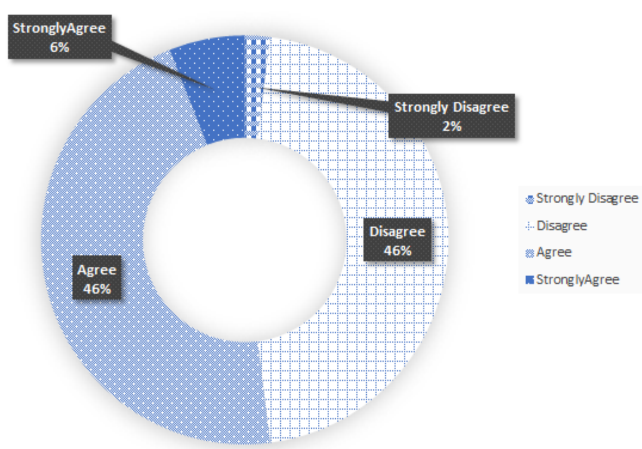
Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure 7.2
Will Forest Industry Bring Prosperity to the People?



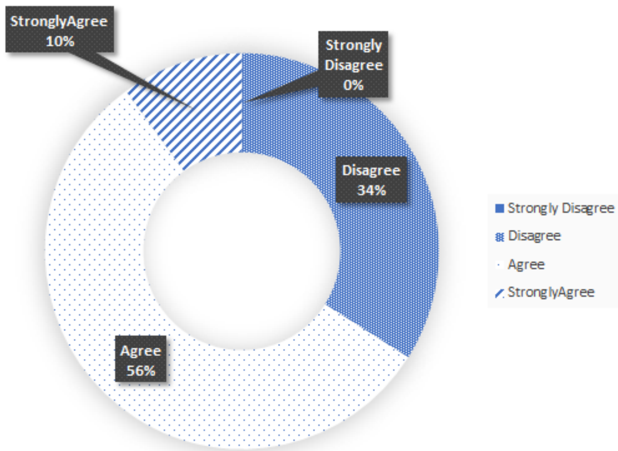
Source: Figure developed by project staff, based on unpublished materials, “Community Survey Questionnaire for the Oki Islands,” Okinoshima Prefecture, received August 2017.

Figure 7.3
Do Forestry Managers on the Oki Islands Care About Forest Resources?



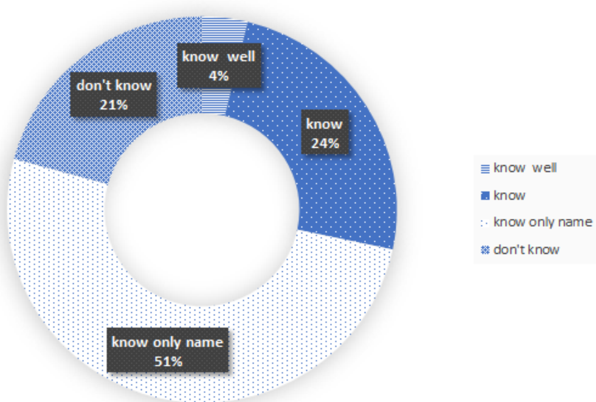
Source: Figure developed by project staff, based on unpublished materials, “Community Survey Questionnaire for the Oki Islands,” Okinoshima Prefecture, received August 2017.

Figure 7.4
Will the Oki Islands Forestry Prosper Without Industry?



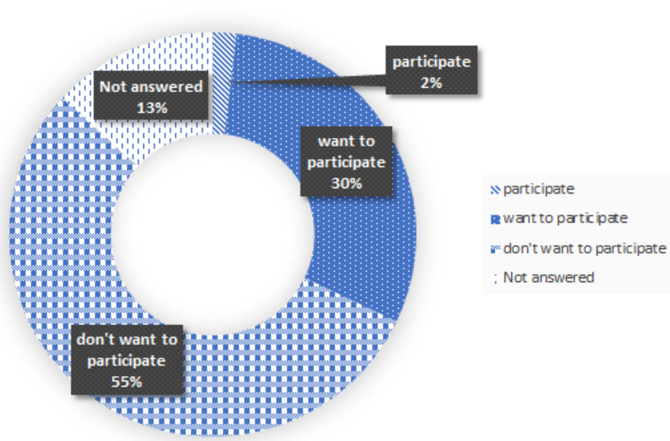
Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure 7.5
Do You Know About the Green Complex Project?



Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure 7.6
Do You Want to Participate in the Green Complex Project?



Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

[1]Raymond J. Burby, "Making Plans that Matter: Citizen Involvement and Government Action," *Journal of the American Planning Association* 69, no. 1 (2003): 33–49, https://www.tandfonline.com/doi/abs/10.1080/01944360308976292.
[2]Soren Gigler, "From citizen feedback to inclusive institutions: 10 lessons," Governance for Development, December 25, 2015, accessed October 24, 2017, http://blogs.worldbank.org/governance/citizen-feedback-inclusive-institutions-10-lessons/.
[3]Unpublished materials provided to project staff by Oki Island staff, "Summary for Oki Islands Biomass Industry City Development Plan," Oki Islands Municipality, received August 20, 2017.
[4]Ibid.
[5]"WoodFest Country Show 2017," WoodFest Country Show, accessed October 10, 2017, https://www.woodfestcountryshow.co.uk/attractions/.
[6]"Smokey Mountain Woodcarver Show and Competition," Great Smoky Mountains Heritage Center, accessed October 10, 2017, http://www.gsmheritagecenter.org/event/smoky-mountain-woodcarvers-festival/

Chapter 8: Discussion

The Oki Islands are endowed with rich natural resources and an abundance of usable biomass. Implementation of the Green Complex (GC) project could enhance Oki's local economy as efficiencies in forestry process lower the cost of biomass resources for other local industries, which in turn can transform biomass resources into sustainable energy, lignophenol, wood pellets, wood chips, and other products. The GC project proposes to use the Oki's biomass in different industries on and off the island. Wood chips are utilized on the island through forming them into pellets or fine coal that can be burned for power or exported as chips or pulpwood. Wood powder can be processed to produce methane for power generation or lignophenol as an industrial chemical. This study reports that using biomass in the form of wood chips and wood powder on the island is more profitable than exporting biomass. The comparative advantage of local use versus export reflects high marine transport costs, which makes it difficult to compete with more efficient vertically integrated wood biomass companies. An example of viable local use of biomass as a medium-scale power plant can more than cover its costs with an internal rate of return of 6.5 percent.

Based on a survey conducted by this project, only a small number of people know about the GC project or wish to participate; younger people showed less interest in the GC project. Although the majority of respondents were government officers, the majority of respondents were unaware of the GC project. Almost half of the local residents reported that they did not believe public involvement could contribute to the revitalization of the Oki Islands. The Oki municipality could conduct its own survey to seek a larger number of respondents and to try to understand the community's desires and needs. The municipality could then consider a strategic marketing plan for the GC project to increase public awareness and support municipal initiatives.

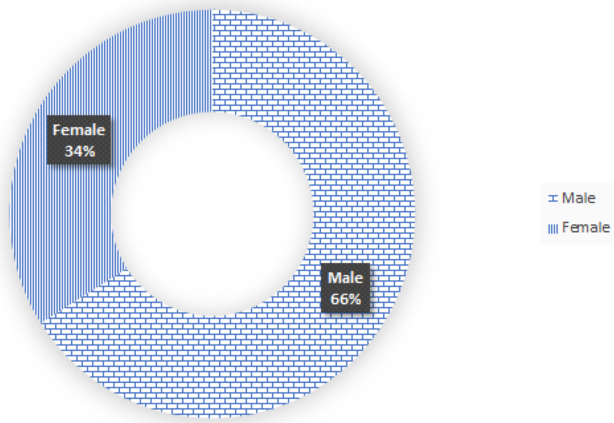
It is not evident that most Oki residents are aware of pellet stove subsidies. Persons who know of the subsidy program are discouraged from participation by a complex application process and uncertainty regarding the cost and efficacy of pellet stoves. If the municipality wants to invite more pellet program participants, it could preapprove vendors willing to install pellet stoves for a fixed price with guaranteed quality and reliability, so that customers face fewer uncertainties. The municipality could conduct a survey of Dogo Island residents to determine their potential needs for home heating replacement. The municipality could require every subsidy recipient to monitor and report on pellet stove heating unit performance and customer satisfaction. The municipality could launch a public relations campaign to encourage the replacement of oil and electric fueled stoves with pellet stoves. The municipality could publicize the program through posters, brochures, social media pages, and books. It could organize seminars promoting forestry and biomass energy. It could provide certificates acknowledging hotels and restaurants that heat with biomass. The municipality could provide tax incentives and penalties to encourage residents on Dogo Island to switch to biomass energy, such as fees for use of petroleum and gas or tax credits to local businesses using pellet stoves and boilers. The economic impact analysis revealed that investing in the biomass industries can benefit the Oki Islands economy with an increase of 975.78 million yen in economic activities, a marginal improvement of 1.67 percent more than investing in the tourism sector.

Investing in tourism, education reform, and more efficient utilization of real estate in the Oki Islands can also enhance Oki economic development. To stimulate tourism, information should be made available in Japanese and English, both online and in the islands' tourist offices. Prefectural leaders could encourage the construction of hotels and entertainment venues through financial incentives. A forest resources center could stimulate the development of new technologies and industries that also could attract long-term visitors to the Oki Islands. As illustrated by Ama's experience, educational reform can encourage economic development and invite immigrants to Oki. Abandoned homes in Oki Islands could be reused to further economic advancement.

Based on this report's evidence, biomass alone is not a source for meeting all of Oki's energy using biomass exclusively, although opportunities exist to reduce reliance on expensive imported fuels. Biomass can create a broad array of new economic activity on the islands by using readily available biomass resources. Biomass resources can create useful products for local consumption and valuable products for export to the mainland and abroad.

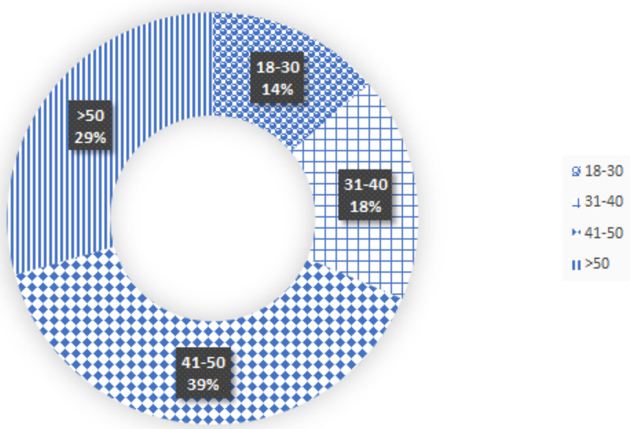
Appendix A: Oki Islands Survey Results

Figure A.1: Gender Distribution



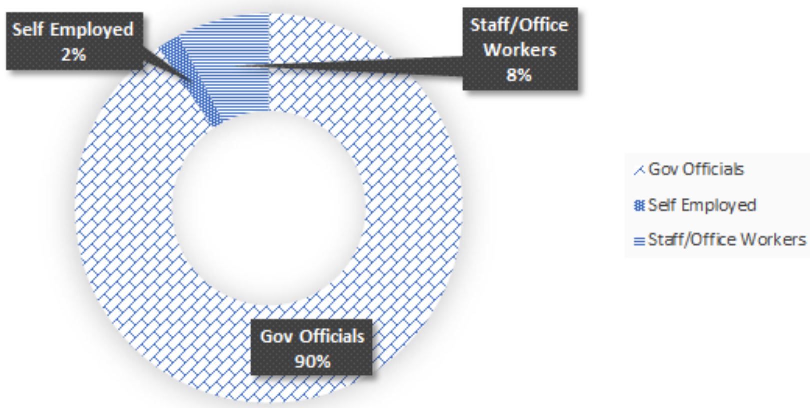
Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure A.2: Age Distribution



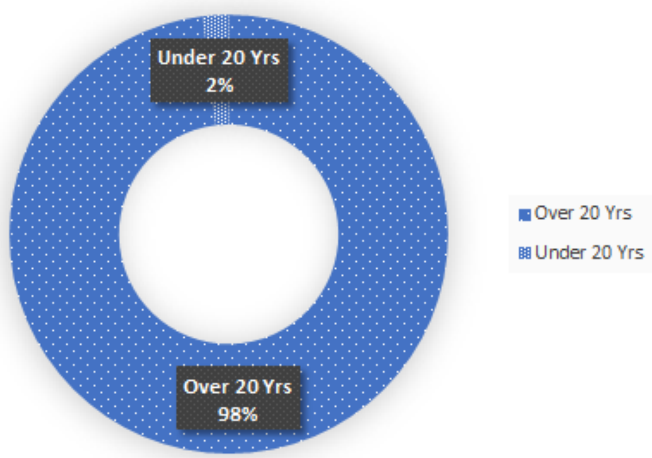
Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure A.3: What Is Your Occupation?



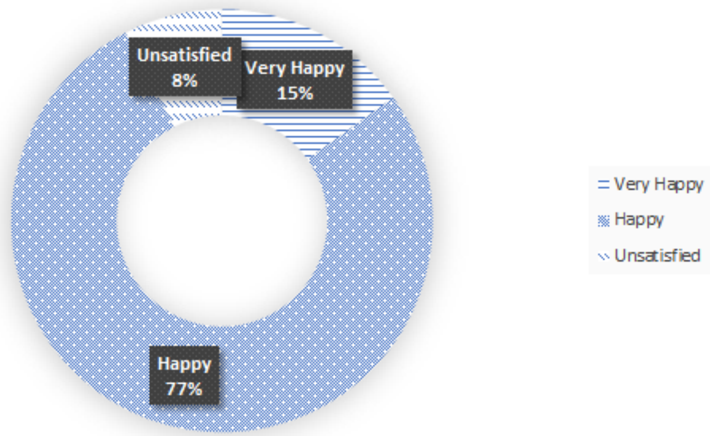
Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure A.4: How Many Years Have You Been Living on the Oki Islands?



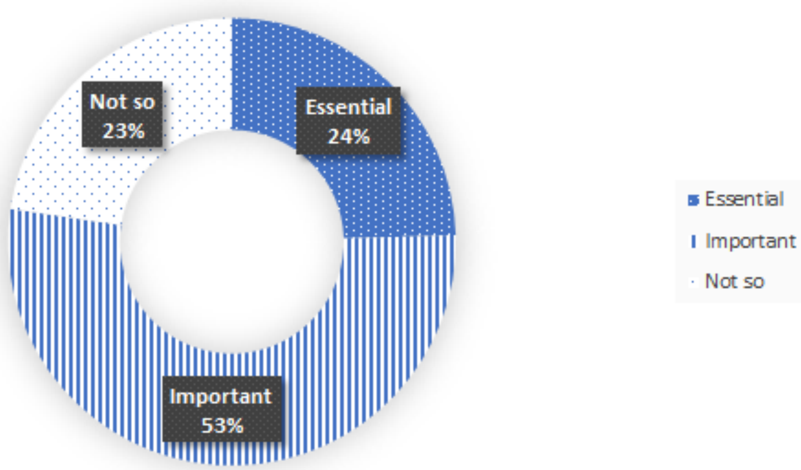
Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure A.5: Are You Happy Living on the Oki Islands?



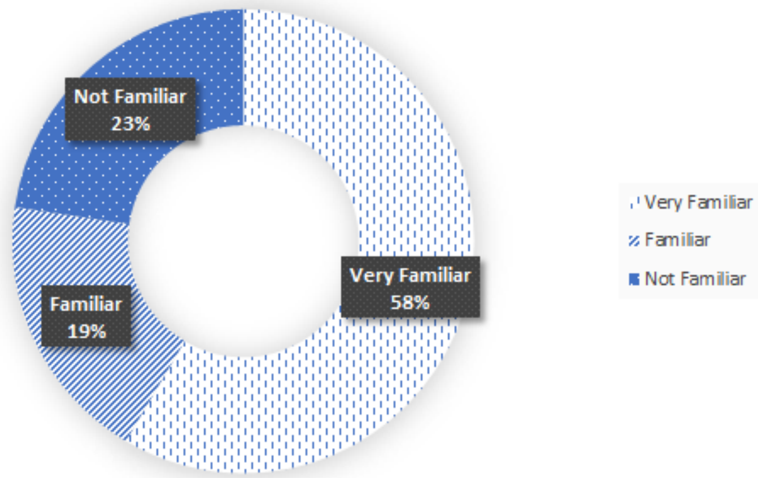
Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure A.6: Do You Think the Forest Is Important?



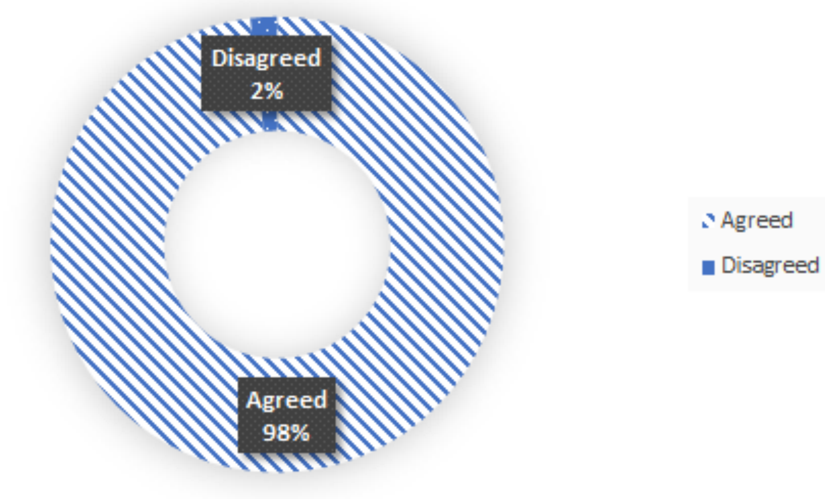
Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure A.7: Are You Familiar with the Forest on the Oki Islands?



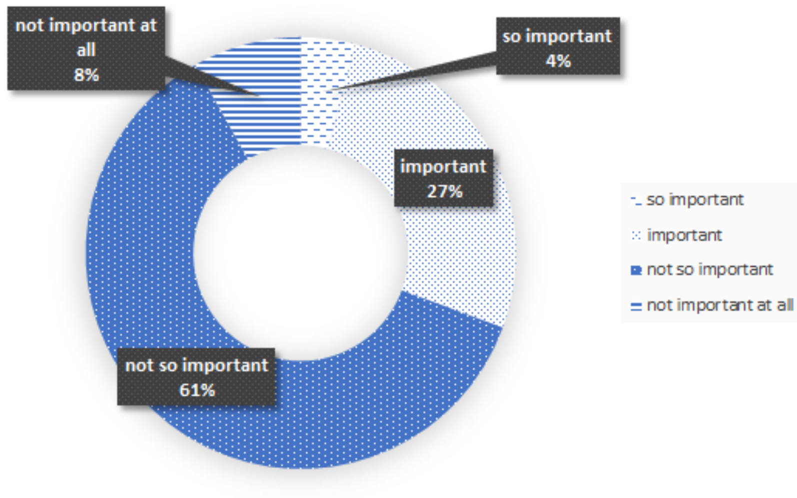
Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure A.8: Do You Agree with Using Forest Resources?



Source: Figure developed by project staff, based on unpublished materials, "Community Survey Questionnaire for the Oki Islands," Okinoshima Prefecture, received August 2017.

Figure A.9: Do You Think the Project Is Important?



Source: Figure developed by project staff, based on unpublished materials, “Community Survey Questionnaire for the Oki Islands,” Okinoshima Prefecture, received August 2017.

Appendix B:
Community Survey Questionnaire for the Oki Islands

(English Version)

Part 1: Basic Information about the respondents

1. Gender:
   a. Male
   b. Female
2. Age:
   a. 18 ~ 40
   b. 40 ~ 65
   c. 65 and above
3. Place of birth:
   a. Oki Island
   b. Others: ________________
4. Occupation: _________________
5. How many years have you stayed in the Oki Islands?
   a. Over 20 years
   b. 10 ~ 20 years
   c. Under 10 years
6. How do you rate the living in this island?
   a. Very happy
   b. Happy
   c. Unsatisfied

d. Unpleasant

7. Please list down any concerns or problems living in the Oki Islands

____

8. How would you give suggestion to improve the living quality in the Oki Islands

____

<u>Part 2: Social involvement to industrialization in the island</u>

Please respond to the following questions by circling your answer, with 1 indicating that you strongly disagree and 4 indicating that you strongly agree

· Residents in Oki Islands are initiatively taking part in the revitalization of the industry in island

· Public servants in Oki Islands are initiatively taking part in the revitalization of the industry in island

· The forest industry in Oki Islands bring prosperity to the people

· The forest industry in Oki Islands care about the management of the forest resources

· With the involvement of factory and industry, the forestry in Oki Islands will become much prosper than without it

Disagree ➡ Agree

1 2 3 4

1 2 3 4

1 2 3 4

1 2 3 4

1 2 3 4

Ø Do you know about the Green Complex project?

a. Not at all.

b. Only the names

c. Slightly knows

d. Have been working on/with the program

What role does forestry play in your professional career? What is your interest in forest management?

____
____

What can be done to improve forest management in the Oki Islands?

____
____

What organizations and/or individuals do you believe are most responsible for improving forest management in the Oki Islands?

____
____

What initiatives are currently working to improve forest management in the Oki Islands?

____
____

(Japanese Version)

隠岐の島町の住民に対するアンケート調査票

同志社大学, 広島大学, テキサス大学オースティン校

このアンケートは隠岐の島町における『緑のコンビナート』計画と地域住民との関係性を調査

する目的で行います。本アンケートは学術･調査目的であり、その他の用途では使用いたしませ

ん。また，集計値は外部に公表いたしません。

上記の主旨をご理解のうえ，アンケートにご協力お願いいたします.

Part 1: 基本情報について

1. 性別:

a. 男性

b. 女性

2. 年齢 :

歳

3. 出身地 :

a. 隠岐の島町

b. その他:______________

4. 職業 :

____

5. 隠岐の島町への在住歴

a. 10 年以上

b. 5 年以上10 年未満

c. 5 年未満

6. 隠岐の島町での生活はどうですか？

a. とても充実している

b. 充実している

c. 満足していない

d. 不快である

7. 森林はあなた自身やあなたの家族に

とって重要なものですか？

a. とても重要である

b. 重要である

c. あまり重要ではない

d. 全く重要ではない

8. あなたは森林に対して親しみを感じ

ますか？

a. とても感じる

b. 感じる

c. あまり感じない

d. 全く感じない

9. 森林資源は隠岐の島町や産業の活性

化に使用されるべきものだと思いま

すか？

a. はい

b. いいえ

10.

全くそう思わない➡とてもそう思う

1 2 3 4

1 2 3 4

1 2 3 4

1 2 3 4

1 2 3 4

2.以下の森林管理に関する質問に回答してくだ

さい。

あなたの職歴は林業や森林管理と関連がありま

すか？

a.関連がある b.少し関連がある

c.あまり関連はない

d.全く関連はない

隠岐の島町において、誰が森林管理を率先して

行うべきだと思いますか？

a.行政

b.森林組合

c.林業

d.地域住民

e.その他 （）

あなたの職業が森林管理に役立つと思うこ

とがあれば教えてください。

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隠岐の島町の森林管理を向上するためのア

イデアは何かありますか？

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隠岐島町の森林管理に関して思うことや、

考えがあれば教えてください。

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3.緑のコンビナート計画について

あなたは『緑のコンビナート』計画を知っていますか?

a. よく知っている

b. 知っている

c. 名前だけ知っている

d. 全く知らない

あなたはこの計画に参加していますか？また、参加していない場合したいと思いますか？

a.参加している

B.参加していないが参加したい

『緑のコンビナート』計画はあなたにとって重要ですか？

a.重要

b.まあまあ重要

c.あまり重要でない

d.全く重要でない

『緑のコンビナート』計画に期待することはありますか？

____

____

c.参加していないし参加したくない

現在隠岐の島町の森林管理を向上させるために，どのような取り組みが行われていますか？

____

____

隠岐の島町民の暮らしを向上させるためのあなたのアイデアを教えてください．(役場はどうすればこの町を発展させられます

か？)

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計画が地域住民と，よりよい合意を得るために最も重要な事柄は何だと考えますか？

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ご協力ありがとうございました。

American Society for Public Administration

CENTEX CHAPTER

2018 CenTex ASPA James McGrew Research Award

Project staff at The University of Texas at Austin's LBJ School of Public Affairs received the **2018 CenTex ASPA James McGrew Research Award** for their work on "Forestry and Economic Development on the Oki Islands, Japan." This award recognizes outstanding student research in the field of public administration or public policy. The following team members were honored with the award:

Cristina Mendez
Cody Brasher
David Patrick Drew
Demetrius Martinez
Ghida Ismail
Huixin Zhan
Kristy Marine McCarville
Marshal Evan Atwater
Patrick William Harned
Samer Atshan
Sara Wadud

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