In Japan No. 4	**Reforestation by public works for the purpose of restoring ecosystem service in the Rokko Mountain Range, Hyogo Prefecture, Japan**

1. Regional Profile

Geographical Location	Country and Region	Rokko Mountain Range, Hyogo Prefecture, Japan, East Asia
	Longitude and Latitude	North Latitude 34° 46’ 41”, East Longitude 135° 15’ 49” (Summit of Mt. Rokko)
	Geographical Conditions	• It is a suburban area, located in Kobe City (prefectural capital), Ashiya City, Nishinomiya City and Takarazuka City1 • Approximately 1-5 km from the nearest sea • Approximately 450 km from Tokyo (capital)
Natural Environment	Topography and Altitude	• Centered along the Rokko Mountain Range as a main axis, this area consists of narrow coastal lowlands at the south east base of the mountain range and a hilly area at the northwest foot of the mountain range. • The southern slope has steep terrain which reaches the 931 m summit of Mt. Rokkoa mere 7 km from the shoreline. The rivers are also steep.
	Climate	• According to the Koeppen climatic classification, the climate is classified as Cfa (humid subtropical climate). • The annual average temperature is approximately 16.5°C and the annual precipitation is 1,250 mm in Kobe City. • The area around the summit of Mt. Rokko receives a larger amount of precipitation than the areas at the bottom of the mountain because of an ascending air current from the sea, with annual precipitation around 1,800-2,000 mm.
	Vegetation and Soil	• The vegetation in the Rokko Mountain Range is mainly secondary vegetation such as Japanese red pine communities. • The Rokko Mountain Range is primarily made of eroded granite, and since there are many active faults, the geology is extremely fragile.
	Biodiversity and Ecosystem	• In the Rokko Mountain Range, most of the forest was lost in the second half of the 19th century due to excessive lumbering. However, reforestation projects have continuously been carried out by the government, prefecture and city since the end of the 19th century, and the Rokko Mountain Range has now regained its forest. • Various animals and plants inhabit and flourish in today’s Rokko Mountain Range as a result of reforestation. Moreover, primeval forests and wetland plant communities untouched by man exist on the summits and along valleys.
Social Background	Population and Changes in Population	• The combined population of Kobe City, Ashiya City, Nishinomiya City, and Takarazuka City related to the Rokko Mountain Range was approximately 1.5 million in 1960, but has increased to 2.3 million in 2005.
	History and Culture	• Kobe City, the center of this region, began to flourish as an important hub for maritime transportation in the second half of the 12th century, and has developed greatly as an international trading port since the second half of the 19th century. Since the mid-20th century, it has unified with Osaka City and other cities adjacent to this region and become one of the largest urban districts in Japan.
	Regional Economy (Major Industries, Livelihood (including data and forecasts))	• The key industries in this region are manufacturing, commerce, and service industries. • The number of workers in each industry sector in 2005 is as follows.

Primary Industry (agriculture, forestry and fishery)	7,508	0.8%
Secondary Industry (mining, manufacturing and construction)	206,542	20.8%
Tertiary Industry (commerce, tourism and others)	776,755	78.4%
Total*	990,805	100.0%

**Note: As the percentages of workers in Primary Industry, Secondary Industry, and Tertiary Industry are rounded off to one decimal place, they may not add up to 100.0%.*

2. Use and Management of Natural Resources in the Region

(1) Use and Management of Natural Resources in the Past and Present

1) Land Use Related to the Use and Management of Natural Resources in the Past and Present

- The area at the bottom of the southeast side of the Rokko Mountain Range had a surge in population after mid-19th century, and urban land use is prominent in commercial, residential and industrial areas.
- The area at the bottom of the northwest side of the mountain range was rural mainly consisted of forests and farmland until the mid-20th century. However, in the second half of the 20th century this area underwent a massive housing development, and today most of the flat areas are residential districts and the slope lands are forests.
- As a result of the above, the Rokko Mountain Range of today is an island of green surrounded by urban land.

2) Objectives and Details of the Current Use and Management of Natural Resources

- In the past, the collection of firewood, charcoal, and timber from the forests, along with food production through agriculture were actively carried out in and around the Rokko Mountain Range. However, as urbanization progressed, such direct uses of natural resources are no longer in practice.
- On the other hand, the area has been developed for recreational activities such as mountain climbing and golf, by the Western people who have been visiting Kobe since the mid-19th century. Furthermore, it has been developed as a popular tourist destination since around 1960, and is now widely received as a major urban tourist destination.
- In order to address the increasing population at the bottom of the mountains, the development of water supply facilities in the mountainous region began in the second half of the 19th century, and continues to be a valuable water source for urban residents today.

Picture: A cross shot of the Rokko Mountain Range and the urban district at the bottom of the mountains (Source: Brochure by Rokko Sabo Works Office, Ministry of Land, Infrastructure and Transport, “Rokko Mountain Range Green Belt Development Project”)

(2) Problems Associated with the Use and Management of Natural Resources and their Impact on Biodiversity

[Mid-19th century: rise of problems from deforestation]

- Forests were gradually lost in the Rokko Mountain Range due to human influences over many years, and in the 17th century damages from floods and landslide disasters began to occur frequently. Furthermore, immediately after the Meiji Restoration in the second half of the 19th century, the remaining forests were cut down recklessly, turning all mountain areas except for the summits and valleys completely bald.
- Meanwhile, as Kobe opened its port in 1867 and became an international trading port, and as the population at the bottom of the Rokko Mountain Range increased, the impact from deforestation on the urban districts spread further. Particular problems included damage from floods and landslide disasters, and dirt flowing into water sources.

Picture: Picture of the Rokko Mountain Range at the end of the 19th century
(Source: Brochure by Rokko Sabo Works Office, Ministry of Land, Infrastructure and Transport, “Rokko Mountain Range Green Belt Development Project”)

[End of 19th century to mid-20th century: Erosion control projects toward quantitative reforestation]

- In order to resolve the above problems, Hyogo Prefecture began tree planting through its erosion control project in 1895. After 1938, the project came under government control, and erosion control works have been carried out continuously by trial and error. Quantitative reforestation was nearly completed in the second half of the 20th century.
- In highly successful erosion control works from the end of the 19th century to the second half of the 20th century, tree species with high fertilizing effects on soil (Japanese green alder, locust tree, etc.) were introduced in order to finish reforestation as soon as possible on lands under hostile conditions where parent rocks were revealed.

Picture: Mt. Futatabi at the time of tree planting and at present
(Source: Brochure by Rokko Sabo Works Office, Ministry of Land, Infrastructure and Transport, "Rokko Mountain Range Green Belt Development Project")

[Recent changes in the situation: Increasing demand for diversified ecosystem services and biodiversity]

- Although the forests have recovered steadily through continuous erosion control projects and quantitative reforestation that was nearly completed in the second half of the 20th century, demand for qualitative improvement has increased from the perspective of the enhancement of diversified ecosystem services.
- In particular, considerable damage in the Rokko Mountain Range caused by things such as landslides due to the Southern Hyogo Prefecture Earthquake in 1995 has triggered recognition by the people for the necessity of the enhancement of erosion control works for improved disaster prevention.
- In addition, as the urbanization of the areas at the bottom of the mountain range progressed inversely with reforestation, concern for the forests in the Rokko Mountain Range as an important green area remaining in the suburbs has heightened, and expectations for the forests to provide recreation spots and conserve landscapes and biodiversity have grown.

(3) Regional Plans and Other Measures toward a Resolution of the Above Problems

- In the wake of a massive flooding and landslide disaster which occurred in the area at the bottom of the Rokko Mountain Range in the second half of the 19th century, the government enacted the River Law, the Erosion Control Law, and the Forest Law in succession, establishing a basic concept for the conservation of devastated national land. Since then reforestation has been carried out in a systematic and continuous way according to these laws.
- In recent years, in response to the changes in demand for forests as stated in 2), the government (Ministry of Land, Infrastructure and Transport) and Hyogo Prefecture developed the "Basic Principles for the Rokko Mountain Range Green Belt Development" in March 1996, and work for the improvement of forest quality has been underway.
- Details of these topics will be given in the following "3. Details."

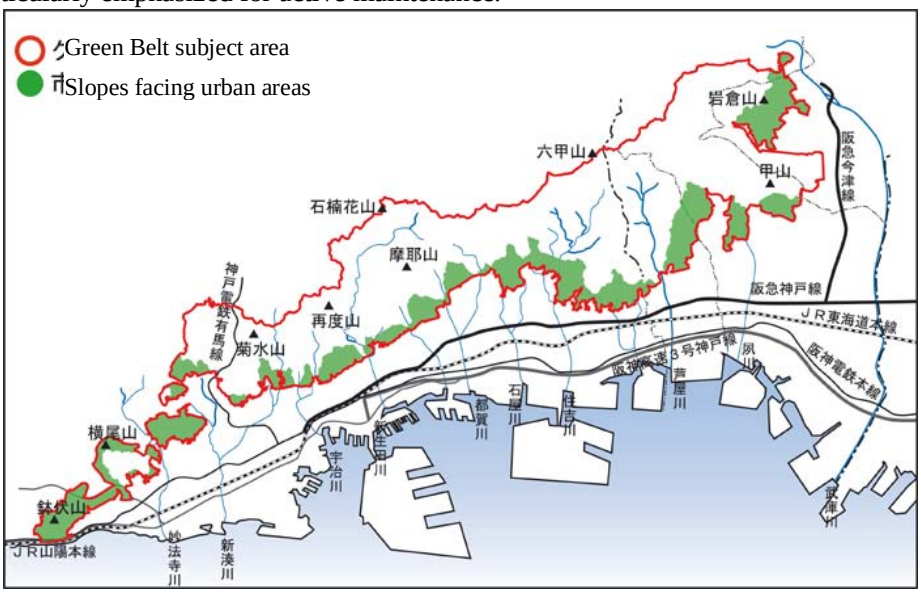
3. Details

(1) Overview

Erosion control projects have been carried out in the Rokko Mountain Range by the government and municipalities since the end of the 19th century, and quantitative reforestation has nearly completed, providing benefits such as disaster prevention, the fostering of water sources, the conservation of landscapes, and the provision of good recreation spots.

The Ministry of Land, Infrastructure and Transport and Hyogo Prefecture, in order to further take advantage of these benefits, and in response to demands for improved biodiversity in recovered forests, launched the "Rokko Mountain Range Green Belt Development Project" (the GB Development Project) in 1996 as a comprehensive development project in addition to existing erosion control projects.

We will describe the details centering on the GB Development Project while referring to efforts in the past as necessary.

Location	• The subject area of the GB Development Project is shown below, extending over Kobe City, Nishinomiya City, Ashiya City, and Takarazuka City in Hyogo Prefecture. • The slopes which can cause direct damage to urban areas from landslide disaster are particularly emphasized for active maintenance. 
Involved Parties	**[Implementing bodies]** Government (Ministry of Land, Infrastructure and Transport) and Hyogo Prefecture * *The slopes in the subject area of the GB Development Project that face urban areas are planned to be turned into public lands in due course.* **[Managers]** Kobe City, Nishinomiya City, Ashiya City, and Takarazuka City **[Parties that participate in management]** Local residents, private corporations
Background and history	*See "2-2) Problems Associated with the Use and Management of Natural Resources and their Impact on Biodiversity."*
Purpose and objectives	**[Objectives of the GB Development Project]** • Prevention of landslide disasters • Conservation and fostering of a good urban environment, scenic spots, the ecosystem, and species diversity • Prevention of urban sprawl • Provision of sound recreation spots

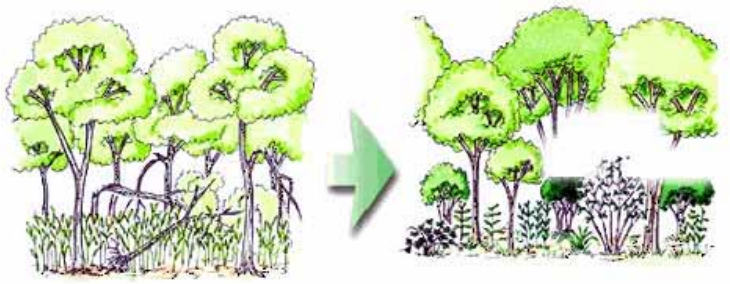
<table>
<tr><td>Main contents</td><td>

[Positioning in urban planning]

- The urban planning decision was made for the slopes in the subject area that required especially active efforts in "erosion control facilities" and "green conservation areas" in July 1998. The planning was made by Hyogo Prefecture and 4 other cities (Kobe City, Nishinomiya City, Takarazuka City and Ashiya City). The plan has been reviewed, added to and revised approximately every 5 years.
- “Erosion control facilities” refer to districts on which efforts to prevent landslide disasters are made. “Green conservation area” refers to an area in which greenery that is helpful in saving the urban natural environment and in preventing disorderly urbanization is conserved.

[Details of the development project]

- The Rokko Mountain Range Green Belt Development Project works to prevent landslide disasters as well as to contribute to the creation of a good urban environment by striving to conserve and foster erosion control forests as hillside works in addition to torrent control works centering on conventional erosion control dams.

<table>
<tr><td colspan="2">Hillside foundation work</td><td>Small check dams and land cofferdams are made in order to prevent sediment transport on slopes.</td></tr>
<tr><td rowspan="3">Hillside greening work</td><td>Planting work</td><td>Planting works (introducing vegetation, etc.) are performed in order to stabilize slopes with vegetation.
 
[Current locust forest] [Targeted forest]</td></tr>
<tr><td>Hillside terracing</td><td>Terracing works, forest fence works, etc. are performed together with planting works.</td></tr>
<tr><td>Vegetation management</td><td>Vegetation management is performed in order to maintain the effect of planting (e.g. improvement cutting and bamboo grass control to help with the growth and succession of plants).</td></tr>
</table>

[Citizen cooperative activities]

- Cooperative activities with local residents and corporations are involved in the GB Development Project as below.

<table>
<tr><td>Creation of Green Belt Forests</td><td>- Rokko Sabo Works Office and Hyogo Prefecture promote “Creation of Green Belt Forests” in cooperation with citizen groups and corporations who are involved in forest creation as part of volunteering or recreational activities or CSR (corporate social responsibility) activities.
- As of August 2009, more than 30 groups and corporations are engaged in forest creating activities such as logging, planting, and weeding.</td></tr>
<tr><td>Acorn Growing Program</td><td>- “Acorn Growing Program” to plant and grow seedlings of native trees from acorns picked up in Mt. Rokko is put into operation.
- This program started in Kobe City Motoyama Daiichi Elementary School in FY 2002, and eight elementary schools in Kobe City participated in this program in FY 2010.</td></tr>
<tr><td>Experience in nature</td><td>- “Environmental learning” in which children get to experience seedling planting, the “Satoyama Nature Experience” in which they observe nature and experience thinning, and “Family Forest Creating Activity” are held so that they can become familiarized with the local area and learn about nature.</td></tr>
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<tr><td>Main achievements</td><td>

- By changing approximately 1,300 ha to public land through government and prefectural efforts as of the end of FY 2008, and developing and conserving this land as healthy forest, the project contributes to the prevention of landslide disasters, the prevention of urban sprawl, and the conservation of the environment and landscapes.

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</table>

(2) Details of the Use and Management of Natural Resources from the "Five Perspectives" of the Satoyama Initiative

The table below shows the primary relevance of this case to the five perspectives.

Details are given below the table for the perspectives which have high relevance (items with the "⊙"mark in the table).

Five Perspectives	Relevance to this Case	
	Degree of Relevance	Summary of Relevance
1) Resource use within the carrying capacity and resilience of the environment	◎	• In the GB Development Project, land-use control based on laws and regulations and systematic management are performed in order to properly conserve and manage forests which are to be the source of diversified ecosystem services. • In the reforestation process in the Rokko Mountain Range up to this time, the targeted image of the forest and the species for planting to realize it have been reviewed in response to changes in natural conditions and social conditions (adaptive management). ** Details to follow.*
2) Cyclic use of natural resources	○	• Currently, the use of natural resources such as forestry and fuel collection is not practiced in the Rokko Mountain Range.
3) Recognition of the value and importance of local traditions and cultures	○	• The technologies and experience accumulated through the erosion control projects in the Rokko Mountain Range since the end of the 19th century are being transferred as "new traditions" to other parts of Japan as well as the world.
4) Natural resource management by various participating and cooperating entities	◎	• Erosion control projects are operated as public works, however, forest management and forest environmental education are actively conducted in cooperation with citizens and corporations who are beneficiaries. ** Details to follow.*
5) Contributions to local socio-economics	◎	• The Rokko Mountain Range, which regained rich forests, is widely used as a place for tourism and recreation. • Thanks to the erosion control projects in the Rokko Mountain Range since the end of the 19th century, the damage from disasters has considerably been reduced. ** Details to follow.*

1) Resource use within the carrying capacity and resilience of the environment

[Proper conservation and management of forests which serve as sources for diversified ecosystem services]

- The main objectives of the erosion control projects which have been carried out since the end of the 19th century are disaster prevention and water source development. And these efforts are for the purpose of developing "regulating services" and "supporting services" out of ecosystem services.
- In the GB Development Project, in addition to the above, the improvement of "cultural services" such as recreation and scenery and the promotion of "biodiversity", which is the value of ecosystem itself, are

also clearly positioned as part of the objectives.

- In order to properly conserve and manage forests that are the sources of the multidimensional ecosystem services described above, land use control based on laws and regulations and systematic maintenance are carried out.

[Selection of tree species and adaptive management taking natural conditions into account]

- In the process of reforestation in the Rokko Mountain Range, the targeted image of forest and the tree species for planting to realize it have been reviewed in response to changes in natural conditions and social conditions.
- From the end of the 19th century to the first half of the 20th century, the Japanese green alder, which has high fertilizing effects on soil, and the Japanese black pine and the Japanese red pine, which grow well even in oligotrophic soil and blend in with the local scenery, were planted so that vegetation would be established as soon as possible. In addition, in the second half of the 20th century, in place of the above species, the locust tree, which has high fertilizing effect on soil as well as rapid growth, came to be used often in tree planting.
- By the end of the 20th century, quantitative reforestation has nearly been completed through the above efforts. However, as locust trees have shallow roots, they tend to fall down or cause soil loss; and artificial forests of Japanese cedar or Japanese cypress which have not been managed through thinning have less undergrowth vegetation and tend to cause soil loss, fallen trees, and driftwood damage, revealing the problems of conventionally planted species.
- In addition to the problem with plant species, changing social conditions have increased the demand for functions such as disaster prevention and conservation of landscapes and biodiversity by urban residents at the bottom of the mountains.
- In response to these changes, the current GB Development Project is attempting a transition to forests composed of local native secondary vegetation such as konara oak and Japanese chestnut oak.

[Efforts taking into account the weak resilience of the environment]

- The Rokko Mountain Range has several natural environmental conditions which weaken the resilience of the environment such as a steep topography, fragile geology consisting primarily of weathered granite, and short heavy rainfalls from ascending air currents that cause the loss of topsoil.
- In the erosion control projects carried out since the end of the 19th century, taking account of the weak resilience of the environment in the area, the use of natural resources was restricted by the Erosion Control Law, the Forest Law, and the River Law. At the same time, current state-of-the-art expertise and technologies were introduced by trial and error, and quantitative reforestation was finally achieved.

4) Natural resource management by various participating and cooperating entities

[Land and natural resources management led by public entities]

- Since the objectives of the erosion control projects in the Rokko Mountain Range are the development of public functions which contribute to the safety and comfort of the lives of the urban residents at the bottom of the mountains, they have been carried out by the government and municipalities since the end of the 19th century.
- In the current GB Development Project, in order to be more comprehensive and active, the government has become the administrative body and advanced the maintenance of forests and the development of

erosion control facilities in close cooperation with local governments and local residents.

- Although land is both publicly and privately owned in the Rokko Mountain Range, in the GB Development Project, in order to further strengthen disaster prevention abilities and to improve the quality of forests, the government and the prefecture are systematically promoting the conversion of project target area into public land.

[Cooperative activities with citizens and corporations at the bottom of the mountains]

- The Rokko Sabo Works Office, Hyogo Prefecture and related cities (Kobe City, Ashiya City, Nishinomiya City, and Takarazuka City) are organizing various activities with the residents and corporations at the bottom of the mountains in order to promote understanding about the GB Development Project (For details, see "3-(1) Overview").

Pictures: Cooperative activities with citizens and corporations
(Left: Management of an abandoned artificial forest, Right: Nature experiential learning by children)
(Source: Brochure by Rokko Sabo Works Office, Ministry of Land, Infrastructure and Transport, "Rokko Mountain Range Green Belt Development Project")

5) Contributions to local socio-economics

[Active use as tourism and recreational spots]

- The natural environment including the forests in the Rokko Mountain Range is not only conserved from the perspective of disaster prevention for the area at the bottom of the mountains and the development of water sources, but also used actively as an suburban tourism and recreational spot.
- This began when westerners who came to live in the Kobe Port since the second half of the 19th century enjoyed recreation, mountain climbing, golf, skiing, and skating in Mt. Rokko, and the habit gradually spread to the Japanese.
- In the second half of the 20th century, as tourism became popular due to economic development, the people's recognition of the value of tourism and recreation which the natural environment of the Rokko Mountain Range held became heightened. In 1956, the mountain range was incorporated into the Setonaikai National Park, and the conservation of the natural environment and its use for tourism were reconciled.
- In today's GB Development Project as well, the "provision of space for sound recreation" is positioned as an objective.

[Mitigation of damages from disaster in the area at the bottom of the mountains]

- According to the estimated results of the cost-effectiveness analysis for erosion control projects conducted in 2005, the damage under the hypothesis that erosion control projects had not taken place was estimated to be 4,598.4 billion yen, while the total cost of the projects was estimated to be 690.5 billion yen.
- In addition, comparisons between the damage size of disasters in 1938 and 1967 clearly show the mitigation effect of the erosion control projects on disaster damage.
- The mitigating effect of these erosion control projects on disaster damage has greatly contributed to the daily life of the residents and the stability of economic activities of corporations in the areas at the bottom of the mountains, and has become a big foundation for the development of the region.

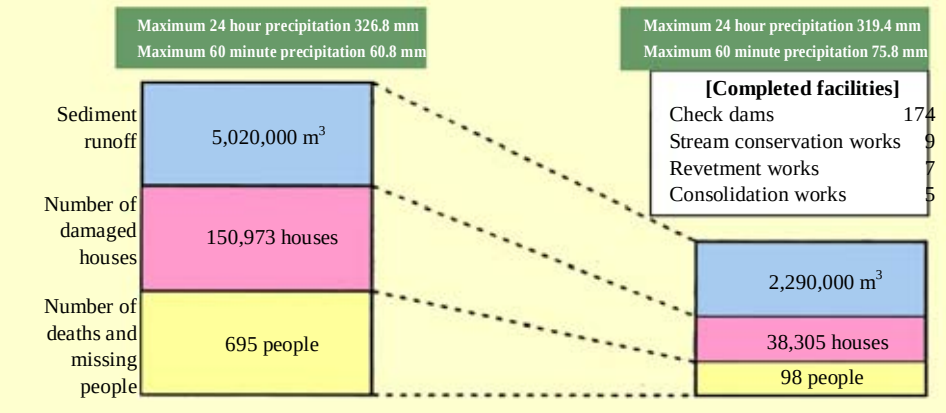

Figure: Comparison of damage sizes between disasters in 1938 and those in 1967
(Source: Data from Rokko Sabo Works Office, Ministry of Land, Infrastructure and Transport)

End