

Addressing Environmental Issues towards Sustainability in Mountains of Japan: Past, Present, and Future

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Abstract

This paper first presents primary mountain-related activities in Japan that have taken place beyond the International Year of Mountains (IYM) in 2002. Subsequently, it summarizes the prevailing issues related to mountain environments in Japan, particularly based on the discourse at the IYM+20 Symposium held in December 2022, and discusses the path towards the future sustainability of the mountain environments and development in Japan. One of the most notable achievements highlighted in this paper is the establishment of Mountain Day (*yama-no-hi* in Japanese) as a national holiday in Japan. This reflects the longstanding and close connection between the Japanese people and mountains, while the establishment of Japan's Mountain Day is also linked to the fact that many challenges persist regarding the mountains. In the future, Japan will grapple with an increasingly severe decline in birth rates and an aging society, a situation that has never been encountered before. This will require a new strategy for addressing mountain-related issues. This paper concludes by summarizing the discussions at the symposium and identifying the key issues that need to be addressed based on emerging science and technology.

Key words: International Year of Mountains (IYM), Mountain Agenda, Mountain Day, partnership, sustainable development

1. Introduction

In the year 2002, the United Nations recognized the International Year of Mountains (IYM), a project initiated by the Kyrgyz Republic in response to discussions on the vulnerability of mountainous regions that took place at the Earth Summit in Rio de Janeiro in 1992. The period following the Earth Summit in 1992 has witnessed significant advancements in science and technology that have helped address various mountain-related issues. However, this period has also brought forth new challenges, and other issues remain unresolved (e.g., Price, 2015; Makino *et al.*, 2019a; Ives, 2022).

In 2002, the Japanese National Committee for the IYM was established under the leadership of Junko Tabei, the first woman to summit Mount Everest. The committee held more than 50 symposia and workshops on various mountain-related topics, and numerous initiatives were undertaken. The International Year of Mountains Plus 10

(IYM+10) Symposium was held at Nihon University in Tokyo in 2012. IYM 2002 served as the driving force behind the establishment of Mountain Day (*yama-no-hi* in Japanese), a national holiday in Japan, which was celebrated for the first time in 2014.

The International Year of Sustainable Mountain Development (IYSMD) in 2022 continues to encourage efforts to tackle environmental issues in mountainous regions worldwide (Romeo *et al.*, 2022). On December 11, 2022, a mountain symposium commemorating the International Year of Mountains Plus 20 (IYM+20) as well as IYSMD was held in Kurobe City, Toyama Prefecture, Japan.

This paper first provides an overview of the establishment of Mountain Day, the largest mountain-related movement in Japan since IYM 2002, and then summarizes the discussions at the IYM+20 Symposium to identify key issues for the sustainability of Japanese mountains that need to be addressed in the future.

2. Major Activities beyond IYM 2002

The Japanese IYM National Committee organized the “Public Forum – Mountains: Environment and Human Activities” at the United Nations University (UNU) in Tokyo, which was coordinated with New Zealand to welcome Sir Edmund Hillary’s speech on April 8, 2003. Also, the IYM 2002 Closing Symposium was held at Nihon University, Tokyo on April 19–20, 2003. Beyond these, there were three major activities that will be briefly described in the following sections.

2.1 IYM+10 Symposium in Tokyo in 2012

In 2012, another important symposium, IYM+10, was held at Nihon University, Tokyo. This symposium concluded that the sustainable development of mountainous areas in a changing environment needs to be addressed in a science-based manner. The participants also discussed establishing a Mountain Day in Japan.

2.2 Japan’s Mountain Day

There had been discussions about creating a mountain day in Japan for quite some time. The Japanese people have long associated with mountains in their daily life. One such tradition has been mountain worship. The use of forest resources was widespread during the Edo period. Ota (2004) pointed out that Japan’s forests were most devastated from the end of the Edo period (the mid-19th century) to the middle of the Meiji period. Recently, there has been an increasing number of opportunities to visit mountains for recreation. Such deep relationships with the mountains are probably the main reason for establishing a mountain day in Japan.

At least as early as 1961, there was a call at a meeting of mountaineers for a mountain day. The idea was conceived and forgotten repeatedly. Among Japan’s various activities in IYM 2002, the Mt. Fuji Eco-Forum declared a call for a mountain day, saying, “to refresh such determination every year, we propose here to establish a ‘Mountain Day’ in Japan” (Japanese IYM National Committee, 2004).

For a while after that, however, activities toward the establishment of Mountain Day stalled. Later, the five major mountaineering associations joined together to form a council for the establishment of Mountain Day in April 2010. The Law on National Holidays was partially amended in 2014, with text was added to Article 2 of the law to say: “to take the opportunity to become familiar with mountains and appreciate their bounty.” This law came into effect on January 1, 2016.

Following the establishment of Mountain Day, the council for establishment of “Mountain Day” changed its name to the “Mountain Day Foundation” in 2014 and launched activities to promote Japan’s Mountain Day. Its website (<https://www.yamanohi.net/>) provides a platform for various information and activities related to mountains, nature, the environment, people and communities.



Fig. 1 Professor Asylbek Aidaraliev of the Kyrgyz Republic delivering his keynote speech at the IYM+20 Symposium in Kurobe City (Photo: Maksatbek Anarbaev, December 10, 2022).

2.3 IYM+20 Symposium in Kurobe in December 2022

As mentioned earlier, the International Year of Mountains Plus 20 (IYM+20) Symposium took place in Kurobe on December 10 and 11, 2022 (Fig. 1). The symposium comprised five distinct sessions: (1) Session 1 (Mountain Hazards and their Reconstruction, chaired by Fukachi Furukawa), Session 2 (Issues and Initiatives for Mountain Huts and Trails, chaired by Shunji Takekawa), Session 3 (Measures and Activities to Conserve Natural Resources in Mountain Areas, chaired by Fumiko Nakao), Session 4 (Current Status of Mountain Geoparks and Informing the Public about Them, chaired by Hajime Iida), and Session 5 (Challenges of Tourism Use in Mountainous Areas, chaired by Thomas Johns).

During the five sessions and the closing session (chaired by Teiji Watanabe), various issues were addressed in common. Below, key topics that were discussed at the symposium will be emphasized, as well as those that were not raised but were still relevant to the discussion.

3. Challenges in the Mountains of Japan: Past and Present

3.1 Mountain Huts and Trails

The majority of Japan’s mountains, excluding those in Hokkaido, feature privately managed mountain huts and lodges (Fig. 2). In contrast to the rest of the country, Hokkaido does not boast business-oriented mountain huts and lodges, but instead relies on public shelters managed by local, national or mountaineering organizations that do not operate for profit. Regardless of the type of huts and lodges, the managers of mountain huts and lodges have played a crucial role in serving the public interest by



Fig. 2 The Enzan-so mountain hut (lodge) and campsite, Northern Japanese Alps, which are privately managed although these facilities have many vital public roles (Photo: TW, October 14, 2020).

providing aid to hikers and climbers in distress. Moreover, they are responsible for maintaining hiking trails. Beyond Hokkaido, the upkeep of mountain trails is essential for the benefit of those who visit the huts and lodges.

The management of mountain huts and trails in Japan has been fraught with difficulties. These facets of mountain culture have traditionally relied on the efforts of numerous stakeholders, with inadequate financial backing from the government.

Traditionally, the upkeep and management of mountain huts and lodges have been the responsibility of their owners; however, this may become untenable in the absence of legal support. Similarly, the maintenance of hiking trails also faces similar challenges. Volunteers play a significant role in the upkeep of trails in national parks in Hokkaido, but the public nature of shelters, campsites, and trails warrants legal provisions to facilitate broader public support for their maintenance.

Although stakeholders, including hut and lodge managers and volunteers, oversee the management of high-altitude trails, many hikers are unaware of who is responsible for maintaining the designated facilities. Users must be cognizant of these realities when utilizing trails and huts/lodges.

Given that the issue of mountain trails has become a significant social concern, the Ministry of the Environment and local governments are actively promoting and maintaining long trails. Nevertheless, it is crucial to allocate more financial resources and human capital to address the deterioration of existing trails.

3.2 Biodiversity

In Japan, a Japan Biodiversity Outlook series was published in 2010, 2016 and 2021. These provided comprehensive assessments of biodiversity and ecosystem services, which have shown that the status of biodiversity in Japan has been on a long-term deteriorating trend. The direct drivers of biodiversity loss in Japan can be classified under “four crises,” described as “impacts caused by human activities,” “declining human intervention,” “things newly brought in by humans” and “changes in the global environment, such as global warming” (Working Group for Comprehensive Assessment of Biodiversity and Ecosystem Services, 2021). Regarding the first and fourth drivers, while it is necessary to promote measures to combat climate change, there are challenges in coordinating the introduction of renewable energy sources such as wind, solar and geothermal energy to avoid adverse effects on the behavior of wildlife, habitats and areas of conservation importance (Government of Japan, 2023; Nakao & Hashimoto, 2023). With regard to the second driver, population decline and changing demands for agriculture and forestry have reduced the use of mountain environments, and there are concerns about loss of the mosaic structure of the *satochi-satoyama* environment. Decline in the use and management of secondary forests has resulted in changes in species composition and diversity. In addition, the direct use of wild birds and beasts has decreased due to a decline in the number of hunters and aging of the hunting population, which have reduced hunting pressure and may have contributed to

increased populations of Japanese deer and wild boar since the 1990s. The impact of an overabundance of wild birds and animals on vegetation is becoming more serious.

Regarding the driver “things newly brought in by humans,” the impact of the invasion and establishment of non-native species has been very significant and is trending in the direction of a long-term increase. The effects of climate change on ecosystems, such as reductions in size and quality, have been particularly apparent in the last 20 years. The effects of rising temperatures on ecosystems include the decline of alpine plant communities since the 1970s and northward expansion of the distribution of non-native bamboo species over the last 30 years.

3.3 Geodiversity, Hazards, Geotourism and Geoparks

Geodiversity in Japan’s geologically and geomorphologically active mountains ranks among the highest in the world. Although discussions surrounding biodiversity began in the 1980s, conversations about geodiversity commenced more recently, in the 1990s. The significance of geodiversity in Japan’s mountainous regions was first recognized in a special issue of this journal’s Japanese-language series, published in 2005 (Volume 10, Number 2, <https://www.airies.or.jp/journal_10-2jpn.html>). In the brief period of less than two decades since then, not only has the concept of geodiversity gained traction, but so too has the importance of geotourism and geo-education, owing to the rise of geoparks.

Mountain development often results in a decrease in geodiversity and consequently, biodiversity, but this does not pose a significant threat to many of the protected areas, such as national parks. Nevertheless, excessive or inappropriate development can cause a decline in geodiversity and biodiversity in unprotected areas.

The promotion of geoparks in Japan offers a valuable opportunity to learn about the natural environment. The number of geoparks in Japan has been increasing annually, with many of them situated in mountainous regions. In a country prone to hazards, geoparks play a crucial role in fostering public understanding and preparedness for mountain disasters.

Hazard-prone areas are often popular tourist destinations, so it is important to understand the occurrence of mountain hazards, predict them using the latest scientific and technological advancements, and prevent and mitigate damage in these areas. While scientific and technological progress is essential, it cannot solve all the problems associated with mountains. It is equally important to consider the humanities and social sciences, as they are necessary to addressing the various challenges faced by mountain areas.

Geoparks serve as a useful tool for learning about all

of these issues. Japan should collaborate with mountainous countries that do not have geoparks, such as Nepal, Bhutan and Kyrgyzstan, and assist in the introduction and establishment of geoparks for the purposes of geodiversity conservation, geotourism and geo-education.

3.4 Human Resource Empowerment

It is imperative to develop human resources across various levels, including national, local governmental (prefectural and municipal), university and individual levels of researchers and citizens, as well as professionals. The development of human resources extends to volunteers and professionals alike.

In Japan, where the population is aging and the birth rate is declining, older individuals in their 60s and 70s have been vital as volunteers in mountain areas. However, this situation is unsustainable and there is a pressing need to increase the number of young people interested in the mountains.

In Japan, the term “volunteer” traditionally refers to an individual who works without compensation. Hiking trail maintenance and repair volunteers (Fig. 3) and forest management volunteers are prime examples (Kobayashi & Watanabe, 2023). Unfortunately, the number of forest management volunteers is decreasing due to the complexity of the tasks required. Effective trail management also necessitates specialized knowledge and experience. Therefore, the cultivation of volunteers must be strategically planned.

The cooperative system in Japan has advanced considerably over the last few decades, particularly in areas such as partnership management in national parks with mountains. Geoparks, which aim to implement geotourism, have also performed quite well in Japan. However, many geoparks face a significant challenge in recruiting enough volunteers to serve as interpreters.

During the IYM+20 Symposium, there was a discussion on the importance of investing in education and technical training in developing countries, including Nepal, Bhutan and Kyrgyzstan. It was emphasized that investing in education is essential for fostering human resources who can act responsibly to protect the natural environment and mitigate hazardous disasters.

In Japan, ecotourism has been promoted in many areas, and geotourism and geo-education are expected to be further promoted in mountainous regions throughout the country.

4. Future Agenda beyond IYM+20

The majority of the challenges previously discussed in the preceding sections are anticipated to continue and even increase in the future. We will not reiterate these issues here, but instead, we will focus on highlighting some of the more significant obstacles that lie ahead.



Fig. 3 Volunteers carrying logs for boardwalks in Daisetsuzan National Park on Japan's Mountain Day (Photo: TW, August 11, 2016).

4.1 Necessity of Further Addressing Biodiversity and Geodiversity

The 10th meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD-COP10) adopted the Strategic Plan 2011–2020, consisting of 20 targets (Aichi Biodiversity Targets), aiming to realize society in harmony with nature in 2050. It has been pointed out that it is necessary to take measures not only regarding direct drivers, but also for society as a whole (IPBES, 2019; SCBD, 2020).

To this end, the Kunming-Montreal Biodiversity Framework adopted at CBD-COP15 in 2022 incorporated the concept of turning the deteriorating trend of biodiversity and ecosystem services in a positive direction by 2030. The guidelines issued by the Task Force on Nature-related Financial Disclosures (TNFD) in 2023 and the development of “Transition Strategies toward a Nature Positive Economy” by Japan's government have led to a growing interest in biodiversity, especially in the business community. Mountains are the backbone of rich biodiversity, and this momentum may be an opportunity to establish a system in which society as a whole can support the insufficiently funded costs of trail management and other conservation activities.

However, efforts made at the national and international levels for the conservation of geodiversity (geoconservation) fall far behind those dedicated to biodiversity conservation. Japan, as a geologically and geomorphologically young and dynamic country, has seen significant development across its territory, which in turn affects the geodiversity of the country. Thus, it is essential

to promote systematic efforts to conserve geodiversity in mountain areas through geo-education and geotourism.

The conservation of both biodiversity and geodiversity is crucial for the preservation of mountain ecosystems. Geodiversity conservation (geoconservation) in a particular area leads to biodiversity conservation in that same area (Watanabe, 2005). In other words, geoconservation contributes to the conservation of geocological diversity in the area. Therefore, it is necessary to adopt a well-balanced approach to both biodiversity conservation and geo-conservation.

4.2 Inbound Tourism and Environmental Conservation

The development of tourism in mountain areas has become a critical juncture in the rapid growth of inbound tourism. Despite this, the percentage of inbound hikers in Japan's mountains remains relatively low, with the exception of a few destinations. For instance, a 2016 survey revealed that 8.8% of the users of the Asahi-dake Ropeway in Daisetsuzan National Park were foreigners, and 12.1% of those who hiked to the summit of Mt. Kuro-dake were foreigners (Table 1). Although the impact of the COVID-19 pandemic on the percentage of foreigners is yet to be determined, field observations suggest an increase in their numbers. This increase is likely to exacerbate the problem of overtourism, as both inbound and domestic hikers compete for access to popular trails and summits. This is already evident in areas such as Mt. Fuji, where overtourism is a pressing issue.

Table 1 Numbers of hikers visiting two major areas of Daisetsuzan National Park, Hokkaido on certain days in August 2016.

Area	Number of hikers			Ratio (J : F)
	Japanese	Foreigners	Total	
Asahi-dake	2641	256	2901	91.2 : 8.8
Mt. Kuro-dake	305	42	347	87.9 : 12.1

The numbers were counted at the Asahi-dake Ropeway Station on August 10, 13 and 14, and at the summit of Mt. Kuro-dake on August 12 and 13. Note that the ratio of foreigners may have been smaller than on other days because the survey was conducted during the Obon Festival holidays when transportation and lodging costs are highest.

In 2024, the national park system in Japan will celebrate its 90th anniversary. Four of the country's national parks with mountains—Daisetsuzan National Park, Chubu-Sangaku National Park, Nikko National Park and Aso National Park—will commemorate this milestone. Additionally, Hidaka-Sanmyaku Erimo Quasi-National Park in Hokkaido is set to be upgraded to national park status. Since 2016, the Ministry of the Environment has been implementing measures to promote inbound tourism in national parks, aiming to protect the country's natural resources and stimulate local economies through a mutually beneficial cycle of conservation and utilization. However, as the popularity of these parks continues to grow, it will be essential to enhance efforts to control overtourism and reinvest profits from tourism into environmental conservation and community development initiatives (<<https://www.env.go.jp/en/nature/enjoy-project/index.html>>). As the issue of overtourism becomes increasingly pressing, it will be critical to address this challenge in the years to come.

4.3 Information Dissemination and Networking

Japan's domestic initiatives during IYM 2002 were quite active. However, the global dissemination of information on such activities related to mountains has been relatively weak, as evidenced during IYM 2002, and improvements have yet to be made. It is also crucial to establish an effective system for propagating Japan's overseas activities related to mountains. International information sharing will be essential for addressing challenges both domestically and abroad, and Japan should make it a priority to enhance these activities in the future.

Promoting international cooperation on mountains is vital, and is already included in Chapter 13 of Agenda 21 (Makino *et al.*, 2019b). The International Year of Sustainable Mountain Development (IYSMD) 2022 presented an opportunity to build upon the Mountain Partnership's multi-stakeholder network, foster global and regional collaboration, conduct research and share information and experience to raise awareness of mountain ecosystems' significance in our daily lives and the threats they face (Romeo *et al.*, 2022). It will be

essential to leverage existing platforms for disseminating and exchanging information, such as the Mountain Partnership and the International Partnership for the Satoyama Initiative, both of which are led by Japan and the UNU. We anticipate making further collaborative efforts to promote the sustainable development of the world's mountainous regions for future generations.

4.4 Use of Advanced and Newly Emerging Science and Technology in an Aging Society

Advancements in remote sensing technology have allowed for a deeper comprehension of complex subjects, such as changes in glaciers and the growth of glacial lakes, which are vital in predicting water supplies and the occurrence of glacial lake outburst floods (GLOFs). Additionally, technological advancements in field observation have played a significant role in identifying the presence of glaciers in Tateyama, Toyama Prefecture, long thought to have disappeared in Japan. Similarly, the development of new strategies for managing sika deer and other wildlife, which often cause damage to agriculture and humans, has enabled us to understand their behavioural patterns and habitats. Even devices such as smartphones, which were not previously envisioned, have become valuable tools for gathering information while hiking and climbing or conducting surveys in mountainous regions. We can anticipate further advancements and emergence in science and technology and expect to develop our own knowledge and technology to enhance our understanding of mountains.

In Japan, where the population is aging, a shortage of human resources is already apparent in various sectors, including the development and management of mountainous areas. To promote more sustainable development and conservation of the natural environment in mountainous areas, it will be necessary to create new technologies that enable more efficient management and conservation in ways that have not been possible before and that can be done by a smaller number of people.

In recent years, there has been considerable progress in promoting collaboration and partnerships in mountain sustainability. The number of partnerships between developed and developing countries has increased, and multilateral efforts have flourished through networking. Furthermore, the sudden unexpected COVID-19 pandemic led to the development of remote communication means, such as Zoom and Webex, that have facilitated nature conservation, wildlife management and the resolution of various mountain-related issues.

5. Conclusions

Significant progress has been made in the field of science and technology over the past three decades, particularly since the Earth Summit in 1992. However, there are still numerous gaps in our understanding of

mountains that need to be addressed. As the birth rate declines and the population ages, it may be necessary to implement a new, highly effective strategy for the sustainable use, management and conservation of mountains, such as the management of mountain huts and trails with fewer resources.

It will be essential to gather scientific evidence to address various mountain-related issues and exchange information with relevant domestic and international sectors. Developing laws and regulations on mountain-related matters would prevent the emergence of new problems in mountain areas.

We must confront both unresolved issues in mountains and unforeseen problems that will arise in the future. It is hoped that Japan will increase its focus on mountain-related issues across all relevant sectors, as global interest in mountains continues to grow.

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