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Overview

The Japan *Satoyama Satoumi* Assessment (JSSA) is a study of the interaction between humans and terrestrial–aquatic ecosystems (*satoyama*) and marine–coastal ecosystems (*satoumi*) in Japan. The study examines and analyses changes which have occurred in these ecosystems over the last 50 years and identifies plausible alternative futures of those landscapes in the year 2050 taking into account various drivers such as governmental and economic policy, climate change, technology, and socio-behavioural responses. This brief suggests that the health of *satoyama* and *satoumi* ecosystems is interlinked with human well-being and biological diversity. Recommendations for policymakers based on the study's findings are also presented here.

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Satoyama–Satoumi Ecosystems and Human Well-Being: Assessing Trends to Rethink a Sustainable Future

THE 2010 BIODIVERSITY TARGET (COMMITTED TO BY Parties to the Convention on Biological Diversity in 2002) to achieve a significant reduction of the current rate of biodiversity loss by 2010 has not been met. In fact, the changes in biodiversity due to human activities have been more rapid in the past 50 years than at any time in history. There is now a high risk of dramatic biodiversity loss and accompanying degradation of a broad range of ecosystem services if ecosystems are pushed beyond certain thresholds or tipping points.

At the same time, however, the human use of ecosystems and their services has contributed to substantial net gains in human well-being and economic development. It is unrealistic to apply mainstream approaches to environmental protection (e.g. expansion of protected areas and preservation efforts) while also attempting to reduce poverty and enhance human well-being. Finding a way to ensure optimal use of ecosystem services without creating loss of biodiversity is critical.

In furtherance of this goal, the Japan *Satoyama Satoumi* Assessment (JSSA) is a study of the interaction between humans and terrestrial–aquatic ecosystems (*satoyama*), and marine–coastal ecosystems (*satoumi*) in Japan. It examines changes in these ecosystems over the past 50 years by applying the framework of sub-global assessments developed by the Millennium Ecosystem Assessment (MA). The MA, commissioned in 2000, focuses on changes in ecosystem services and their consequences on human well-being (ecosystem services being defined as the benefits people obtain from ecosystems).

The overarching goal of the JSSA is to provide scientifically-credible and policy-relevant information on the significance of ecosystem services provided by *satoyama* and *satoumi* landscapes, and their contributions to economic and human development for the use of policymakers.

The specific objectives of the JSSA are to:

- improve understanding of the relationship between *satoyama*–*satoumi* and biodiversity, ecosystem services and human well-being;



- provide policymakers in Japan with a sound and credible scientific basis for the *Satoyama* Initiative the Japanese government intends to promote;
- establish credible baselines for a number of key ecosystem services provided by *satoyama* and *satoumi*;
- provide information on possible future trends in ecosystem services

Of the two concepts, *satoyama* is the older, dating back to the seventeenth century. It is a term used to describe landscapes that comprise a mosaic of different ecosystem types including secondary forests, agricultural lands, irrigation ponds and grasslands, along with human settlements. These landscapes have been formed and

“Satoyama and satoumi are useful heuristic devices for better framing the relationship between ecosystem services and human well-being.”

provided by *satoyama* and *satoumi* under a specific hypothesis on plausible alternative futures;

- identify sound policy responses to address the decline in ecosystem services through the use of *satoyama* and *satoumi* management in Japan;
- provide the scientific basis for the use of *satoyama* and *satoumi* in an international context, and in particular, as part of the *Satoyama* Initiative.

Satoyama and Satoumi in Japan

Satoyama and *satoumi* are Japanese concepts for long-standing traditions associated with land (*satoyama*) and coastal (*satoumi*) management practices. These traditions have, in the past, allowed sustainable use of the resources encompassed by *satoyama* and *satoumi* through the symbiotic human interaction with those ecosystems, thus providing a historical model for environmental stewardship and resource management that contributes to human well-being. Within the context of the JSSA, *satoyama* and *satoumi* may also be understood as useful heuristic devices for better framing and analysing the relationship between ecosystem services and human well-being.

developed through prolonged interaction between humans and ecosystems, and are most often found in the rural and peri-urban areas of Japan. *Satoumi*, by contrast, is a term first used in the twentieth century to refer to Japan’s coastal areas where human interaction over time has resulted in a high degree of productivity and biodiversity.

For the purposes of the JSSA, we define *satoyama* and *satoumi* landscapes as *dynamic mosaics of managed socio-ecological systems producing a bundle of ecosystem services for human well-being*.

Recent Changes

There has been a rapid decline in both *satoyama* and *satoumi* landscapes in the last half century. This has been brought about by a convergence of trends, some endemic to Japan, others global in origin.

The “drivers” of change and decline in Japan’s ecosystems may be identified as “direct” and “indirect”. Direct drivers include changes in land- or coastal-area use, such as under- or over-utilization. Indirect drivers include economics, culture and religion, science and technology, population, and public policy. These latter forces are often less



obvious than direct drivers but no less critical in their impact.

The chief forces behind the decline in *satoyama* in post-war Japan are twofold: first, rapid urbanization resulted in a physical loss of *satoyama* landscapes as woodlands were converted to other uses (e.g. residential housing or golf courses), and concomitantly, degradation of the landscape as the rural population declined. With fewer rural area dwellers, there is reduced capacity to use and manage *satoyama* landscapes. Second, a boom in demand for timber by Japan's construction industry in the post-war years also altered traditional *satoyama* landscapes; monoculture plantations made up of shallow-rooted coniferous trees (cedar and Japanese cypress) replaced traditional broad-leaved, deep-rooted species. This caused a disruption of key ecosystem services such as flood and soil erosion prevention.

Satoumi landscapes have undergone similar transformations as a result of rapid industrialization in Japan. These include a reduction in the amount of seashore area available for recreational and traditional fishing activities, as well as increased pollution which has affected marine fisheries. Over-fishing—a result of new mechanized techniques—has also impacted on *satoumi* fishing communities in some regions of Japan by changing the traditional culture; these places now rely on commercial off-shore fishing for their economic survival.

Approach to Biodiversity and Ecosystem Services in *Satoyama* and *Satoumi*

Although Japan has maintained a high level of biodiversity compared to other developed nations, changes in *satoyama* and *satoumi* landscapes since World War II have resulted in a decrease in biodiversity. For instance, certain species of

collectable mushrooms have declined, while coastal fisheries have experienced declines in species once bountiful.

Among the factors having a negative impact on *satoyama* and *satoumi* landscapes, five have proved particularly critical: 1. habitat modifications, 2. climate change, 3. the introduction of alien species, 4. pollution, and 5. an under-utilization of resources. These have contributed to an overall loss of biodiversity and a decrease in the ability of *satoyama* and *satoumi* ecosystems to provide critical “services” which benefit human well-being as well as biodiversity.

The three key ecosystem services provided by *satoyama* and *satoumi* may be defined as: provisioning, regulating and cultural.

Provisioning services are those resources supplied by *satoyama* and *satoumi* to human communities. *Satoyama* provisioning services include timber for construction; fuel, in the form of wood and charcoal; and food, including wild game, rice and edible wild plants such as mushrooms. *Satoumi* provisioning services include seafood and salt.

Regulating services derived from *satoyama* include functions such as climate control, water-quality control, wildlife habitat regulation and disaster control. Thus, they are traditional mainstays for the sustainable supply of many provisioning services.

Finally, *cultural* services provided by *satoyama* and *satoumi* ecosystems are embedded in the very foundations of Japanese society and provide the basis for traditional *satoyama/satoumi* landscape practices, such as how rice is grown, how forests are maintained and how fishing is undertaken. Indeed, it is the myriad of practices with respect to *satoyama* and *satoumi* that to a large extent comprise and define traditional Japanese culture.

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Impact of Changes

How the five factors cited above—economics, culture and religion, science and technology, population, and policy—have negatively affected the ecosystem services provided by *satoyama* and *satoumi* is summarized below.

Provisioning Services

Forestry provisioning services have generally had mixed outcomes. Although the demand for timber and fuel-wood has decreased, the standing stock of forest has increased. The increases in forest plantations, coupled with cheap imports of timber, have been the primary reasons for this trend. However, although the stock of forest has increased, the characteristics of the forests have changed. For example, the new forest plantations do not provide as efficient regulating services such as soil run-off prevention.

When looking at the situation in non-forest environments, we can see a similarly mixed picture. For example, considering paddy fields, while it is clear that there has been a reduction in the total cultivated acreage of rice paddies, output has remained consistent due to improved agricultural technology and methods; however, the use of commercial fertilizers and pesticides has caused the pollution of streams and ground water leading to the costal *satoumi* ecosystems.

Other changes in the *satoumi* ecosystem mirror those of *satoyama*. Economic development coupled with technological modernization has led to over-fishing and marine coastal pollution. Climate change has also had an impact on the ecosystem as warming waters in parts of Japan have led to decreased stocks of fish such as herring and cod that favour cold waters.

Regulating Services

Transformations in *land use* noted above are the key *direct driver* in changes in *satoyama*-regulating services since they impact the ecosystem's ability to regulate critical functions such as water quality control, wildlife habitat regulation and disaster control. While the relationship between changes in land use in *satoyama* areas and the occurrence of natural disasters such as floods has not been investigated on a national scale, some local reports show a relationship between decreases in rice paddy field area and increases in flood damage on a local scale.

Cultural Services

The production of traditional handicrafts, as an industry, has declined. Contributing factors include the reduction of rural communities that have traditionally produced handicrafts and the loss of traditional *satoyama* landscapes which in the past provided thematic material for many handicrafts.

In terms of *satoumi*, recreational fishing has been in decline for the past decade; similarly traditional activities such as shellfish gathering and sea bathing have begun to disappear as more and more beaches have been converted to other, commercial uses.

In sum, the past 50 years have seen a decline in both *satoyama* and *satoumi* landscapes resulting in a loss of both ecosystem services and biodiversity.

What Responses Have Been Useful?

A variety of responses to the declining health of Japan's ecosystems have been analysed by the JSSA. These include 1. legal, 2. economic, 3. social and behavioural, 4. technological, and 5. cognitive responses.



Legal

Up until the 1980s, most laws regulating *satoyama* landscapes focused on residential and commercial land development. Since the Earth Summit in 1992, however, a series of laws has been implemented in Japan managing *satoyama* landscapes in their larger context. These include the Act on the Promotion of Nature Restoration (2002),

that penalize corporations for polluting landscapes, and through taxes that are paid by a wide range of citizens to support the costs of maintaining ecosystems whose benefits they enjoy.

Social and Behavioural

Citizens, non-profit organizations (NPOs) and non-governmental organizations (NGOs) contribute significantly

has gained new currency as an opportunity to create a “new public” which embraces decentralized, regional and local initiatives that involve government as well as non-government groups such as NPOs and NGOs.

Effectiveness of Responses

The most effective response to *satoyama* and *satoumi* degradation to date has

“Japan has seen an increase in *local* and *regional* initiatives, reflecting a conscious decision to decentralize decision-making whenever possible.”

the Landscapes Act (2004) and the Act on Promotion of Ecotourism (2007).

In the case of *satoumi*, until the 1990s most legislation resembled a patchwork of regulations, dispersed among various unconnected agencies. However, beginning with a series of initiatives by the 5th Comprehensive National Development Plan in 1998, Japan has recognized that its coastal areas constitute a unified ecosystem and thus regulations should be developed that manage “projects, facilities, and use in an integrated manner, while formulating integrated management planning of coastal areas by local public organizations as the main participants” (National Land Agency, 1998).

While national initiatives have emerged treating *satoyama* and *satoumi* as unified ecosystems, Japan has also seen an increase in the number of *local* and *regional* initiatives, reflecting a conscious decision at the national level to decentralize decision-making whenever possible.

Economic

Taxation has been the primary form of economic regulation of *satoyama* and *satoumi* landscapes, both through taxes

to *satoyama* and *satoumi* management and conservation. This is a consequence of the Japanese government’s decentralization strategy implemented to foster regional and local initiatives. Decentralization has resulted in greater involvement by NGO and NPO groups.

Technological

Technological advances—such as the production of fertilizers with reduced negative environmental impacts—are helping to restore *satoyama* landscapes. But there is growing recognition that traditional methods, as well as advanced scientific knowledge, must be applied to protect the biodiversity within *satoyama* and *satoumi* ecosystems. This reflects the fact that “traditional” knowledge has successfully ensured both the use and protection of these landscapes in the past, and thus can contribute today.

Cognitive

Perhaps the most promising cognitive response has been a rediscovery of the idea of the “commons”, understood both as a system of co-management of natural resources and the natural resources themselves. The idea of the commons

been legal. Most promising is legislation at the regional and local level that has promoted greater involvement by citizens and non-governmental groups in planning and carrying out environmental initiatives.

Of the responses outlined above, economic initiatives have been the least successful. This reflects the current limited ability of economic valuation to calculate the value of *satoyama* and *satoumi* landscapes, considered either in their human interactions (e.g. for their spiritual value) or as stand-alone ecosystems which promote biodiversity.

The chief challenges moving forward are twofold: 1. finding new and more effective ways to involve citizens and encourage non-governmental participation in the re-establishment of *satoyama* and *satoumi* “commons” and 2. creating economic incentives for protecting non-economic values present in *satoyama* and *satoumi*.

Four Future Scenarios of *Satoyama* and *Satoumi* Landscapes

The JSSA has developed four scenarios describing the plausible future of *satoyama*, *satoumi* and human well-being in Japan in the year 2050. These have



been named: 1. Global Environmental Citizens, 2. Global Technotopia, 3. Techno Introvert, and 4. *Satoyama–Satoumi Renaissance*. These are presented not as *ideal* or *likely* futures, but

Global Technotopia

This scenario also envisions expanded global migration coupled with liberalized trade and economic policies. Centralized government promotes the

especially in critical industries to increase self-sufficiency regarding the production of food and materials. Scientific and technical knowledge is emphasized over traditional and indig-

“Critical to the success of a more integrated and holistic approach to ecosystem management is creation of a new ‘commons’.”

merely different plausible outcomes given certain trends posited in the scenarios.

Global Environmental Citizens

This scenario envisions expanded global migration of humans and labour forces, and emphasizes the liberalization of trade and the development of green economies. It posits a centralized governing system seeking to increase investment in education, social security and the environment. In agriculture, forestry, fisheries, public works and ecosystem management, society employs eco-friendly technology for food production and management of *satoyama* and *satoumi* ecosystems.

In this scenario certain ecosystem services improve (e.g. those producing food and products for exportation) while others decline (e.g. those associated with production for domestic consumption). Energy-related ecosystem services decline through the exploitation of biomass and renewable resources.

Overall, both levels of biodiversity and human well-being are reduced. The former occurs due to the continued importation of non-native species, and the latter because of a loss of job security due to the globalization of the world economy, and because of an increased dependence on imported food and critical materials.

development of technology and amends national policies to enhance international cooperation. However, political and social interests towards education, social security and the environment decrease. In food production, public works and ecosystem management, society leverages technological development to effectively utilize and extract ecosystem resources.

There is a general diminishment in the quality of ecosystem services as a result of the adoption of high-tech agricultural and aquacultural methods leading to degraded regulatory capacity. Somewhat countering this trend is an increase in the quality of energy-related provisioning services due to a reliance on nuclear and high-efficient thermal power generation.

Increased importation leads to a degradation of biodiversity, while it also threatens the job security of those not involved in export production or related activities. Also, with the increased mechanization of production processes, human security is diminished through job loss and transformation of cultural traditions.

Techno Introvert

This scenario anticipates continued population decline and migration from rural to urban settings. In terms of trade and the economy, the government adopts protectionist policies,

enous knowledge. In primary industries, public works and ecosystem management, society looks to technological developments to effectively utilize and extract ecosystem services such as food and water.

Protectionist trade policies somewhat help ecosystem services which are abandoned or under-used in scenarios positing global trade and relaxed import policies. However, much of this ground is lost, since even though domestic production of food and materials increases, this is attributable to high-tech methods (e.g. indoor farming) that do not rely on traditional *satoyama* and *satoumi* techniques.

Biodiversity is more or less protected by restrictive import policies on non-native species, but this is offset by the abandonment of traditional landscapes noted above. The overall effect on human well-being is mixed. While those involved in domestic production of food and goods realize greater security, those who are uninvolved in these activities (e.g. rural dwellers), as well as those who lose their jobs due to new high-tech methods, experience diminished security.

Satoyama–Satoumi Renaissance

In the final scenario, excessive population concentration in mega-cities is reversed though a counter-urbanization movement to the countryside. This is



coupled with decentralized governmental authority and a gradually declining population. The government adopts protectionist trade and economic policies, especially in critical industries, to improve self-sufficiency in food and materials, while embracing the idea of a green economy. In critical industries, public works and ecosystem management, society relies on eco-friendly technology for food production and ecosystem management, such as low-input agriculture, nature restoration and adaptive management involving various stakeholders. There is an overall gain in ecosystem capacity, brought about by protectionist trade policies which encourage domestic production and through the use of management techniques that preserve and enhance ecosystem health.

Biodiversity flourishes best under this scenario; a result of restrictions on the importation of non-native species and the counter-urban movement which sees people returning to traditional *satoyama* and *satoumi* landscapes, and effectively using and managing them. Finally, human well-being is best preserved and enhanced in this scenario. Overall, human security improves as there is less reliance on imports, more job security without the threat of an in-migration of labour (which would be the case in futures that promote the global market), and renewed cultural traditions as connections with *satoyama* and *satoumi* are re-established.

Conclusion

Key Findings

1. The critical feature of *satoyama* and *satoumi* landscapes is the mosaic

composition of different ecosystem types that are managed by humans to produce a variety of ecosystem services benefiting human well-being.

2. *Satoyama* and *satoumi* landscapes have undergone significant decline over the last 50 years, resulting in a drop in their resilience to provide a sustainable supply of ecosystem services.
3. Continued loss of *satoyama* and *satoumi* landscapes has important and potentially negative consequences for human well-being and biodiversity.
4. Integrated approaches, including citizen participation, have been implemented increasingly over the past 10 years and show potential for reducing biodiversity loss and maintaining sustainable flows of ecosystem services.
5. Critical to the success of a more integrated and holistic approach to ecosystem management is creation of a new “commons”, understood both as a system of co-management of ecosystem services and biodiversity within private and public land, and as a single system to produce a bundle of ecosystem services for direct and indirect use by society.

Key Recommendations

1. Policies that take a *satoyama*–*satoumi* approach towards managing biodiversity and ecosystem services should be developed. This approach recognizes the mosaic composition of ecosystem types and their inherent interlinkages.
2. New institutions should be designed under the lens of landscape

governance that can manage both public and private lands. These institutions are needed to govern the “new commons” and allow for decentralized decision-making on the use of land and water bodies within a mosaic structure of different ecosystem types.

3. Institutions that complement the institutions of the new commons (above) should also be designed. This should ensure equitable access and use of ecosystem services provided by *satoyama* and *satoumi* landscapes.
4. A 10-year research programme with adequate funding and human resources to gain a better understanding of the dynamics of *satoyama* and *satoumi* ecosystems, their linkages, and their relationship with human well-being and biodiversity should be devised and put into action. This would be able to provide input to international assessment processes such as the Intergovernmental Panel on Climate Change (IPCC) and the soon-to-be-established Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).
5. Comprehensive, integrated assessments of potential *satoyama* and *satoumi* ecosystems across a number of developing and developed countries should be conducted. These assessments will establish baselines of ecosystem services and form an epistemic community of scholars and practitioners within and across countries who can study and provide guidance to policymakers.



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This brief presents recommendations emerging from the study of Japanese ecosystems.

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