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Research Report

Initial Report on the Examination of Collective Action by Multi-stakeholders Based on a Nature-based Landscape Approach

Mechanism for Achieving Water Positive through the Promotion of Green Infrastructure through Public-Private Partnership in Kumamoto, a Region with a Semiconductor-Related Industrial Cluster

Study group on nature positive in Kumamoto through practices towards water positive

Initial Report on the Examination of Collective Action by Multi-stakeholders Based on a Nature-based Landscape Approach

Table of Contents

Cover : *Photo by Makoto Eguchi*

This research report was written by members of a research group established in March 2024, which is made up of a diverse range of stakeholders, mainly from the private sector. This report is a summary of the initial results of the research group's discussions and investigations into the mechanisms for achieving Water Positive (WP) in Kumamoto, where business investment in the semiconductor industry is currently concentrated.

Executive Summary

The Kumamoto metropolitan area is the second largest urban area in Kyushu, located in the Shirakawa, Kikuchi and Midorikawa river basins, which are fed by Mt Aso. It is a rich region blessed with abundant groundwater and greenery, and 100% of the tap water in Kumamoto City, the central city of the area, is supplied by groundwater. In this region, continuous, progressive and proactive efforts have long been made to conserve and utilise groundwater, with the cooperation of the local governments, businesses and citizens. The groundwater conservation efforts of more than half a century of collaboration between various actors in the Kumamoto region have been recognised worldwide, and in 2013 the region was awarded the UN Water for Life (Water Management Category) Grand Prize. Donations to groundwater conservation organisations are increasing year on year, and it can be said that the people of this region have a strong attachment to their groundwater.

Current groundwater protection, which is mainly based on ordinance- and regulation-based measures, faces challenges, such as the limited number of business operators targeted by the initiatives. It is desirable to promote groundwater conservation on a region-wide basis with an expanded scope of coverage, based on the current groundwater conservation system, and by mobilizing the power of the private sector to support and complement it. In order to halt and restore the loss of Kumamoto's water resources, i.e. to realize water positive in Kumamoto, a new scheme to add to existing efforts is needed.

The importance of responsible management of water resources (water stewardship) by companies involving stakeholders in the basin is becoming more prevalent to address water issues in the basin, and the Alliance for Water Stewardship (AWS), an organisation that certifies water stewardship activities, was established in 2010, and the AWS International Standard was published in 2014. Volumetric Water Benefit Accounting (VWBA) is also known as a method for calculating and sharing the effects of initiatives among stakeholders working on water issues. It will be necessary to establish a mechanism in Kumamoto's groundwater conservation efforts that refers to such systems and methods from an international perspective.

There is room for expansion not only in the framework for groundwater conservation, but also in the methods of conservation. Currently, groundwater conservation in Kumamoto mainly involves winter flooding of rice paddies, conservation of water source forests and stormwater infiltration box. In order to expand these existing methods, the implementation of ‘rain gardens’, which are becoming increasingly popular in the Kumamoto region, in non-pervious areas is considered to be effective. A rain garden is a slightly sunken planting space with a structure that temporarily stores rainwater that has fallen on the roof or elsewhere, rather than allowing it to flow directly into the sewage system, and then slowly allows it to seep into the ground. As plants are grown, they are also expected to provide a habitat for living organisms. The appeal of rain gardens in Kumamoto, where urbanisation is progressing, is that they are expected to have a variety of benefits, including not only groundwater recharge, but also flood mitigation and improved biodiversity.

As an approach that complements existing

initiatives, the development of funding methods could be considered in the future. Green finance is known as an effective means of introducing private-sector funds into green projects that contribute to the prevention of global warming and the degradation of natural capital. In recent years, the need for fundraisers and financial institutions to address climate and nature-related issues has increased, and green finance is developing in various forms. In Kumamoto, the regional financial institution Higo Bank has started to offer ‘green loans’ for environmentally friendly projects, and it is hoped that green finance will also be used for projects related to the current issue of groundwater conservation.

More cooperation and action will be needed in the future to preserve the water of Kumamoto, Japan's world-class groundwater city, for future generations. Direct groundwater abstraction is not the only factor affecting groundwater due to concentrated investment in large-scale industrial locations. The covering of natural and agricultural land with man-made structures as a result of the expansion of relevant enterprises and the development of residential and commercial areas, road construction, etc., changes the hydrological cycle, microclimate and stormwater run-off. In order to assess and address these risks, the establishment of a Public-Private Partnership action mechanism is urgently needed. At present, relevant companies and organisations share a sense of the issues in the Kumamoto region and have only started to consider the overall picture and framework of possible initiatives from early 2024. The aim is to develop a logic model that can be used as a use case for solving nature-related issues in the region and to contribute to international rule-making.

Introduction: Prospects for water positive in the Kumamoto region

In recent years, the semiconductor and digital industries have been developing and expanding rapidly. In particular, the fields of application for the ‘Internet of Things’ (IoT), which connects objects to the internet, and ‘Artificial Intelligence’ (AI), which gives machines intelligence, are expanding rapidly on a global scale as they are used to solve social issues and improve the convenience of people's lives. Data centres that use cutting-edge semiconductors are essential for an IoT/AI society. On the other hand, it is known that large amounts of water are used in the manufacture of semiconductors and the operation of data centres, and there are growing concerns around the world about the depletion of water resources and the impact on the water cycle due to the development of IoT and AI. These concerns are not irrelevant even in Japan, which is said to be blessed with water resources. Even in Kumamoto City, which is known as one of the world's leading cities for groundwater, maintaining the balance between supply and demand for water has become an urgent issue due to the development of the semiconductor industry and rapid urbanisation.

Nature Positive (NP) is the concept of `halting and reversing the loss of nature by 2030 and achieving full restoration by 2050`, consistent with the 2050 Vision and 2030 Mission of the Kunming-Montreal Biodiversity Framework adopted at the 15th Conference of the Parties to the Convention on Biological Diversity (CBD COP15) held in December 2022. Against this backdrop, interest in the nature has been growing internationally in recent years, and countries and companies are developing strategies with NP in mind.

In Kumamoto, the need for groundwater conservation measures with NP and 'living in harmony with nature' in mind has been recognised, and attention is being paid to Green Infrastructure (GI) as a means of achieving this. In order to realise Water Positive (WP) in Kumamoto, i.e. to halt the loss of water resources and restore them through the use of nature-based GI, a private-sector-led study group was initiated in March, 2024. This report presents the results of the study to date.

[Participating organisations in the study group]

- Prefectural University of Kumamoto
- Higo Bank, Ltd.
- The Regional Economic Research Institute
- Kumamoto University
- Kumamoto Ground Water Foundation
- The Foundation for the preservation of Green and Water Resources of Higo
- Suntory Holdings Ltd.
- Development Bank of Japan Ltd.
- MS&AD Insurance Group Holdings, Inc.
- Mitsui Sumitomo Insurance Co.
- MS&AD InterRisk Research Institute Ltd.
- Kumamoto prefecture*.
- Kumamoto city*.

*Participating as an observer

Recently, investment in cutting-edge semiconductor manufacturing facilities and AI data centres has been concentrated in the Asian monsoon region, including Japan. There is concern that if the water cycle system changes in these countries, the same issues as those in the Kumamoto metropolitan area may arise. The

measures that the Kumamoto region has been promoting to preserve groundwater could become a model for groundwater areas where the development of semiconductor and data centre-related businesses is progressing. At the study group, we will continue to consider how to make the ‘Kumamoto City Model’ a model that can be used worldwide.

In the future, we will continue to consider NbS (nature-based solutions) with a view to formulating rules to help the Japanese government achieve the transition to an NP economy. We will continue to discuss the development of a global model that covers the entire process from quantitative assessment of the impact (risk) on groundwater resources and microclimate in river basins, to quantitative assessment of the impact using the NbS method, to specific PPP (public-private partnership) actions that positively improve the impact.


Photo by Makoto Eguchi

1. Groundwater city Kumamoto

1.1. Overview of the Kumamoto metropolitan area

The Kumamoto metropolitan area is located in the mid-western part of Kyushu Island, Japan, with a population of approximately one million. The central city is Kumamoto City, located in the Shirakawa, Kikuchi and Midorikawa river basins, which are fed by Mt Aso in central Kyushu, and are rich in water and greenery. Most of the basins are covered by volcanic geology and have abundant groundwater resources. Annual rainfall is 2,000 mm on the plains and over 3,000 mm in the mountains, and the average annual temperature in Kumamoto City is about 18°C, making it a warm and rainy region. There are many scenic spots with springs in this urban area, such as Suizenji Seishuen, which is designated as a Great Scenic of the Nation, Hakenomiya, Lake Ezu and Kashima Spring Group, which are well known to the citizens.

1.2. Groundwater in Kumamoto

The 11 municipalities in the Kumamoto region (Kumamoto City, Kikuchi City (former Shisui Town & Kyokushi Village), Uto City, Koshi City, Ozu Town, Kikuyo Town, Nishihara Village, Mifune Town, Kashima Town, Mashiki Town and Kosa Town), which extend from the western foot of the Aso Outer Rim to the Kumamoto Plain and its surrounding plateau, share one groundwater basin. The groundwater is the basis for the livelihoods of local people and economic activities such as agriculture and industry. In particular, the Kumamoto region, which is made up of 11 municipalities including Kumamoto City, is known as a 'groundwater city', which is rare in the world, as it obtains 100% of its tap water from groundwater. Groundwater has become an irreplaceable and precious resource that supports

Figure 1-1 Groundwater flow in the Kumamoto area

the Kumamoto region, and continuous, progressive and proactive efforts have long been made in the region to conserve and utilize groundwater, with the cooperation of the local governments, businesses and citizens. The groundwater conservation efforts of more than half a century of collaboration between various actors in the Kumamoto region have been recognised worldwide, and in 2013 the area was awarded the UN Water for Life (Water Management Category) Grand Prize.

1.3. The history of groundwater conservation in Kumamoto

In the 1970s, the environment surrounding groundwater changed due to urbanisation and the development of the industrial economy, and gradual changes such as a drop in groundwater levels and deterioration in water quality began to be seen. In response, Kumamoto Prefecture and Kumamoto City conducted the "Kumamoto City and Surrounding Area Groundwater Survey" in 1973 to ascertain the actual situation. In light of the results, in 1977 Kumamoto City enacted the Kumamoto City Groundwater Conservation Ordinance, and in 1978 Kumamoto Prefecture enacted the Kumamoto Prefecture Groundwater Ordinance, and initiatives to conserve groundwater in cooperation with residents and businesses as well as the government began.

In 1984, the prefecture and city once again conducted a "Kumamoto Area Groundwater Survey", and in 1986, the "Kumamoto Area Groundwater Conservation Measures Council" (hereinafter referred to as the "Council") was established, chaired by the Governor of Kumamoto Prefecture, in order to promote further measures based on the survey results. In 1991, the "Kumamoto Groundwater Foundation" (hereinafter referred to as the "Foundation") was established, chaired by the Mayor of Kumamoto City, and in 1995, the "Kumamoto Area Groundwater Conservation Utilisation Council" (hereinafter referred to as the "Utilisation Council") was established, mainly comprising many businesses including groundwater extraction businesses, to promote groundwater conservation from their respective perspectives. Efforts to conserve groundwater from different perspectives have been further promoted.

In 2003, the first paddy flooding project in the middle reaches of the Shirakawa River was launched. This initiative, which started with an area of approximately 30 ha in collaboration with groundwater extraction companies and NGOs, would later lead to the expansion of groundwater irrigation projects. The following year, Kumamoto City also started a paddy flooding project with a total area of 255 ha, and the groundwater recharge project through paddy flooding continues to this day, with the number of participating businesses increasing.

In 2008, Kumamoto Prefecture and 11 municipalities formulated “the Kumamoto Regional Groundwater Comprehensive Conservation and Management Plan”, which specified the study of a system to promote groundwater conservation through the united efforts of residents, businesses and the local governments. As a result, a new organisation integrating the task force, the fund and the utilisation council started to study more effective conservation measures.

In 2012, the “Kumamoto Prefecture Groundwater Conservation Ordinance" was amended, positioning groundwater as 'public

water' and introducing a permit system for groundwater extraction. In addition, groundwater extraction operators are obliged to rationalise groundwater use and groundwater recharge, and operators extracting groundwater above a certain size are required to formulate a groundwater use rationalisation plan and report on its implementation every year, as well as formulate a groundwater recharge plan and report on its implementation every year.

The Kumamoto Prefectural Government's “Guidelines for the Promotion of Groundwater Recharge” (hereinafter referred to as the "Recharge Guidelines"), which set out specific groundwater recharge measures, designates the Kumamoto area as a priority area under the Ordinance and sets a target of 10% of groundwater extraction for recharge measures to be implemented. In order to achieve the 10% target, groundwater extraction operators were given examples of measures to promote on-site recharge, flooding of rice paddies and conservation of farm lands, forests and grasslands, and these measures were expanded in each of the groundwater extraction projects in various regions. In addition, collective actions with other business operators are also considered to be good.

In 2012, the Kumamoto Ground Water Foundation (hereafter Ground Water Foundation) was established with the participation of local residents, businesses and the local governments as a result of studies towards the integration of the two foundations. The Ground Water Foundation has a Board of Trustees and a Board of Directors comprising the Kumamoto Prefectural Government, 11 municipalities in the Kumamoto region, business operators and academics, and groundwater conservation projects are implemented under their deliberation and approval. In addition, there is a supporting organisation made up of many residents and businesses, and the number of supporting members has almost doubled since the foundation was established, providing the financial basis for the foundation's groundwater conservation projects. In addition, the amount of donations to the Ground Water Foundation has been increasing year by year, as it is possible to contribute to groundwater conservation measures through donations to the Foundation, as part of the collective actions of groundwater extraction operators as specified in the above-mentioned recharge guidelines.

Furthermore, in recent years, against the backdrop of the increasing social contribution activities of companies, groundwater conservation activities by non-groundwater extraction businesses have also become more and more popular year by year. Through such integrated efforts by residents, businesses and the government, the paddy field flooding project has also expanded with the participation of various entities, and initiatives such as the development of water source reforestation projects and the expansion of contract cultivation areas to make rice cultivation sustainable have also become established.

As a result of these efforts, the downward trend in groundwater levels in various areas has begun to be halted, and in some places groundwater levels are even beginning to rise, showing signs of improvement in the groundwater environment.

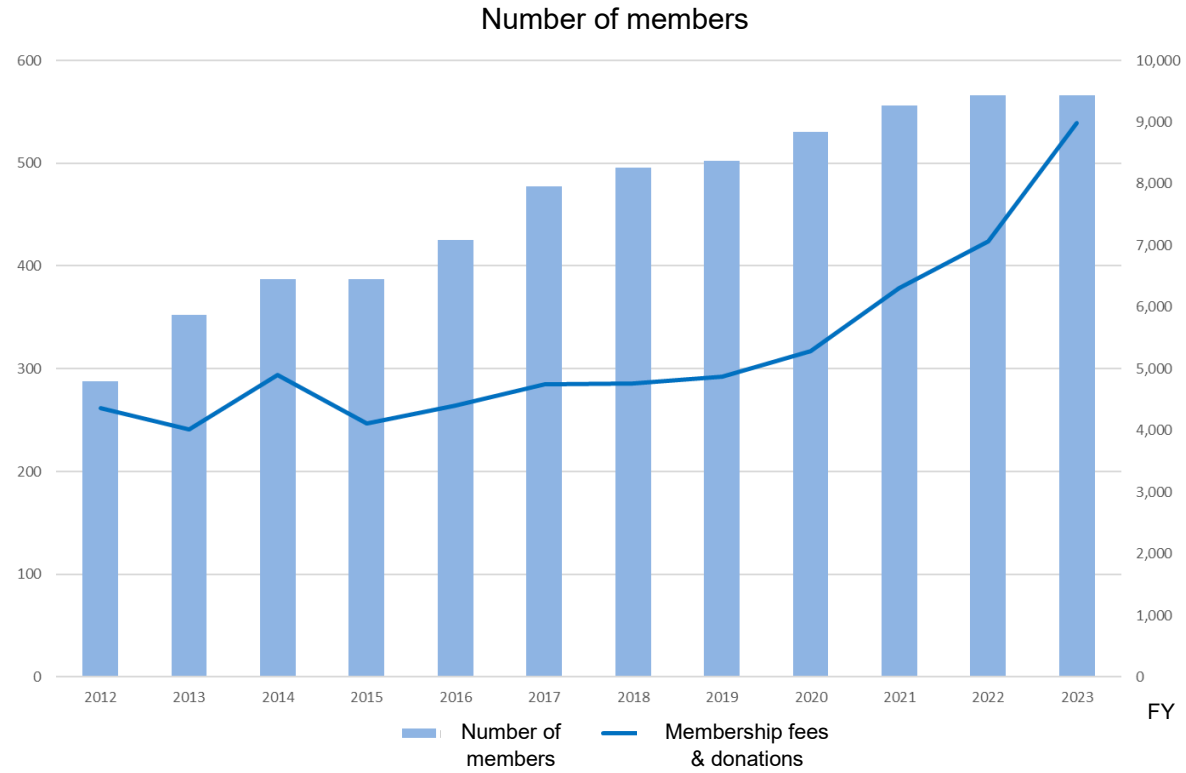


Figure 1-2 Amount of membership fees and donations

However, the recent influx of major semiconductor companies and the resulting concentration of semiconductor-related facilities has had a significant positive impact on the local economy, but at the same time has also led to a huge increase in demand for groundwater, causing great anxiety among the residents of the Kumamoto area. Fearing that the balance between the amount of groundwater being extracted and the amount being recharged would be disrupted, in October 2023 Kumamoto Prefecture revised its recharge guidelines, significantly strengthening the obligation of groundwater extraction businesses to take recharge measures. Under the new recharge guidelines, the obligation for new groundwater extraction businesses in key areas to take recharge measures has been raised from 10% to the amount equivalent to the amount of groundwater extracted (in principle, 100%). Furthermore, with the cooperation of related organisations centred on Kumamoto Prefecture, they are working to expand recharge measures to meet new water demand, such as adjusting water rights during the non-irrigation period with the aim of extending the period of water retention in rice paddies, and considering the resumption of rice cultivation in fields that have been converted to other crops

1.4. Groundwater conservation initiatives in Kumamoto

1.4.1. Paddy flooding initiatives

The Kumamoto area is made up of layers of volcanic ash that were ejected during the prehistoric eruption of Mt. Aso, and the soil is rich in gaps, so water easily seeps in. In addition, it is thought that the groundwater became even more abundant about 430 years ago when many rice paddies were opened in the middle reaches of the Shirakawa River and irrigation of river water began.

When rice cultivation was flourishing, groundwater was rechaeged in many paddy fields during the irrigation season, but the amount of groundwater recharge has been declining as a result of factors such as increasing urbanisation and decreasing rice cultivation.

Therefore, artificial recharge measures have been implemented, such as waterlogging projects in rice fields under irrigation and waterlogging projects after the end of rice cultivation in non-irrigated seasons. In all of the waterlogging projects, cooperating farmers are paid in the form of cooperative funds. In some cases, the cooperative funds are paid directly by the local governments or business operator, while in other cases, the funds are paid through the Ground Water Foundation after the Foundation receives them as donations or support from the business operator.

In recent years, the project has been working to recharge groundwater in the Shirakawa River basin in one city and two towns, with a total of 15.79 million m3 of groundwater being recharged by Kumamoto City and private companies, and in the area of four towns and one village, with a total of 5.4 million m3 of groundwater being recharged by the Ground Water Foundation and private companies.

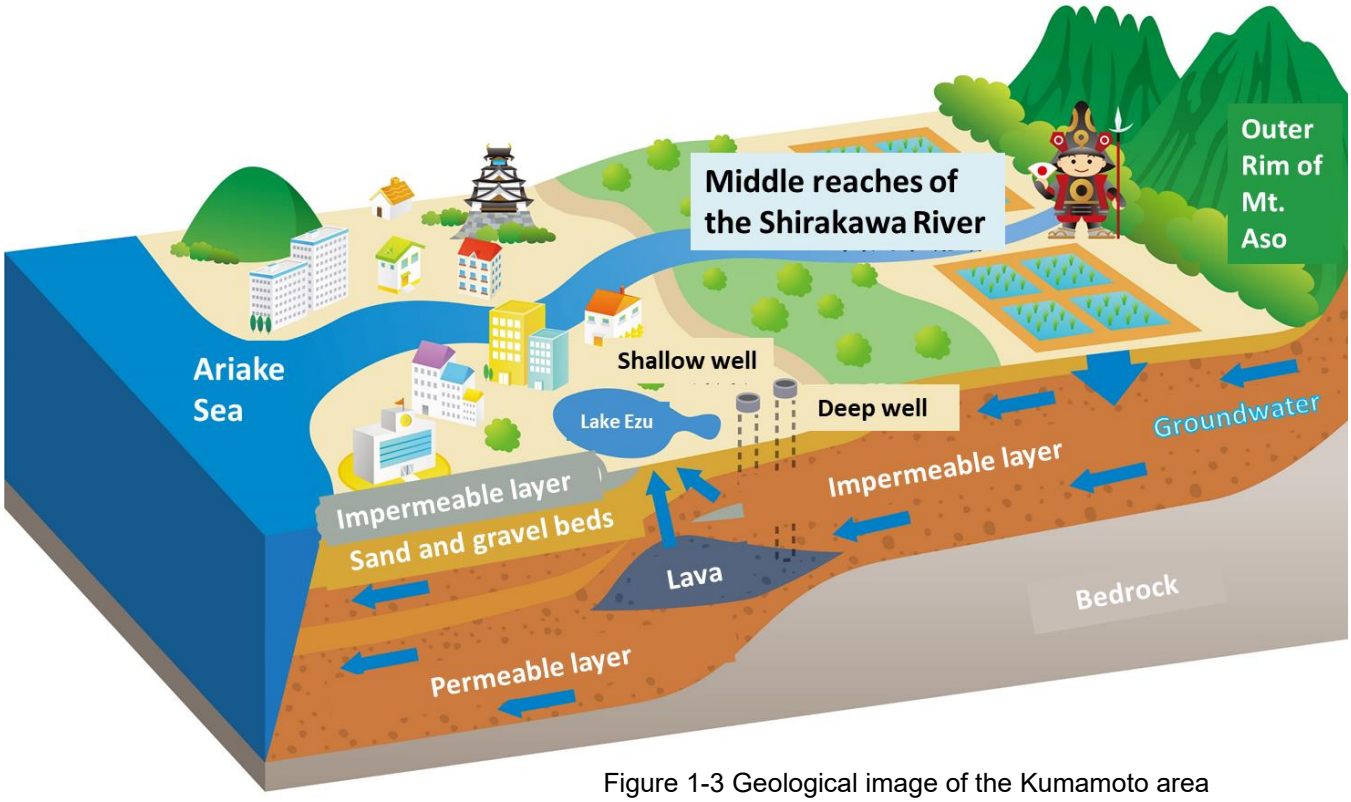


Figure 1-3 Geological image of the Kumamoto area

Figure 1-4 Winter waterlogging

1.4.2. Water source forestry initiatives

Rain that falls in forests is stored once in the forest soil and then soaks into the ground over time. Focusing on the water source recharge effect, which is one of the multifaceted functions of forests, the local governments and business enterprises are developing and managing water source recharge forests. As of the end of fiscal 2022, Kumamoto City is carrying out forest management of 877 hectares in the upper reaches of the Shirakawa and Midorikawa rivers, which are located upstream of the city. In addition, other cities, towns and villages in the Kumamoto area, as well as the Groundwater Foundation, are each carrying out appropriate development and management of approximately 300 hectares of water source recharging forests. In addition, several businesses are also involved in water source recharging forest projects.

1.4.3. On-site recharge initiatives

Various stormwater infiltration facilities have been installed by various business operators to allow rainfall on their sites to infiltrate underground as far as possible. Examples include rainwater infiltration boxes, rainwater infiltration trenches, rainwater infiltration gutters, permeable pavements, greening blocks, green spaces and permeable regulating ponds. In addition, 11 cities and towns in the Kumamoto region have set up a subsidy system for local residents to install rainwater infiltration boxes, and are working to promote their installation.

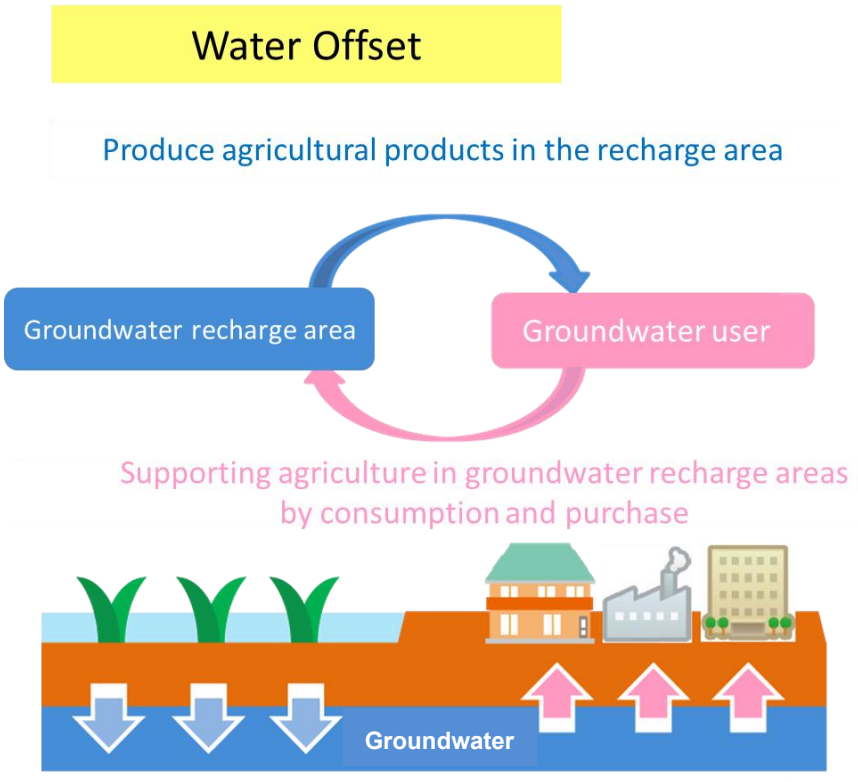
1.4.4. Initiatives to reduce groundwater extraction

Efforts to reduce, as much as possible, the amount of groundwater extraction that supports the daily lives and business activities of the residents of the Kumamoto region are also important. Voluntary initiatives by businesses to reduce the amount of water used in various processes in their business activities through water recycling and the introduction of water-saving equipment are also being undertaken.

In FY2021, the annual amount of groundwater extracted in the Kumamoto region was approximately 160 million tonnes, of which approximately 100 million tonnes, or 65%, was pumped up by the water supply system. As water conservation by local residents can lead to a significant reduction in the amount of groundwater extracted, 11 cities and towns in the Kumamoto region are also focusing on water conservation campaigns for local residents. In addition, to promote rainwater harvesting, a subsidy system has been set up for residents to install rainwater harvesting tanks, and efforts are being made to promote their use.

1.4.5. Efforts to increase agricultural consumption for groundwater recharge

Groundwater in the Kumamoto region has been heavily recharged by agriculture for many years. In order to make agriculture a sustainable industry, it is important for local people, who are consumers, to support agriculture in areas with high groundwater recharge effects. Therefore, in order to increase consumption of rice and processed products made from rice produced in areas with high recharge effects, as well as livestock products grown on feed rice, various awareness-raising activities have been conducted under the title of the 'Water Offset Project', and businesses are purchasing those products for their cafeterias, and many local residents are also purchasing them.



Rice produced in the middle reaches of the Shirakawa River (Ozu town and Kikuyo town) and miso made from that rice

Ekome beef
Cattle fed with feed rice produced in the Kikuchi region

Figure 1-5 Image of water offset

Box: Higo bank's approach

Higo Bank, which has its head office in Kumamoto, proposed in 1987 that 'we should protect the groundwater, which is an important asset of our hometown, from depletion and contamination', and together with Kumamoto Prefecture and the Kumamoto Nichinichi Shimbun newspaper company, established the "Higo Water Resources Preservation Award" (now the Higo Green and Water Resources Preservation Award).

This prize is awarded to groups and individuals who are working to conserve water resources, and since its establishment a total of 353 groups and 16 individuals have received the award.

This activity was taken over by the Foundation for the preservation of Water Resources of Higo, which was established in 1992, and a wide range of activities are being carried out, including holding symposiums, displaying water-saving devices, and planting trees in forests near water sources. In September 2008, the name was changed to the 'Foundation for the preservation of Green and Water Resources of Higo' as environmental issues reached a stage where greater emphasis should be placed on promoting greening. The foundation mainly focuses on commendation projects, and also carries out educational activities through symposiums, newspapers, TV, etc., and provides grants to volunteer groups.

"Aso Mizukake Tanada" terraced rice fields

[Examples of social contribution activities]

・Tree-planting activities in the 'Aso Taikan no Mori' forest. With the aim of cultivating water source forests, a total of 62 ha and over 150,000 trees have been planted (since 2006)

・Rice cultivation in the 'Aso Mizukake Tanada' terraced rice fields

We are working on a project to restore terraced rice fields that have been abandoned and to practice agriculture that maintains the rice paddies in a flooded state (from 2011).

The tree planting and rice harvesting are carried out by volunteers, mainly employees of Higo Bank, but in recent years the circle of people involved has been expanding, with employees of business partners also taking part. The groundwater that has been recharged through these activities greatly exceeds the amount of water used in Higo Bank's business activities, making it a water positive.

"Aso Taikan no Mori" forest

2. Water Positive' in Kumamoto

2.1. Nature positive (NP) and water positive (WP)

Nature Positive (NP) is the concept of `halting and reversing the loss of nature by 2030 and achieving full recovery by 2050`. It is consistent with the 2050 Vision and 2030 Mission of the Kunming Montreal Biodiversity Framework of the Convention on Biological Diversity and has been incorporated into the G7 2030 Nature Compact and the Japanese government's “Nature Positive Economic Transition Strategy”.

The Earth's life-support systems (biosphere), on which society and the economy depend and impact, are referred to in environmental economics as “natural capital”. The SDG wedding cake (Figure 2.1) is a simple and straightforward illustration of how the sustainability and resilience of natural capital is a necessary condition for an economy and society to be sustainable.

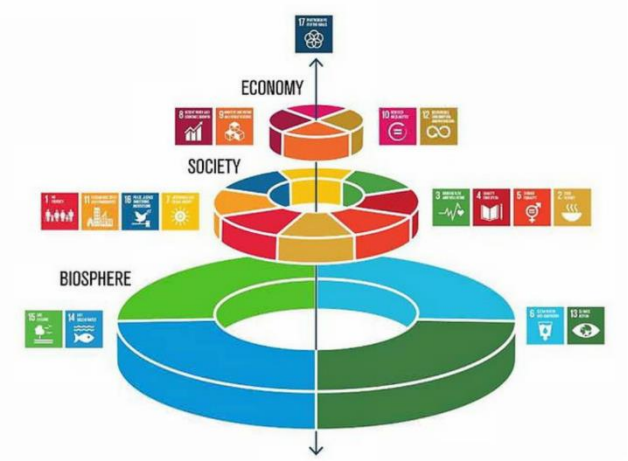


Figure 2-1 The SDGs wedding cake
Credit: Azote for Stockholm Resilience Centre, Stockholm University CC BY-ND 3.0

One of the proponents of this diagram, Johan Rockström of the Stockholm Resilience Center, is a leader in Planetary Boundary research group, which sets nine boundaries within which humans can safely survive, to see how much humanity is abrogating the biosphere (natural capital). and continually assesses the state of these boundaries. The abandonment of natural capital has worsened over the years, and currently six of the nine areas, including 'freshwater use', are beyond the safe zone (green zone). (Figure 2-2)

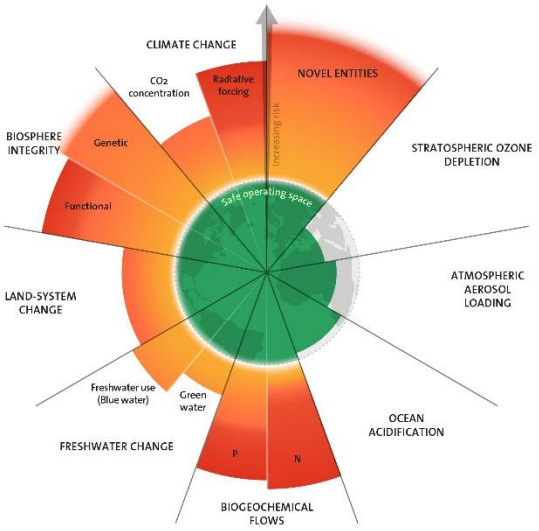


Figure 2-2 The 2023 update to the Planetary boundaries
Credit: Azote for Stockholm Resilience Centre,

The NP seeks to transform economic and social systems to fit within this safety zone, and to create money flows that invest in the conservation and restoration of natural capital so that these boundaries can be extended.

As semiconductor-related companies rush to invest in Kumamoto Prefecture, “halting and restoring the loss of water resources” based on the concept of NP, or “Water Positive (WP)” in Kumamoto, will be a very important activity to ensure the global trend of NP.

2.3. WP issues implied by the TNFD assessment approach

The Taskforce on Nature-Related Financial Disclosures (TNFD) was established in 2021 “to develop and provide a risk management and disclosure framework for organizations to report and act upon changing nature-related risks and to help shift global money flows from nature negative to nature positive.” Many large Japanese companies are using this framework to assess how their operations depend on and impact natural capital, and are preparing to disclose the risks and opportunities arising from this.

The scope of this risk assessment includes not only where they operate directly, but also upstream and downstream in the value chain. For example, for industry sectors that use semiconductors or AI services, their operations fall upstream of their own, so they need to be included in the risk assessment. Five impact factors from operations are covered, including freshwater use. (Figure 2-3)

More importantly, not only the dependence and impacts of the operating facilities need to be assessed, but also external impacts ('external drivers of change' in Figure 3-4). This is because, for example, assuming a semiconductor plant in Kumamoto, the dependence and impact on the region's natural capital cannot be properly assessed without also considering the impact of roads and other infrastructure development, housing and retail development and the operations of suppliers' facilities that will be built in conjunction with the plant.

Therefore, using the TNFD framework, it can be understood that achieving WP in the operations of individual sites does not necessarily translate into WP for the region as a whole. This is why, as set out in the aforementioned action policy, private sector-led voluntary initiatives are needed to complement groundwater conservation efforts based on ordinances and other measures.

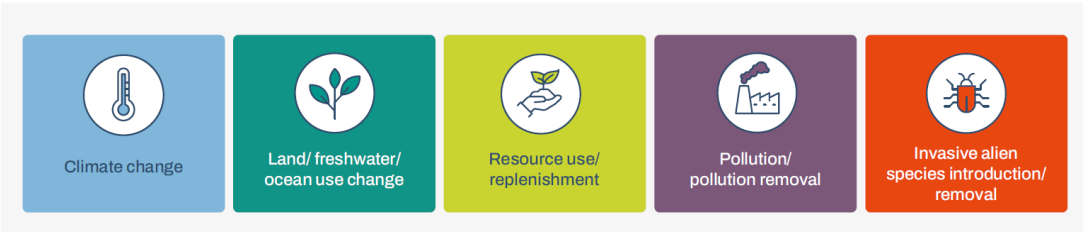


Figure 2-3 Five change drivers of nature (TNFD, 2023)

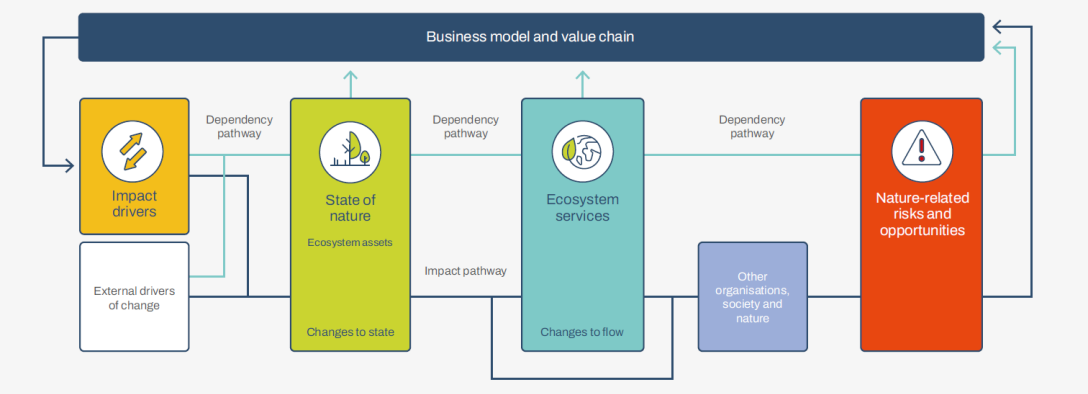


Figure 2-4 Linkages between nature-related dependencies, impacts, risks and opportunities - impact and dependence pathways (TNFD, 2023)

2.4. Addressing WP as an essential industrial infrastructure in the age of Artificial Intelligence

The Semiconductor and Digital Industry Strategy [1], revised in May 2023 by the Ministry of Economy, Trade and Industry, states that "The appearance of generative AI, combined with the quantum computer and AI computer, and the quantum leap in another dimension of information processing, will further overwhelm the expansion of computational processing in data centers/use-specific processing, and also the expansion of edge areas, where distributed information processing. In addition, there is a need to reduce electric power consumption." The need to reduce the carbon footprint of the AI industry is suggested as "a major challenge for the industry". On the other hand, there is no mention of water footprint. This may be due to the fact that, at present, the disclosure and analysis of water footprint data in semiconductor manufacturing plants and AI data centers is not well developed.

Semiconductor manufacturing plants use ultrapure water in every stage of the manufacturing process, and as semiconductors become finer, water consumption increases. A case study analysing TSMC's water demand in Taiwan estimates that it will double from 2022 levels by 2030. Meanwhile, Taiwan is experiencing declining precipitation and drought, and there is a risk that production declines due to water shortages could disrupt the global supply chain.[2]

Current generation semiconductors will be manufactured in Kumamoto, but changes in the global economic situation could lead to a shift to the manufacture of cutting-edge semiconductors, which would require a scenario in which water demand doubles on a per-wafer basis compared to current assumptions.

In addition, a study of data centers built using advanced AI semiconductors, which considered not only the carbon footprint but also the water footprint of water taken and consumed for on-site server cooling and off-site power generation, found that by 2027, due to the increasing demand for AI water footprint could reach 4.2-6.6 billion m3, which is equivalent to more than half of the UK's current total annual water abstraction[3]

In view of this, it is necessary to envisage the possibility that water resources in Kumamoto and elsewhere in Japan may become one of the attractions for domestic and foreign business operators to locate semiconductor manufacturing plants and data centers.

2.5. How to achieve WP in Kumamoto

It was mentioned earlier in Chapter 1 that groundwater recharge measures by various actors have been ongoing in Kumamoto for many years. On the other hand, in order to achieve WP, a framework and initiatives that complement existing efforts are needed. A private-sector-led study group was launched in March, 2024 to examine additional initiatives targeting areas that are beyond the reach of conservation measures by Kumamoto Prefecture and municipalities alone, and to promote them in collaboration with Kumamoto Prefecture, municipalities and the national government.

In considering a framework that complements existing initiatives, the study group is exchanging information on international trends in water resource management, groundwater recharge methods using green infrastructure, and the implementation of green finance.

3．International trends in water resources management

3.1.（WS）Water stewardship (WS)

Water is a resource that circulates through river basins, and we can continue to benefit from its appropriate use. On the other hand, in order to maintain the water cycle in river basins, it is necessary for stakeholders in the basin to work together to manage it. In Japan, many private companies have set their own water risk management targets based on their own understanding of the issues in their watersheds, but their own initiatives alone are not enough to deal with the risk of changes in the external environment caused by excessive water extraction by other stakeholders. In order to deal with these risks, it is necessary to carry out 'water stewardship activities' in collaboration with stakeholders in the watershed.

Water stewardship (WS) is defined as 'the use of water in a way that is socially and culturally equitable, environmentally sustainable and economically beneficial, and achieved through a process that involves stakeholders and includes on-the-ground and watershed-based activities'[4] The word 'stewardship' means 'the management of assets entrusted to others' in English, and the 'stewardship' referred to here is derived from the 'stewardship theory' proposed by Dr. Elinor Ostrom, the 2009 Nobel Prize winner in economics, and others through their research on common resources (commons). Through several case studies, including forest management in Japanese mountain villages, Dr. Ostrom showed that sustainability of resources can be achieved when users of common resources voluntarily organise cooperatives and manage resources independently while monitoring each other. In this context, water stewardship means that water users work together with stakeholders in the watershed to have a positive impact on the water cycle in the watershed, such as maintaining river flow, recharging groundwater, and restoring wetlands, while working beyond their own premises.

3.2. International progress in water stewardship

The management of water has been advocated by various international NGOs, and its importance has been shared, disseminated and spread internationally through collaboration with businesses and public policy.

In the early 1970s, the Water Pollution Control Law was enacted in Japan and the Clean Water Act in the United States, and companies focused on water management within their own premises, such as thorough management of the quality of wastewater discharged from factories and water intake and water conservation management. However, in the 2000s, global companies, particularly those in the beverage and food industries that use a lot of water, began to face conflicts with local residents at their production bases, and in some cases were forced to suspend operations or relocate their production bases. In response to this situation, companies have recognised the importance of not only managing water on their own premises, but also managing water resources in the catchment area in cooperation with other water users, and in the 2010s, several companies began to engage in water stewardship.

The Coca-Cola Company has set a target of achieving 'water neutrality' by returning the amount of water used at its production sites (the

amount of water withdrawn minus the amount of water discharged) to the source of the water by 2020, and has reported that it achieved this target globally by 2016.[5] In order to achieve this goal, the company worked with several international NGOs (including The Nature Conservancy (TNC) and the World Wide Fund for Nature (WWF)) to implement activities such as the conservation and restoration of land cover and the restoration of wetlands in the watersheds where its production bases are located, and reported on the quantitative impact of these activities in its reports.

Nestlé also helped to set up the Water Stewardship Alliance (AWS, see 3.4.1. for an overview) in collaboration with WWF and other organisations, and in 2014 the AWS published international water stewardship standards. [6] Based on these standards, the AWS is promoting the auditing and certification of water stewardship activities at companies' production sites and other locations, as well as activities in the surrounding watersheds. In 2017, Nestlé's Seacpura factory in Pakistan became the first company in the world to receive AWS international certification.[7] The factory was recognised for its initiatives, including the reuse of water from milk through reverse osmosis membrane separation, wastewater treatment within the factory, tree planting activities in water source areas, support for efficient agricultural recharge, and the provision of safe, clean water to 30,000 local residents. Nestlé Waters has set a target of obtaining AWS international certification for all of its production sites by 2025, and it is reported that by 2023, 23 of its 44 sites will have obtained AWS international certification, and its volume water benefit (VWB) will reach 4.4 million m3.[8]

More recently, water management initiatives have expanded beyond the beverage and food industries to include the ICT and electronics industries, the pharmaceutical industry, and more. Apple is pursuing long-term water management initiatives in areas of high water stress, including watersheds where its data centres and suppliers' manufacturing sites are located, as well as in northern and southern California, the Colorado River basin in Arizona, and the Indian states of Telangana and Maharashtra. California, the Colorado River basin in Arizona, and the Indian states of Telangana and Maharashtra, where water stress is high. In Northern California, they are planting native species to restore the natural floodplain at the confluence of the Sacramento, Feather, and Butte creeks, reconnecting large areas of the historic floodplain and increasing its resilience to flooding. Through similar initiatives, Apple announced that as of April 2024, five data centres and 20 supplier manufacturing sites had achieved AWS International certification.[9]

3.3. Watershed conservation initiatives in Japan

In Japan, the Basic Act on Water Circulation was enacted in July 2014. The Basic Plan for Water Circulation, formulated by the Secretariat of the Headquarters for Water Circulation Policy of the Cabinet Secretariat, defines watershed management as ‘the comprehensive and integrated management of a watershed does not mean the existence of a single administrator managing the entire watershed, but rather refers to the management of the quantity and quality of water, as well as human activities related to water, in forests, rivers, agricultural land, urban areas,

lakes, marshes, coastal areas, etc. It is defined as ‘activities in which the various entities involved in river basins (governments, experts, companies, organisations, residents, etc.) work together through various initiatives to maintain or improve the natural environment in a proper and favourable state’. Based on this definition, the government has confirmed that plans have been drawn up in each region that set out basic policies for basin management, etc., and as of June 2024, 102 plans have been announced as ‘Basin Water Cycle Plans`[10]。

3.4. International water assessment, measurement and certification methods

In order to promote collaboration with stakeholders, it is necessary to have a common understanding of shared issues in the river basin, a mechanism for linking issues to initiatives, and a common measure for understanding the effectiveness of initiatives and responses to issues. In this section, we will discuss the Alliance for Water Stewardship (AWS), a system that involves stakeholders in a river basin in the responsible management of water resources and certifies companies that have taken such action, and the Water Stewardship Standard (WSS), a system that allows stakeholders to calculate the quantitative benefits of water (the amount of water gained through their efforts). Volume Water Benefit Accounting (VWBA) is a method for calculating and sharing the quantitative benefits of water (the amount of water gained through initiatives) among stakeholders working on water issues.

Photo by Makoto Eguchi

3.4.1. Alliance for Water Stewardship

AWS (Alliance for Water Stewardship) is a certification standard that aims to promote the responsible management and use of water resources (water stewardship). Through the implementation of this standard, AWS aims to achieve the following five outcomes

① Good water governance
② Sustainable water balance
③ Good water quality status
Important water-related areas
④ Safe water, sanitation and hygiene for all (WASH)

Although certification is basically for individual sites, group certification with other sites is also recommended if they are located in a shared watershed and have common issues. The standard consists of five steps, and each step consists of multiple criteria that should be addressed, as shown in Figure 3-1.

Step 1 aims to collect data to understand the shared water challenges and their impacts, risks and opportunities. Step 2 requires the development of a water management plan based on the information gathered in Step 1. This focuses on how to improve the condition of the shared watershed from the perspective of the five outcomes and what actions the site will take to achieve this. Step 3 requires the site to implement the plan developed in Step 2. For example, if the site has set targets to improve the recycling rate and reduce water intake, it will be required to report on these targets and progress. In this way, Step 3 requires reporting on the progress of risk mitigation. In Step 4, the actions taken in Step 3 are evaluated, and the contribution to achieving the five outcomes is analysed, and the water stewardship plan is reviewed as necessary. Finally, in Step 5, dialogue with stakeholders regarding water stewardship and disclosure of information regarding initiatives at the site are carried out.

There are 10 to 40 indicators set as standards to be complied with for each step. These indicators include 'core indicators' that indicate minimum requirements and 'advanced indicators' that encourage the achievement of a higher level of water stewardship and continuous improvement.

The minimum requirement for certification is to meet the criteria for all core indicators. The more points you score for advanced indicators, the higher your water stewardship performance, and the higher your AWS certification level (core, gold, platinum). Suntory has obtained AWS certification for the Okudaisen Beech Forest Plant and the Kyushu Kumamoto Plant.

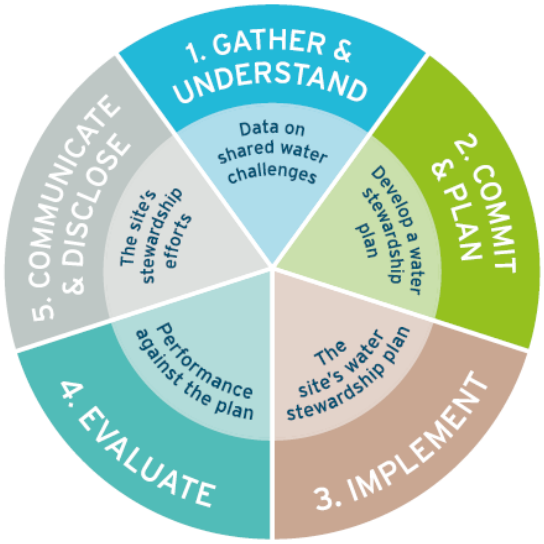


Figure 3-1 Stages of engagement indicated by water stewardship[11]

Box: Suntory's approach

The Suntory Group acquired Japan's first AWS international certification at the Suntory Natural Water Okudaisen Beech Forest Plant (Tottori Prefecture) in 2018, and acquired certification at the Kyushu Kumamoto Plant (Kumamoto Prefecture) in 2019 and at the Suntory Natural Water Minami Alps Hakushu Plant (Yamanashi Prefecture) in 2021. At the Kyushu Kumamoto Plant, an area of 420ha has been set aside as the 'Natural Water Aso' area in the Minami-Aso outer rim mountains, which are the source of the groundwater pumped up in the factory, and forest maintenance activities are being carried out. To improve the condition of unmanaged plantations, we are starting by building access roads and thinning the trees to the appropriate density. By thinning the trees to an appropriate density, sunlight can grow the vegetation on the forest floor, and it has the effect of controlling soil runoff and protecting the soil that supports the infiltration of rainwater into the groundwater. In addition, fallen leaves and branches provide nutrients to the soil, creating healthy soil that is soft and highly permeable. Furthermore, thinning also improves the hunting environment for the hawk eagle, a bird of prey, and contributes to the improvement of biodiversity. Suntory has named these initiatives 'Natural Water Forest' and is promoting them as part of its core business of forest creation, rather than as a volunteer activity. In addition to the 'Natural Water Forest' project, every winter Suntory works with local farmers, land improvement districts and the Kumamoto Ground Water Foundation to flood 11 hectares of rice paddies in Mashiki Town. Through these 'Natural Water Forest' and 'Flooding Paddy Field in Winter' activities, Suntory is recharging more than twice the amount of groundwater pumped up at the Kyushu Kumamoto factory. The factory manages its annual water conservation targets and promotes daily water intake and discharge management, and as a result of these comprehensive efforts were recognised, and in 2023, the company was awarded the highest-level AWS 'Platinum' certification.[12]

3.4.2. Volumetric Water Benefit Accounting （VWBA）

In order to solve water issues in river basins, it is necessary to have the participation of a wide range of stakeholders. In addition, because the activities carried out by each stakeholder as a contribution to WS activities are diverse, there is a need for a consistent method that allows a wide range of stakeholders to participate in WS activities and that can measure their effectiveness.

VWBA is a method for estimating the benefits of water from water stewardship activities, and was developed as a common method for evaluating the effectiveness of activities across activities, markets, regions and companies.

Volume Water Benefits (VWB) are defined as the amount of water gained per unit of time from water stewardship activities, such as recharge water, water quality and improved access to water.

In this section, we will introduce VWBA based on the working paper published by the World Resources Institute.[13]

The working paper presents the following perspectives on the implementation and evaluation of WS activities

① Three steps for using VWBA in WS activities
② Recommended indicators and calculation methods for measuring the effects of WS activities

3.4.3. Three steps for the use of VWBA in WS activities

The VWBA provides a method for stakeholders to select activities and calculate their effectiveness, and shows the next steps for using the VWBA in stakeholder communication.

Step 1: IDENTIFY SHARED WATER CHALLENGES AND UNDERSTAND LOCAL CONTEXT

Step 2: DEFINE WATER STEWARDSHIP PROJECT ACTIVITIES AND PARTNERS

Step 3: GATHER DATA AND CALCULATE VOLUMETRIC WATER BENEFITS

In Step 1, you will identify shared water challenges and their root cause, understand the catchment. These problems can be identified through official data held by the government and consultation with stakeholders in the catchment. In addition, in order to identify water issues, it is necessary to understand the water cycle in the catchment.

You also understand catchment stakeholders and ongoing water stewardship activities. This will allow you to assess what kind of activities you should start, for example, whether new initiatives are needed or whether existing initiatives should be strengthened.

In Step 2, you will select appropriate project partners and actions to implement as water strategy activities that contribute to solving the water issues identified in Step 1.

You will calculate the VWB of the actions you have selected, assess the expected VWB of the water strategy activities, and determine the distribution of the VWB among the relevant project partners. The distribution is shown as a percentage of the investment amount, for example.

In Step 3, the VWB generated by the WS activity is calculated. Since the VWB is the benefit generated before and after the WS activity, the baseline is the state before the project is implemented.

Next, an appropriate VWB indicator is selected and calculated based on the WS activity. Typical WS activities and their VWB indicators are shown in Figure 3-2. Although this is not an exhaustive list of all possible activities, project participants can use it as a common indicator for common activities and their benefit calculations. Furthermore, secondary benefits other than VWB generated by WS activities, as shown in Figure 3-3, should also be evaluated as far as possible. VWB generated by WS activities should be allocated to project partners based on the allocation ratio determined in Step 2.

Finally, the author's thoughts on the key points for using VWBA to promote communication and information disclosure with project stakeholders are as follows.

- Common water issues to be addressed and how to identify them
- Estimate the VWB at the planning stage of water service activities and reflect it in policy decisions
- Indicate the menu of workshop activities, the VWB evaluation method, the percentage of allocated project participants, and the people who will participate in the activities
- Indicate the benefits of the workshop activities for society, the economy, and the environment
- Indicate the base year for measuring the effects of the workshop activities and the expected time for the effects to appear
- Indicate the maintenance and management plan after the implementation of measures

CATEGORY	ACTIVITY	VWB INDICATOR	CALCULATION METHODS
Land conservation and restoration	Land conservation	Avoided runoff	Curve number method
	Land cover restoration	Reduced runoff	
Water supply reliability	Agricultural water demand reduction measures	Reduced withdrawal or reduced consumption	Withdrawal method or consumption method
	Operational efficiency measures	Reduced withdrawal	Withdrawal method
	Leak repair		
	Consumer use efficiency measures		
	Water reuse		
	New water supply for crop irrigation	Volume provided	Volume provided method
	Rainwater harvesting	Increased recharge	Capture and infiltration method
Water access	Access to drinking water supply	Volume provided	Volume provided method
Water quality	Agricultural best management practices (BMPs) related to conservation tillage, laser leveling, and cover crops	Reduced runoff	Curve number method
	Stormwater management	Volume captured	Runoff reduction method
	Constructed wetland treatment systems	Volume treated	Volume treated method
	Wastewater treatment plants		
Aquatic habitat restoration	Wetland protection	Maintained recharge	Recharge method
	Wetland restoration and creation	Increased recharge	
	Legal transactions to keep water in-stream	Reduced withdrawal	Withdrawal method
	In-stream barrier removal	Improved flow regime	Hydrograph method
	Dam reoperation		
	Floodplain inundation/reestablish hydrologic connection	Varies based on objectives	See Appendix A-7
Water governance	Direct engagement in water governance and public water management	Same as the water stewardship activities they support	
Catalytic activities	Activities that pave the way for longer-term water stewardship outcomes	Same as the water stewardship activities they support	

Figure 3-2 General water management activities and recommended VWB indicator calculation methods

Source: VOLUMETRIC WATER BENEFIT ACCOUNTING (VWBA): A METHOD FOR IMPLEMENTING AND VALUING WATER STEWARDSHIP ACTIVITIES

SAMPLE COMPLEMENTARY INDICATORS	UNIT OF MEASUREMENT
Activity beneficiaries	Number of people over time
Crop yield	Mass per area over time
Economic welfare	Number of jobs created over time
Flood frequency	Frequency
Incidence of disease	Frequency
Income	Currency over time
Land protected and or restored	Area (e.g., square kilometers, square meters, square miles, hectares, acres) over time
Native trees planted	Number of trees
Policy, legislation, directives, standards, programs, data	Name and reference number over time
Pollutant load	Mass over time
Species protected	Number of endangered species over time
Stream protected or restored	Length (e.g., kilometers, meters, miles) over time

Figure 3-3 Examples of indicators of secondary benefits

Source: VOLUMETRIC WATER BENEFIT ACCOUNTING (VWBA): A METHOD FOR IMPLEMENTING AND VALUING WATER STEWARDSHIP ACTIVITIES

3.5. Prospects in groundwater conservation in Kumamoto in light of international trend

As we have discussed so far, water stewardship is a framework for water users (companies, local governments, residents) to cooperate on a watershed basis and voluntarily manage water, which is a shared regional resource. Water is a local resource that is essential for the lives, economic activities and ecosystems of local residents. For companies that use water in the local area, water stewardship initiatives are important not only from the perspective of securing sustainable water sources, but also from the perspective of so-called social licensing, that is, whether or not the local community accepts the company's business.

According to the Copernicus Climate Change Service, the European Union's meteorological agency, the average global temperature in 2023 was 1.48°C higher than pre-industrial levels, the highest on record, and there are estimates that economic losses due to heat waves and flooding will reach 420 trillion yen by 2029. In addition, as companies are required to respond to the 'Kunming-Montreal Biodiversity Framework' adopted in 2022, initiatives for water use and water resource management from the perspective of watershed water circulation are effective for achieving a balance between business growth and positive impacts on nature.

It is hoped that investment in and activities related to the WP in Kumamoto will be promoted through collaboration between multiple stakeholders. By introducing the AWS Step and Core Indicators and VWBA as common indicators for activities as checkpoints for promoting collaborative action, it is hoped that activities as a community will be promoted and that this will lead to the promotion of effective measures. The Kumamoto WP Initiative aims to build a system by referring to these mechanisms and methods.

Photo by Makoto Eguhi

4. Introduction of groundwater recharge and runoff control by rain gardens

4.1. Overview of rain gardens

A rain garden is a slightly sunken planting space with a structure that temporarily stores rainwater that has fallen on the roof or elsewhere, rather than allowing it to flow directly into the sewer system, and then slowly allows it to seep into the ground. Depending on their shape, they are known internationally as a type of green infrastructure, such as rain garden, bioswale or planter box, but in Japan, these series of green infrastructures are collectively referred to as rain gardens and are being introduced.

Rain gardens can be expected to have an effect on reducing rainwater runoff through infiltration and storage, and they can also provide a habitat for living creatures through planting. The appeal of rain gardens is that they can be expected to have a diverse range of effects, including not only groundwater recharge but also flood mitigation and biodiversity enhancement, and even in Kumamoto, where urbanisation is progressing, their introduction is beginning in places such as buildings, sportsgrounds and parks.

We believe that a complementary approach using rain gardens is effective for areas that cannot be dealt with by the existing groundwater conservation measures implemented by Kumamoto Prefecture and municipalities.

4.2. History of the introduction of rain gardens in Kumamoto

On 4 July 2020, a linear precipitation zone stalled over the Kuma River basin in Kumamoto Prefecture, causing unprecedented heavy rain. The main stream of the Kuma River flooded in the Hitoyoshi Basin and the mountainous areas

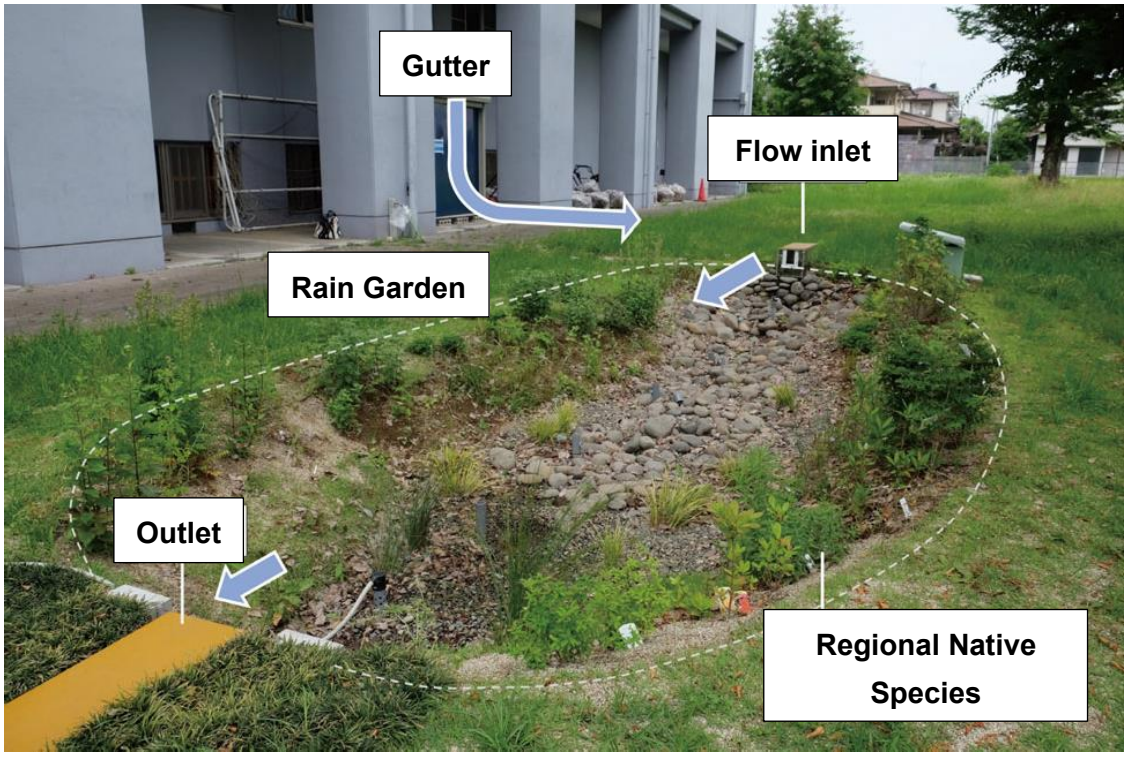


Figure 4-1 Rain Garden at Prefectural University of Kumamoto

downstream, resulting in 50 deaths and extensive damage to houses and bridges. In order to recover from this disaster, Kumamoto Prefecture has launched a new policy called ‘Green Dam Disaster Prevention’. This is a policy that aims to create a sustainable society by promoting environmental industries and other industries through flood control in the entire river basin, and is also known as the Green New Deal. In order to support this policy, Prefectural University of Kumamoto applied for the Japan Science and Technology Agency's (JST) competitive funding for the Regional Co-Creation Centre - Full-Scale Type (research period: 10 years, maximum annual research funding of 200 million yen), and was selected as the representative organisation, with Kumamoto Prefecture and Higo Bank as the implementing organisations. The centre is called the ‘Centre for Co-creating a Sustainable Society Based on Recovery’, and it will be a collaborative effort between private companies such as Mitsui Sumitomo Insurance and research institutions such as Kumamoto University.

At this centre, they are researching flood prevention measures for river basins, and are also proposing green infrastructure such as rain gardens as a measure for non-permeable areas such as buildings, car parks, sportsgrounds and roads. They are introducing rain gardens at Prefectural University of Kumamoto and other universities in the prefecture, and are verifying their effectiveness.

4.2.1. Rain garden at Prefectural University of Kumamoto

Figure 4-1 shows the rain garden at Prefectural University of Kumamoto. Prefectural University of Kumamoto is located on a plateau in Kumamoto City, and the rain garden is installed on the ground within the campus. The soil classification is a region of black soil. One rain gutter from the roof of the gymnasium is introduced into the rain garden, and the excess rainwater flows into the sewer.

The rainwater gutter has a catchment area of 178m^2, and the rain garden has an area of 35m^2, giving a total catchment area of 213m^2 and a depth of 60cm. The rain garden is sunken and has a gradient of 1.50%. Rainwater that exceeds the capacity of the rainwater storage tank is designed to flow into the existing gutter. The bottom is paved with round stones, and native species (*Higotai*, *Nokonogiku*, *Fujibakama*, etc.) are planted on the slopes, and it was completed in November 2021.

For approximately 17 months from 26 April 2022 to 20 September 2023, we observed rainfall, inflow from the roof, outflow from the rain garden, and the water level within the rain garden. The total rainfall during the measurement period was 3,094 mm.

The inflows and outflows during the period are shown in Figure 4-2. Over 100 rainfalls flowed into the rain garden during the period, and there were 6 outflows.

The total inflow to the rain garden during the period was approximately 657.1m^3, of which 131m3 fell on the rain garden and 49.8m^3 flowed out, meaning that 8% of the inflow flowed out and 92% infiltrated. The largest outflow occurred on 28 June 2023, when there was very

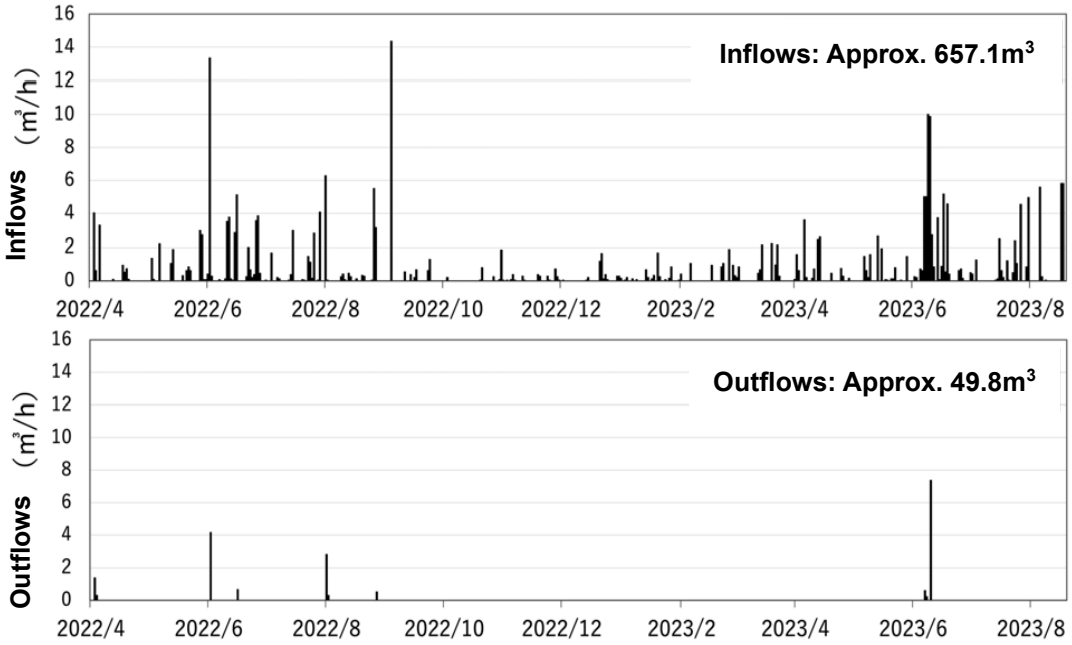


Figure 4-2 Inflow and outflow to rain gardens

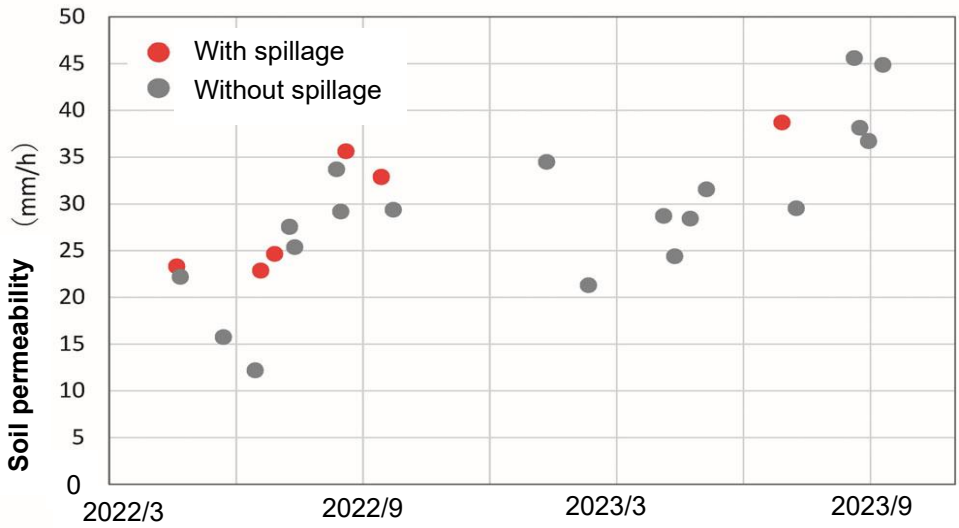


Figure 4-3 Inflow and outflow to rain gardens

heavy rainfall, with a total rainfall of 453.8 mm and an hourly rainfall of 57.2 mm. The inflow was 96.4 m^3, the outflow was 34 m^3, and the runoff control rate was 65%, showing a remarkable runoff control effect. One rainfall accounted for 68% of the total runoff for the entire period.

The runoff control effect of the rain garden is due to its storage and infiltration functions, but there are differences in the infiltration capacity of the soil, and Figure 4-3 shows the change in the infiltration capacity of the soil at Prefectural University of Kumamoto.

At the time of construction, the infiltration capacity was low, but by September 2023 it had increased to around 45mm/h, more than doubling. The increase in infiltration capacity is thought to be due to the formation of macropores and aggregation by plants and soil animals.

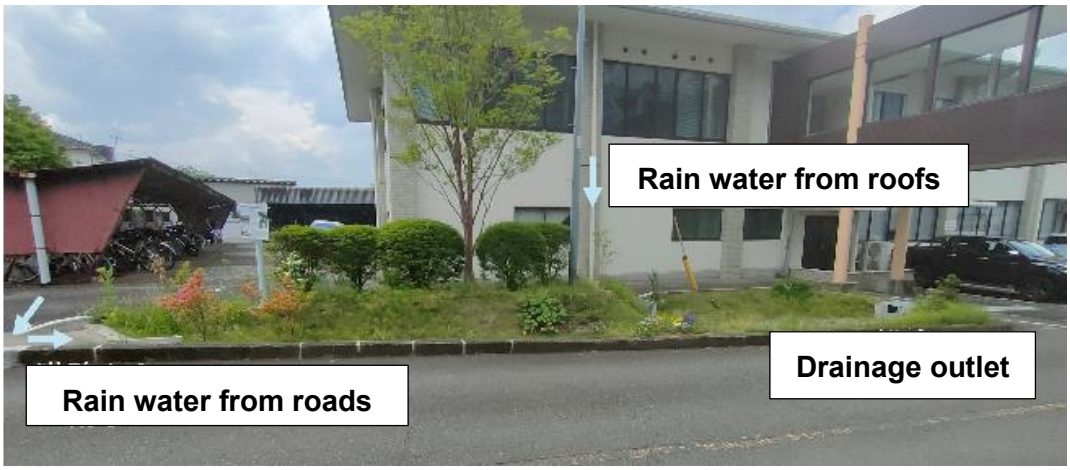


Figure 4-4 Rain Garden at Kuma Promotion Bureau

4.2.2. Rain garden infiltration and runoff control effects

In Kumamoto, rain gardens have been constructed in places other than Prefectural University of Kumamoto and their infiltration and run-off control effects have been verified. For example, the rain garden at the Kuma Regional Promotion Bureau in Hitoyoshi City, Kumamoto Prefecture, was constructed by digging down an existing planting strip to store and infiltrate rain that fell on the roof of an adjacent building and part of the rain that fell on a road on the site. The amount of runoff is 0.33 m3, which is almost the entire amount of infiltration, showing the same effect as in the Prefectural University.

As these examples show, the groundwater recharge and flood protection effects of rain gardens are significant, and if the infiltration capacity and storage capacity of rain gardens are equivalent to those of Prefectural University of Kumamoto, it is possible to recharge more than 90% of the rainfall in the catchment area with groundwater.

4.3. Promoting rain gardens through partnerships

In order to spread the creation of rain gardens throughout Kumamoto Prefecture, volunteers from industry, government, academia and the general public have come together to form the Kumamoto Rain Garden Partnership, with the aim of creating 2030 rain gardens by 2030.

The team is made up of a loose association of organisations and citizens, and rather than being bound by obligations or quotas, each member cooperates to achieve the goals within the scope of what they can do voluntarily, and contributes to the development and spread of rain gardens. At present, around 30 organisations are participating in this partnership.

The Kumamoto Rain Garden Partnership provides technical guidance on rain gardens, certifies rain gardens, and awards rain gardens.
https://www.kumamoto-ameniwa-partnership.com/

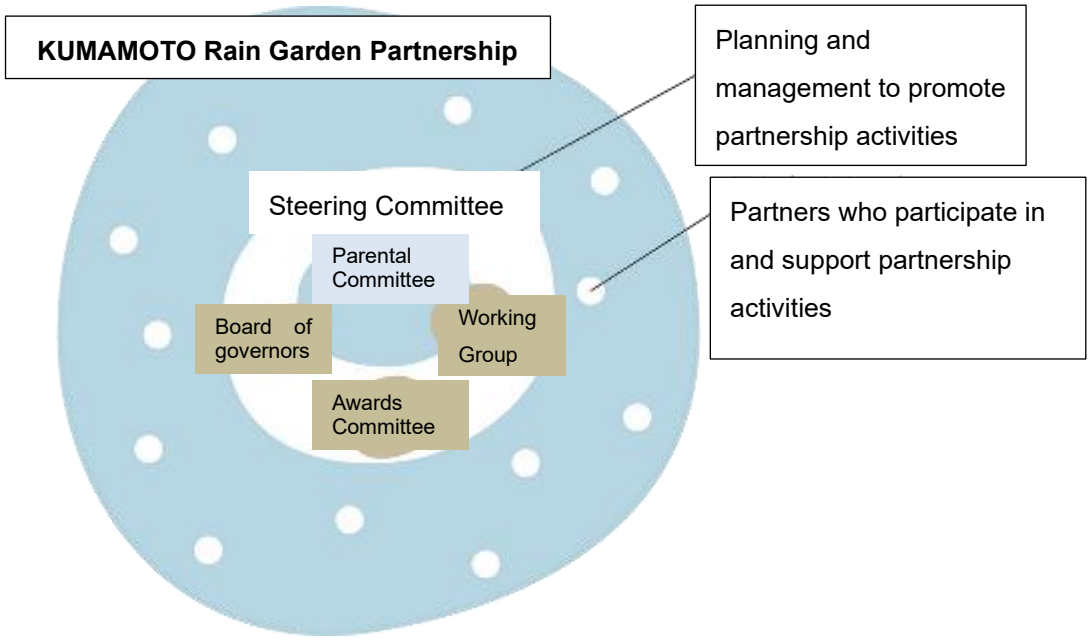


Figure 4-5 KUMAMOTO Rain Garden Partnership

Box: Higo Bank and the 'rain garden'

The rain garden concept of the 'Green Water Ship Flood Control Project', a joint initiative of the host organisation Prefectural University of Kumamoto and Kumamoto Prefecture, will be introduced.

[Menda tributary, planter-type rain garden].

Made from thinned cedar wood for forest conservation with the cooperation of the Itsuki Village Forest Cooperative. Students from Nanryō High School and local residents also participated in the installation work.

[Higo Bank, Kikuyo Sportsground, Rain Garden].

The sportsground itself is 100% natural grass and is permeated underground.

In order to prevent puddles from forming in the car park area, a 70cm depression was created and covered with recycled concrete blocks.

[Bunker-type rain garden]

An affiliated company dug a depression with the same volume as the first hole at the Hyakkaen Golf Course, which has poor drainage, filled it with sand, and constructed a new bunker.

Box: Promoting rain gardens through local human networks

Higo Bank is the designated financial institution for 30 of the 46 cities, towns and villages in Kumamoto Prefecture, and 60% of companies use it as their main bank.

At present, the bank is calling for information about rain gardens through its network of branches, and the number of consultations is increasing. Local governments are beginning to consider large-scale rain gardens as a measure against internal flooding, and there are also cases where they are considering installing them in conjunction with construction work on factory, school and kindergarten grounds.

In collaboration with the Prefectural University of Kumamoto research laboratory, we are promoting green infrastructure such as rain gardens as a measure against impervious surfaces such as buildings, car parks, school grounds and roads, with the aim of flood prevention and groundwater recharge.

5. Future extention: Kumamoto WP and green finance

5.1. Overview of green finance

Green finance is one of the effective instruments for introducing private finance into green projects that contribute to combating global warming and preventing the degradation of natural capital and is characterised by the fact that it guarantees the green nature of the issuing entity and the project for which the funds are used. In particular, as large investments are required to achieve carbon neutrality, a large amount of private finance needs to be introduced. Green finance is considered an effective instrument for increasing the introduction of private finance with environmental impact for the following reasons.

- Strong assurance of environmental improvement benefits (GHG reductions) through pre- and post-external evaluations and explanations to the market
- Recognition both nationally and internationally as green by being implemented in accordance with national guidelines consistent with international principles, prompting eligibility for investment by national and international ESG funds.
- In the case of publicly offered bonds, potential procurement advantages for companies (e.g., stable amortisation in the market, a larger investor base, lower interest rates).

5.2. Types of green finance

Green finance is typified by the use of the funds and the effectiveness of the project for which they are used (Figure 5-1).

Green bonds (green loans) are considered to be bonds (loans) issued by companies and municipalities to raise funds for green projects (e.g., renewable energy projects, construction and recovery of energy-saving buildings, biodiversity conservation, projects related to resource recycling), for which the use of the funds is limited to projects with environmental

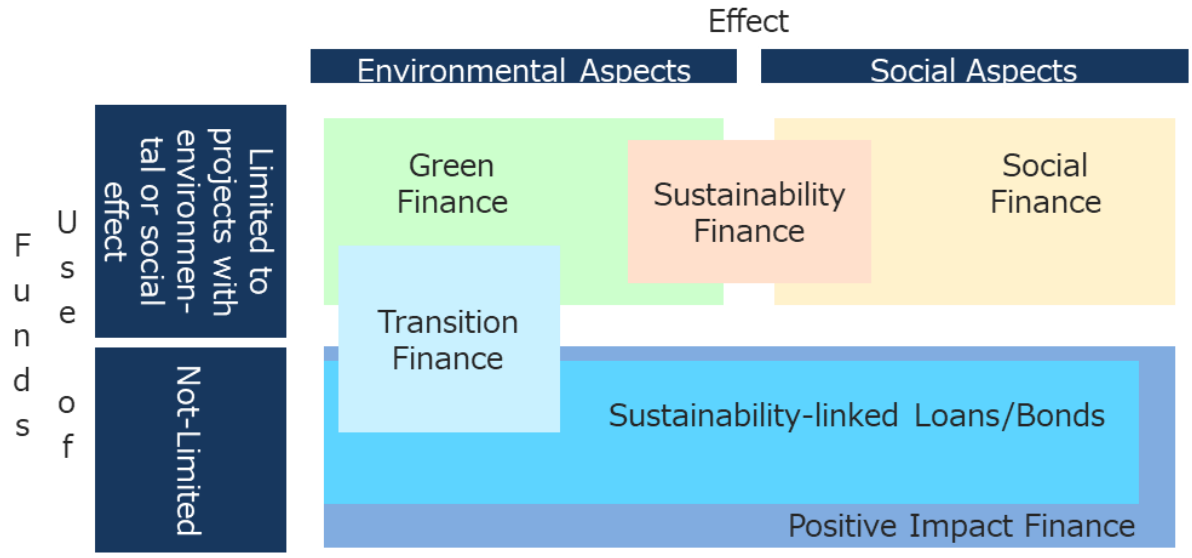


Figure 5-1 Types of green finance

Source: Prepared by DBJ from Ministry of Land, Infrastructure, Transport and Tourism data.

improvement effects.

Sustainability bonds are bonds in which the use of the funds is limited to projects with social and environmental effects, with the effects of the projects in which the funds are used extending beyond green projects to social projects (e.g., community revitalisation, healthcare, women's activities, welfare).

Sustainability-linked bonds (sustainability-linked loans) are considered to be bonds (loans) with no restrictions on the use of the funds, with interest rates and other conditions varying according to the degree of achievement of sustainability targets (e.g., CO_2 reduction targets) set in advance by the financier (company, municipality, etc.) with the aim of promoting sustainability management. The loan is regarded as a credit (loan) that always includes certain conditions (e.g., interest rate falls if the target is achieved, interest rate rises if not achieved, substantial donation is made).

Positive impact finance has the same characteristics as sustainability-linked bonds (loans) in the organisation of this paper, but the provided funding aims to increase positive impact based on a comprehensive analysis and assessment of the environmental, social and economic impact of the financier's activities. In other words, the comprehensive analysis and assessment is meant to support the reduction of negative impacts.

Transition finance does not have strong restrictions on the use of funds and can target a wide range of projects. On the other hand, its effects are clearly required to contribute to greenhouse gas (GHG) reductions towards a decarbonised society, and it is finance for actors (funders) that guarantee ambitious initiatives based on strategies to realise long-term goals consistent with the Paris Agreement. In order to be labelled as transition finance, the four elements of strategy and governance, materiality, scientific evidence and transparency must be met, with an emphasis on the evaluation of the strategy.

5.3. Greenness assessment

The International Capital Markets Association (ICMA) Green Bond Principles state that eligible green projects for which green bond proceeds are to be used should have clear environmental benefits, which should be assessed and where possible quantified by the issuer. Funds raised through green finance should be used to fund projects with clear environmental benefits, the appropriateness of which is ultimately left to the market in the case of bonds and to the judgment of the parties involved in the case of loans.

When funders conduct their own preliminary assessment of the greenness of a project, the Green Bond and Sustainability Linked Bond Guidelines 2022 contain four perspectives for determining green projects.

① Be able to explain logically how this will lead to environmental goals (positive impact).

② Expect clear improvement in indicators for measuring environmental benefits compared to business as usual' (i.e., if the project would not be implemented or would go ahead as originally planned).

③ Where there is a long-term goal (e.g.,

the achievement of carbon neutrality in Japan by 2050), in principle have consistency and no apparent inconsistency between the implementation of the project in question and the achievement of that long-term goal.

④ Have processes in place to identify negative effects and to mitigate and manage them.

It is recommended that being assessed as a green project is not dependent on fulfilling every one of the above perspectives but rather on a comprehensive assessment based on each of them, depending on the project.

5.4. Application of green finance to Kumamoto groundwater conservation

Green finance has developed in a wide variety of ways in recent years, as described above, due to the increased need by funders and financial institutions to address global warming and natural capital. Discussions are still taking place among ministries and between ministries and private sector organisations to ensure consistency with the multiple international principles, national plans and so forth., while responding to the demand of funders and ensuring the quality of green projects.

In Kumamoto, local financial institution Higo Bank has started providing green loans as finance for green projects, and it is expected that green finance will be used for projects related to groundwater conservation, which is an issue related to the local concentration of semiconductor companies. In order to smoothly achieve the original objective of introducing private-sector funds into green projects, it is hoped that financing will be considered in light of these trends in discussions.

Photo by Makoto Eguchi

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