KuWP
Kumamoto Water Positive Design Center
熊本ウォーターポジティブデザインセンター

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Recharging the Future: The Kumamoto Model for Water-Positive Growth in the Age of AI-Driven Industry

Kumamoto Water Positive Design Center (KuWP) — General Incorporated Association

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Executive Summary

The world has entered a new era that the United Nations has called “water bankruptcy.” On top of climate change, the rapid expansion of the AI and semiconductor industries is concentrating water stress in specific river basins. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Business and Biodiversity Assessment (BBA), the World Economic Forum (WEF), and the TNFD frame the degradation of natural capital as a systemic economic and financial risk, calling on companies to respond at the watershed scale. Kumamoto—which depends on groundwater for nearly 100% of its drinking water yet has welcomed the arrival of the world’s largest semiconductor manufacturer—is one of the regions taking a leading-edge approach to the universal challenge of reconciling economic growth with the mitigation of impacts on natural capital.

This white paper details the framework now taking shape in Kumamoto as a response to that challenge: a two-tier governance structure consisting of a broad-based conservation foundation led by local government (Tier 1) and a private-sector co-creation layer (Tier 2) led by the Kumamoto Water Positive Design Center (KuWP), a general incorporated association formed through industry–academia–finance collaboration. Its core strategy is to deploy the multifunctional green infrastructure known as the “rain garden” across urban areas and to standardize both its construction and its monitoring. Over the medium term, it envisions creating a market for “groundwater recharge credits” that would offset the loss of recharge capacity caused by changes in land use. This credit concept remains at the planning stage at present.

Kumamoto’s effort is only halfway through. Rather than presenting a finished model, this white paper candidly shares six lessons emerging from the journey so far—identifying changes that existing institutions have failed to capture; leading with implementation and data; designing standards that government can adopt; institutionalization as relationship-building; the hub function of regional finance; and a shared goal—together with the challenges that remain. Government currently participates as an observer, and the initiative has come to be recorded as a pilot in Kumamoto Prefecture’s official planning documents.

What this white paper offers is not a special-case solution viable only in Kumamoto. It is the first demonstration of a landscape-approach framework that—while rooted in each region’s distinctive environment, culture, and traditional knowledge—can be built in any river basin. As a “living showcase” responding to the international call set out by the BBA and the TNFD, Kumamoto’s experience is open to dialogue and scrutiny with watersheds around the world.


Photo: The Higo Bank, Ltd.

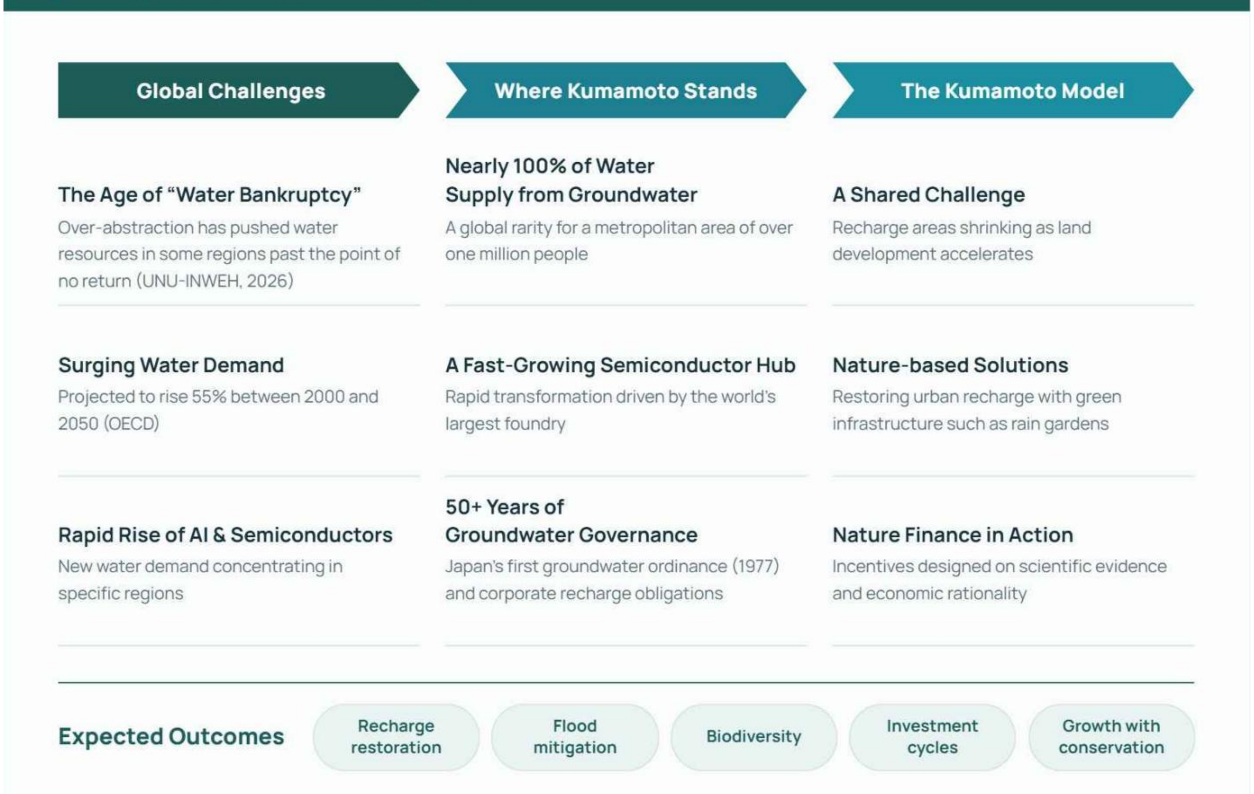
CHAPTER 01

Introduction

As of 2026, the world is entering a new phase. In January, the Water Bankruptcy report released by UNU-INWEH (the United Nations University Institute for Water, Environment and Health) warned that human over-abstraction is driving water resources in some regions toward a point from which they may never return to their former levels.[1] Such water stress will only intensify in the years ahead. The Organization for Economic Co-operation and Development (OECD) projects that global water demand will rise by 55% between 2000 and 2050,[2] and the rapid expansion of the AI and semiconductor industries is concentrating new demand in particular regions[3].

As the world confronts these challenges, Kumamoto stands out as one of the regions that has pursued advanced groundwater governance for more than half a century. Kumamoto is an exceptionally rare place worldwide—an urban area of more than one million people that meets nearly 100% of its drinking-water needs from groundwater—while at the same time undergoing a dramatic transformation into a cutting-edge industrial cluster following the arrival of the world's largest semiconductor manufacturer[4]. In response to this challenge of reconciling the conservation of natural capital with economic growth, the work of the Kumamoto Water Positive Design Center (KuWP)—a general incorporated association born of industry–academia–finance collaboration—offers a leading-edge showcase for watershed governance worldwide[5]. That said, what this paper presents is not a special-case solution viable only in Kumamoto. It is a replicable landscape-approach framework that builds answers rooted in each region's

Fig. 1 Why the Kumamoto Model, Why Now



distinctive environment, culture, and traditional knowledge, addressing the universal challenge—faced by regions everywhere—of reconciling economic growth with the mitigation of impacts on natural capital. This white paper sets out, in logical sequence, the implementation process of a “nature finance” grounded in scientific evidence and economic rationality, detailing how local watershed governance can become a standard protocol for an environmental-credit market that can be presented to the world.

2026 will be a decisive year for natural capital and water governance worldwide. The year will see the 2026 UN Water Conference and World Water Week, and—at the 17th Conference of the Parties to the Convention on Biological Diversity (CBD COP17) in Yerevan, Armenia, in October—a global stock take of progress on the Kunming-Montreal Global Biodiversity Framework. Moreover, the Business and Biodiversity Assessment (BBA), approved at the 12th IPBES Plenary in February 2026, makes clear that biodiversity loss is not merely an environmental issue but a systemic risk to the entire economic and financial system, strongly calling on companies to reconcile economic growth with reduced damage to natural capital and to engage inclusively in ways that respect the knowledge and rights of local communities[6]. The Global Nature Positive Summit (GNPS), to be held in Kumamoto City, Japan, on 14–15 July 2026, will serve as a key node linking this series of international agendas and a historic milestone in moving the global framework for the 2030 nature-recovery goal (nature positive) from conceptual consensus-building toward concrete, evidence-based implementation[7]. This white paper aims to contribute to the discussions at that summit and to present the Kumamoto Model as the first demonstration—a model case—of a “landscape-approach framework implementable in any watershed worldwide” that embodies these international imperatives.

CHAPTER 02

Rising Global Water Risk and the Place of the “Kumamoto Model”

Water has moved beyond being a mere environmental issue to become a critical geopolitical variable shaping national security and industrial competitiveness. On top of the rise in extreme weather driven by climate change, the proliferation of data centers and the expansion of semiconductor fabrication facilities that accompany advances in AI are placing extreme stress on particular regional water systems[8]. At the same time, the relocation of supply chains in response to geopolitical risk is creating a different risk—water availability—at the destinations to which those operations move[1]. Indeed, according to TNFD analysis, more than 40% of new semiconductor plants announced since 2021 are located in watersheds projected to face high or extremely high water stress by 2030, thrusting global companies into uncharted territory that conventional supply-chain management cannot address[8].

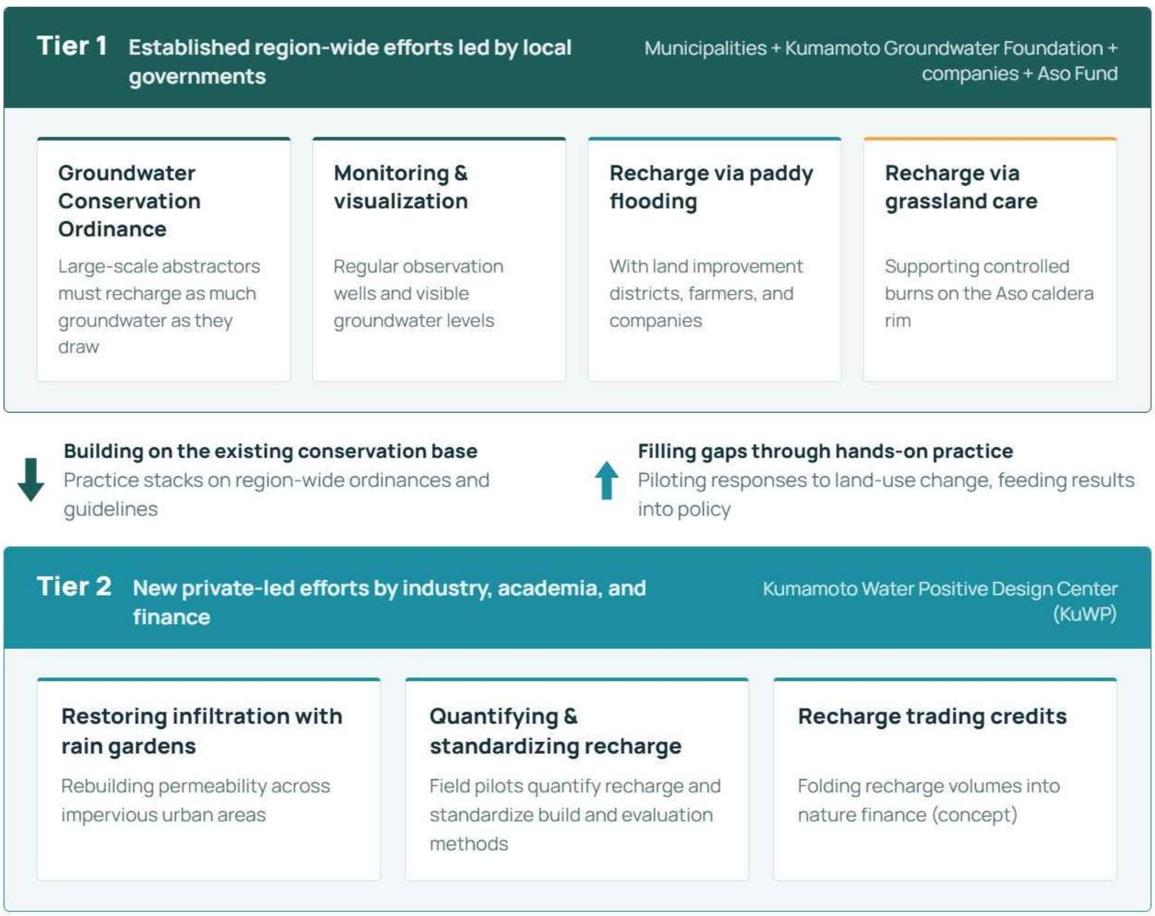
Financial markets and regulators are responding rapidly to these upheavals in the macro environment. The framework of the Taskforce on Nature-related Financial Disclosures (TNFD) has already taken hold as a global standard, and sector guidance issued in 2025–2026—including guidance for "water utilities and services"—now strictly requires companies to quantitatively assess and disclose their dependencies and impacts on natural capital across the entire supply chain, using approaches such as LEAP (Locate, Evaluate, Assess, Prepare)[9]. Friction with local communities arising from rapid changes in the water cycle and water balance now feeds directly back into companies' cost of capital and corporate value.

At the same time, investment in Nature-based Solutions (NbS)—as a means of tackling climate change and biodiversity loss simultaneously—is expanding rapidly. According to the latest data, global investment in NbS for water security roughly doubled from about US$22.4 billion in 2013 to US$49 billion in 2023, as public and private capital flows rapidly into natural infrastructure[10]. As things stand, however, 97% of this NbS investment is funded by the public sector, such as government finance, while private investment remains less than 1% of the total[10]. Private capital is not a substitute for public funding, but by partnering strategically it is expected to act as a catalyst that unlocks scalable, high-impact solutions[10].

To manage nature-related risks rigorously in line with the TNFD framework and to advance nature recovery through NbS, the need is growing ever greater for "local implementation models" that can absorb global frameworks and investment capital into the context of local communities and put them to effective use. Water resources and ecosystems have characteristics unique to each locality, rooted deeply in its particular geology, topography, and land-use history. Translating globally shared goals such as TNFD disclosure and nature positive into concrete action therefore requires scientific, effective local-governance models at the watershed level.

The "Kumamoto Model" in this paper is an effort to implement—in a way that reflects the region's specific natural environment and social realities—the broad direction set by global frameworks and trends such as TNFD and NbS. The Kumamoto Model has a two-tier governance structure that combines, in complementary fashion, a “broad-based conservation foundation led by local government” (Tier 1) and a “private-sector co-creation layer that drives market mechanisms” (Tier 2). Strip away the proper noun “Kumamoto,” and this combination is a general architecture applicable to any watershed in the world.

Fig. 2 The Kumamoto Model: A Two-Tier Governance Structure



Note: Government runs Tier 1 while connecting both tiers through collaboration with Tier 2. Recharge credit trading is at the concept and planning stage.

- Tier 1: A broad-based conservation foundation led by local government and a public-interest foundation. This is the long-standing conservation framework built around administrative collaboration among 11 municipalities centered on Kumamoto Prefecture and Kumamoto City, with the Kumamoto Groundwater Foundation (a public-interest incorporated foundation established in 2012) at its core. It provides the scientific base—such as visualizing and monitoring groundwater flow—operates regulations requiring “100% groundwater recharge” for incoming companies above a certain abstraction scale, and runs payment-for-ecosystem-services (PES) schemes for traditional NbS-type practices such as flooding paddy fields in cooperation with farmers, functioning as the base that protects the water cycle of the entire region.

- Tier 2: A private-sector co-creation layer led by KuWP through industry–academia–finance collaboration—implementing the "Kumamoto Water Positive Action" with a focus on urban areas. Built on the conservation foundation above, this is the cutting-edge layer of practice led by the Kumamoto Water Positive Design Center (KuWP). While government (the public sector) carries the Tier 1 conservation foundation, the direction is to connect the two tiers through collaboration with KuWP in this second tier. In response to the new challenge of "expanding impervious surfaces" brought by semiconductor-industry growth and urbanization, it restores physical infiltration capacity by networking multifunctional green infrastructure (rain gardens). By scientifically quantifying their recharge effect and incorporating it into nature-finance frameworks such as "groundwater recharge credits," it aims to provide concrete solutions and an investment cycle that—by combining the regulation requiring 100% recharge of abstracted volumes with the institutionalization of recharge-credit trading—enable companies to meet their recharge obligations through diverse means.

The "Kumamoto Water Positive Action," uniting companies, universities, financial institutions, government, and citizens, aims to systematize on-the-ground data on the region's water resources and ecosystems into reliable methods that other regions can reference, establishing a referenceable model that can contribute to forming international norms and assessment regimes for watershed governance. Building such a shared framework, however, does not mean homogenizing regions. As the IPBES BBA report emphasizes, conserving natural capital requires respect for locally rooted traditional knowledge. The Kumamoto Model is an ongoing effort to establish a methodology that translates place-specific wisdom into the language of science and connects it to trust from around the world[6].

Photo: Suntory Holdings Limited

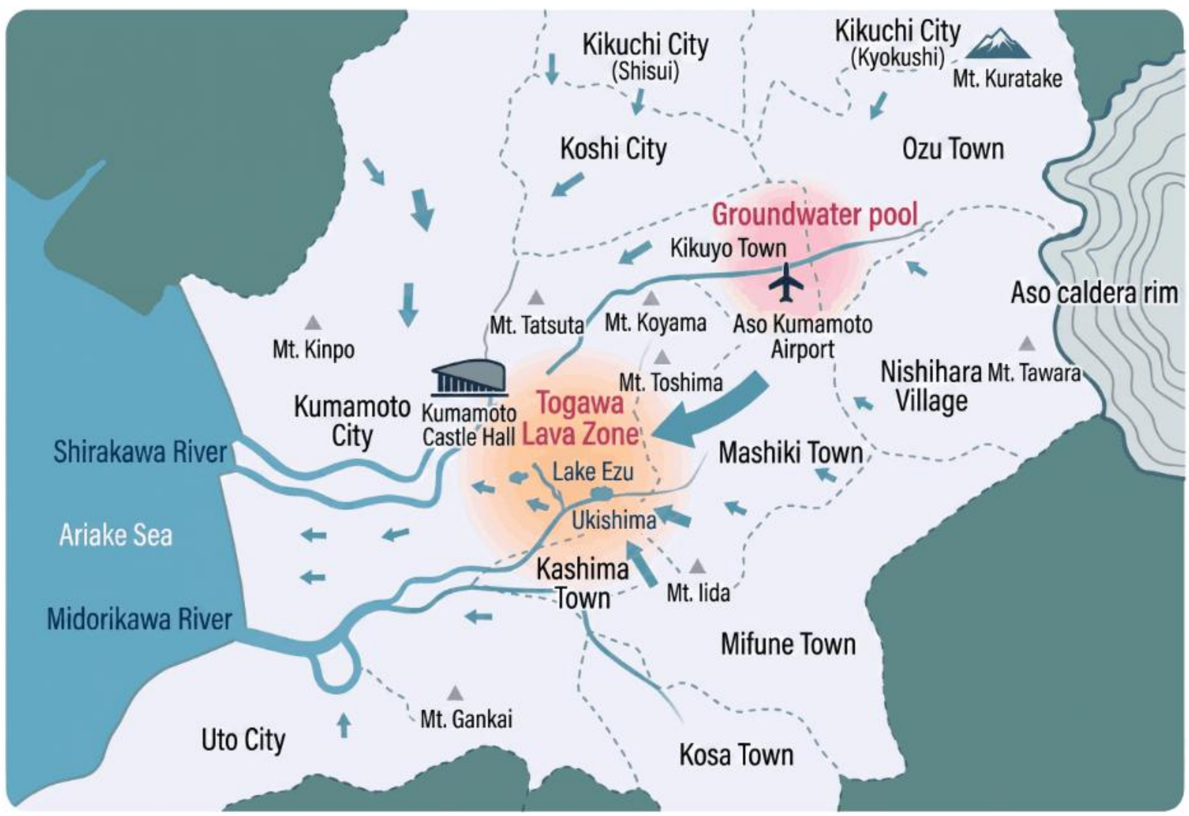
CHAPTER 03

Kumamoto’s Historical Legacy: Half a Century of Groundwater Stewardship and Basin Governance

To understand structurally why Kumamoto can serve as a global showcase for water-resource management, one must trace the region's distinctive geological background and its history of institutional evolution spanning several centuries—and, in its modern form, half a century. This is not, however, to emphasize Kumamoto's exceptionalism. Every watershed has its own geology, history, and culture. The Kumamoto case presented in this chapter illustrates a universal methodology: that deeply understanding a region's particular conditions and drawing on the wisdom accumulated there is precisely the starting point for effective watershed governance.

The "Kumamoto region," made up of Kumamoto City and its surrounding areas, is a metropolitan area of more than roughly one million people that nonetheless relies on groundwater for nearly 100% of its drinking water[4]. This broad-area water-resource management system is sustained not by a single municipality but by the firm collaboration of 11 municipalities that share the groundwater basin. Specifically, 11 municipalities—Kumamoto City, Kikuchi City (limited to the former Kyokushi and Shisui areas), Uto City, Koshi City, Ozu Town, Kikuyo Town, Nishihara Village, Mifune Town, Kashima Town, Mashiki Town, and Kosa Town—jointly manage the

Fig. 3 How Groundwater Flows through the Kumamoto Region



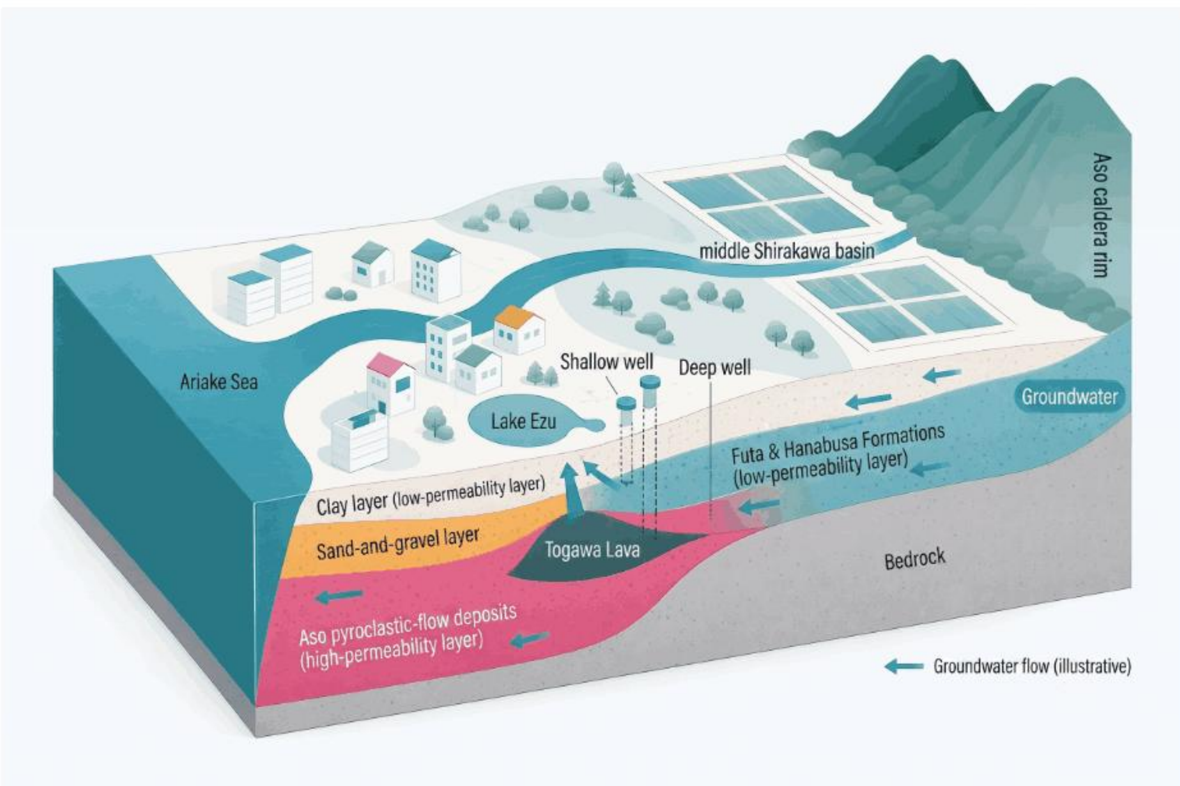
Legend Groundwater flow direction · Groundwater pool (aquifer) · Togawa lava zone · Rivers & springs

Note: Arrows show the approximate direction of groundwater flow. Water recharged on the Aso caldera rim and the plateau travels through the Togawa lava aquifer and resurfaces as springs such as Lake Ezu.

Kumamoto region's groundwater as a single unit, beyond administrative boundaries[11].

This abundant groundwater has been nurtured by both natural endowment and historical human effort. Pyroclastic-flow deposits from Aso's massive eruptions tens of thousands of years ago gave Kumamoto's soil porous, highly permeable layers; the middle Shirakawa basin in particular lets water percolate as through a sieve, earning it the name "zaru-da" (sieve fields)[12]. In the 17th century, moreover, Kato Kiyomasa—the warlord and lord who built Kumamoto Castle—developed flood control and paddy cultivation in the Shirakawa basin, creating a system that lets paddy water percolate underground and nurtures groundwater; this still sustains today's springs, such as those at Lake Ezu, and the citizens' tap-water sources[4]. Advanced water-management wisdom has likewise been handed down—such as the "hanaguri," which creates eddies in the flow to prevent silt clogging, an idea akin to today's managed aquifer recharge[13]. Such traditional knowledge is a land-rooted body of knowledge that IPBES values as "indigenous and local knowledge (ILK)," and the essence of the Kumamoto Model lies in not replacing it with a modern system but rediscovering its value through scientific measurement and assessment and placing it back at the core of contemporary watershed governance.

Fig. 4 Kumamoto's Water Cycle in Cross-Section



Note: Water recharged on the Aso caldera rim and in the middle Shirakawa basin travels underground through the highly permeable Aso pyroclastic-flow deposits and resurfaces as springs such as Lake Ezu. Arrows show the approximate direction of groundwater flow.

Kumamoto's modern governance was not designed top-down by government; it was built starting from citizens' sense of crisis, who saw groundwater as "a shared resource to be protected." As rapid urbanization in the 1970s threatened development of water-source areas, a residents' movement prompted Kumamoto City to enact Japan's first groundwater-conservation ordinance in 1977, with Kumamoto Prefecture following suit. Building on these institutions, government, universities, and citizens worked together and, using scientific methods such as isotope-tracer surveys, determined that the middle Shirakawa basin was the principal recharge area sustaining the metropolitan area's groundwater[12]. This union of "citizens' will" and "scientific evidence" defined the character of the governance that followed. The prefectural ordinance evolved into an effective mechanism—introducing a permit system for groundwater abstraction, designating "priority areas" where water levels are falling, and requiring operators who abstract above a certain scale to recharge groundwater in proportion to the volume they take. Then, in 2012, the Kumamoto Groundwater Foundation (a public-interest incorporated foundation) was established with joint funding from the prefecture, Kumamoto City, the surrounding 11 municipalities, and the local business community, culminating in a broad-area management and monitoring system that transcends administrative boundaries[14].

This prefectural-ordinance-based recharge framework has grown more effective by combining with companies' voluntary efforts. A pioneering example is the "winter-flooded paddy (fuyu-mizu-tanbo)," which embodies the idea of payment for ecosystem services (PES). Since 2003, incoming companies such as Sony Group and Suntory Holdings have signed agreements with local farmers and land-improvement districts to carry out winter flooding and flood fallow paddies, recharging groundwater[15]. This is a mechanism by which companies offset their own water use while supporting farmers economically; together with the recharge measures required of abstractors under the prefectural ordinance, it is steadily expanding public-private recharge. Paddy flooding alone was estimated to produce a recharge effect of roughly 32.93 million m^3 in FY2024 (Japan's fiscal year runs April–March), with companies' expanded planting projected to add up to a further 3 million m^3[16]. This public-private practice was awarded the top prize at the UN "Water for Life" Best Practices Award in 2013[17], and this historical track record and citizen consensus are precisely the social capital that underpins the next-generation "Kumamoto Water Positive Action."

CHAPTER 04

A New Phase: Pressures on the Water Cycle from Industrial Agglomeration and Land-Use Change

Yet even half a century of accumulation must be continually renewed amid new environmental changes. The rapid global spread of AI is driving up semiconductor demand, and against the backdrop of supply-chain restructuring, Kumamoto is now rapidly becoming a major cluster of semiconductor-related industries. While this change brings great opportunity to the regional economy, it is also generating new pressures on groundwater through rising water demand and changing land-use, creating a new phase that voluntary efforts and current abstraction regulations alone cannot fully address.

A symbolic case is the arrival in Kumamoto, the world's largest semiconductor foundry. Semiconductor manufacturing uses large volumes of ultrapure water to clean and polish wafers, and as circuits grow finer the number of cleaning and polishing steps rises, increasing water use[8]. The first plant, which began operating in December 2024, handles processes such as the 22–28 nm class, and at the adjoining second plant now under construction the introduction of finer, more water-intensive 3 nm-class processes has been announced amid the spread of AI[18]. Together, the two plants are expected to draw about 8 million tonnes of groundwater per year[19]. Kumamoto Prefecture is also taking measures: to meet the industrial-water demand that accompanies the semiconductor cluster, it is developing a new industrial water supply (total project cost about ¥15 billion, with supply expected to begin during FY2027) that will carry unused water from the Ryumon Dam—a multipurpose dam serving both flood control and water use—to the cluster area, easing the burden on groundwater[20]. The plant itself also recycles about 75% of the water it uses to curb its abstraction[21], and to meet the "100% recharge of abstracted volume" that the prefectural ordinance requires of newly arriving companies, it is undertaking paddy flooding across a wide area of the middle Shirakawa basin. Specifically, working with local land-improvement districts and farmers, it floods off-season paddies that are not under rice cultivation, such as in winter, and advances groundwater recharge exceeding the volume it abstracts[22].

These measures, however, all revolve around the "volume of abstraction." The rapid expansion of the semiconductor industry brings impacts that go beyond increased abstraction—ones that are more structural and harder to address. That impact is the indirect and irreversible alteration of land use. Through factory construction, the clustering of related suppliers, the development of housing for employees, and the accompanying road networks, farmland and forests that once recharged rainwater underground are being paved over with asphalt and concrete, and "impervious areas" are expanding rapidly[5]. Compounded by the decline in paddy area that accompanies changes in agricultural structure, the balance of the water cycle (the cycle of rainfall, infiltration, recharge, use, runoff, and evaporation) is increasingly breaking down[12].

In the Kumamoto region, paddy fields, upland fields, and grasslands on the plateau have been estimated to account for more than 80% of groundwater recharge (about 700 million m^3 per year)[23]. Meanwhile, as urban areas expand, non-recharge land such as residential areas has grown roughly 2.3-fold over the 45 years since 1976[24]. According to Kumamoto Prefecture's estimation formula, annual recharge per unit area differs greatly by land use: a paddy field, depending on the region and the growing season, recharges roughly 48,000–84,000 m^3 per hectare per year and an upland field about 14,000 m^3, whereas paved and built-up land recharge almost nothing[25]. In other words, the very conversion of recharge-capable land into urban land deals a direct blow to the basin's water balance. This expansion of impervious area simultaneously raises the risk of urban flooding (inland inundation), in which rainwater runs off directly to rivers and the sea instead of percolating underground; the traditional water-cycle system handed down since Kato Kiyomasa's time now stands at a major crossroads[5]. Indeed, recent extreme weather has brought real damage to Kumamoto. The torrential rain of July 2020 caused the Kuma River to flood, inflicting catastrophic damage and many casualties across the basin[26]. In August 2025, record rainfall again caused river flooding and inundation across the prefecture, and the effects of such extreme weather are feared to grow stronger in the years ahead[27].

In recent years, moreover, this land conversion has entered a new phase triggered by the arrival of semiconductor-related companies. Since the autumn of 2021, when the arrival of a major contract semiconductor manufacturer became known, demand for industrial land, housing, and roads has risen in the two cities and two towns where the cluster is growing, and the cumulative converted farmland has reached about 278 ha[28]. Onto an urbanization that had advanced over a long period, the new pressure of semiconductor clustering has been added, accelerating the loss of the farmland that has carried recharge functions. The impact of this change on groundwater is also quantitatively confirmed. In a future projection of groundwater levels (FY2030 versus FY2023) that Kumamoto Prefecture conducted using the GETFLOWS basin water-cycle simulation model, under an assumption of no countermeasures such as on-site recharge, land-use change alone would lower groundwater levels by up to 0.95 m around the Semiconductor Techno Park, affecting a wide area; factoring in increased abstraction, a decline of up to 1.12 m is shown[29]. However, it is said that if measures to increase recharge—such as artificial recharge—are implemented together with measures to reduce abstraction, such as drawing on other water sources, the decline can be held to a maximum of 0.88 m. This result shows how much greater the impact of the "loss of rainwater-infiltration function" from land-use change can be—even compared with "the absolute reduction caused by abstraction"—in present-day groundwater conservation. A study using GETFLOWS by the Suntory Global Innovation Center's Institute for Water Science and the Kumamoto Groundwater Foundation, among others, has likewise quantified the magnitude of the effect that land-use changes—such as the halting of irrigation when farmland is converted to housing—have on the spring discharge at Lake Ezu[30].

That said, local governments have not been idle in the face of this situation. As already noted, Kumamoto Prefecture has set regulations requiring groundwater abstractors to recharge in proportion to the volume they take and has strengthened them in recent years[31]. It has also repeatedly tied land use to groundwater recharge in the face of recharge areas shrinking through urbanization: Kumamoto City continues to subsidize paddy flooding by upstream farmers, and in 2023 Kumamoto Prefecture revised the rules of its environmental-impact-assessment ordinance to require, for development above a certain scale, recharge that exceeds the sum of the project's abstraction and the recharge lost to development[32].

Fig. 5 A New Phase: Two Pressures on the Water Cycle from Industrial Growth

Becoming a Major Semiconductor Hub

The global AI boom is driving semiconductor demand. The world's largest foundry has come to Kumamoto, and with a second fab under construction, groundwater abstraction is projected at roughly **8 million tonnes per year**. Industrial water demand is set to grow **35%** — and to keep climbing as factories cluster.

DIRECT, OPERATIONAL PRESSURE

Rising Water Abstraction

— Government countermeasures are underway

New industrial waterworks

Piping unused water from the Ryumon Dam to the industrial cluster to ease pressure on groundwater (Kumamoto Prefecture)

Meeting the "100% recharge" requirement

Flooding off-season paddies in the middle Shirakawa basin, with mandatory recharge exceeding abstraction

Both target abstraction volumes

INDIRECT, IRREVERSIBLE PRESSURE

Rapid Land-Use Change

— Outpacing existing administrative frameworks

278 ha of farmland already converted

Factory sites and housing are rapidly consuming farmland that once recharged the aquifer

Groundwater projected to drop up to 0.95 m

Prefectural simulations project land-use change alone will lower groundwater levels by up to 0.95 m

Permeable surfaces must be restored

These mechanisms, however, all presuppose that the farmland carrying recharge functions continues to exist as farmland. Subsidies for paddy flooding support cooperation with recharge carried out on farmland; they are not a mechanism for preventing the farmland itself from being converted into housing or factory sites. If development pressure permanently converts farmland into urban land, the very farmland eligible for subsidy is lost, and with it both the agents and the foundation of recharge. A scheme that merely subsidizes individual recharge activities cannot easily keep pace with the basin-wide shrinkage of the recharge base itself.

What is needed here is a way of thinking that acts on land conversion itself—protecting land that holds recharge functions and creating economic value in the very act of generating that function anew, even within urban areas. Rather than dwelling only on the question of who bears the cost of conservation, we must assign value to the natural capital thus maintained and restored and build mechanisms through which private capital flows in autonomously in pursuit of that value. To keep the water cycle in balance and bring long-term resilience to both the region and business, we must reconceive water-nurturing land use, and the natural capital that underpins it, not as a cost but as an object of investment. To protect groundwater as common property and to achieve nature positive, what Kumamoto now needs is to step toward a new framework that—building on the conservation efforts accumulated so far—draws in private capital through firm economic incentives.

Photo: Suntory Holdings Limited

CHAPTER 05

The Kumamoto Water Positive Action and the Role of KuWP

In response to these challenges, the Kumamoto region has stepped into a new phase of governance. Faced with a shrinking recharge base, it does not simply pile up regulations and individual conservation efforts; instead, it treats the natural groundwater-recharge function as something to be maintained and restored through investment in green infrastructure and draws in private capital through economic incentives. The driving force behind this is the "Kumamoto Water Positive Action," which—centered on the general incorporated association Kumamoto Water Positive Design Center (KuWP)—unfolds through the participation of companies, universities, financial institutions, government, and citizens[5].

KuWP, whose incorporation was completed in 2026, was founded by five organizations as its founding members—Kumamoto Prefectural University, Kumamoto University, Higo Bank, Suntory Holdings, and MS&AD Insurance Group Holdings—spanning academia, a regional financial institution, and private enterprise[5]. With Distinguished Professor Yukihiro Shimatani of Kumamoto Prefectural University serving as Representative Director, KuWP is building an agile, multi-layered governance structure that fuses the rigorous scientific knowledge of academia, the powerful fundraising and lending capacity of a regional financial institution, and the outstanding implementation and risk-management capabilities of private enterprise[5].

KuWP's reason for being is to serve as a "catalyst" that connects the knowledge, implementation experience, and capital once dispersed across individual companies and municipalities, and that supports efforts to nurture groundwater across the whole watershed by harnessing nature. Especially important is the mobilization of public and private funds in the initial stage, in order to

Fig. 6 Kumamoto's Groundwater Conservation Map

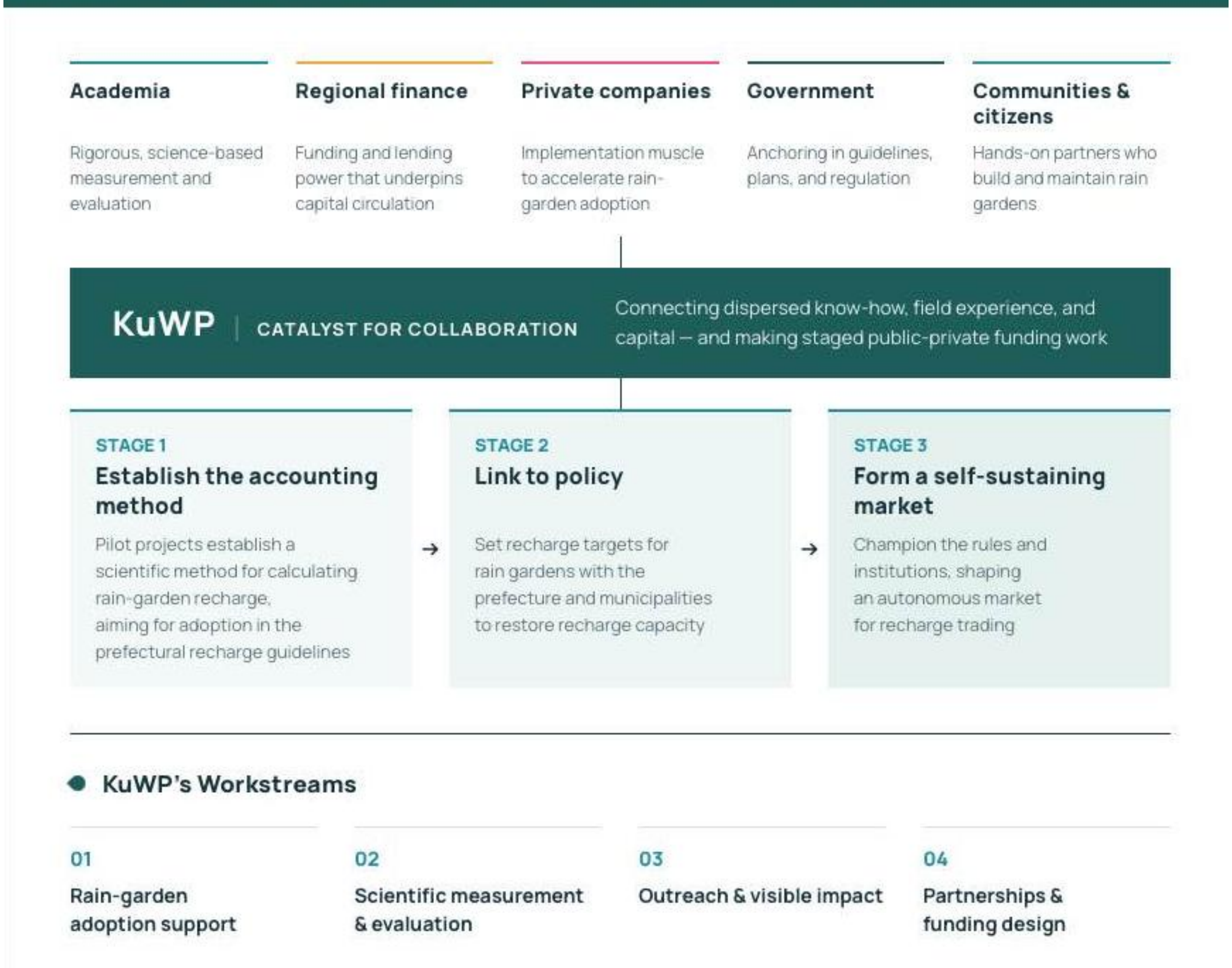
WATERSHED-WIDE	MIDDLE SHIRAKAWA BASIN & PLATEAU	ALTERNATIVE SOURCES	ASO CALDERA RIM	URBAN AREAS
Groundwater monitoring & visualization	**Recharge via paddy flooding**	**Alternatives that curb abstraction**	**Protecting recharge through grassland care**	**Restoring recharge with rainwater infiltration**
Kumamoto Prefecture, Kumamoto Groundwater Foundation	Prefecture, municipalities, land improvement districts, the Foundation, local farmers, partner companies	Kumamoto Prefecture	Aso Guardians Fund (Kyushu Water Fund)	Kumamoto Water Positive Design Center
Regular observation wells, real-time groundwater levels, and spring-flow surveys at Lake Ezu	Summer and winter flooding with rice growing, targeting 48.2 million m³ of recharge by 2030	Exploring unused capacity of the Ariake industrial waterworks and recycled water	Channeling donations into controlled burns and grassland upkeep in the upper basin	Private-led rain gardens counter shrinking recharge areas – piloting the evidence and feeding it into public policy
Established efforts				New effort

Note: The Kumamoto Prefecture Groundwater Conservation Promotion Headquarters positions these activities as complementary.

launch a system that makes the conservation of natural capital function sustainable through private investment. In other words, at the stage of designing incentives that encourage private investment in conserving the good public value of groundwater resources and a healthy water cycle, it is necessary to draw on public funds while progressively inducing private investment. Specifically, such public funds and contributions from the founding companies serve as pump-priming, supporting the high-risk demonstration and start-up phases. Then, as the value of the work becomes clear—and in alignment with municipal policy goals and regulations—broader private capital is drawn in, ultimately leading to a state in which funds circulate autonomously through the market. KuWP itself takes charge of designing this staged mobilization of capital.

KuWP plans to advance its near-term activities in parallel as four workstreams. The first supports the installation of rain gardens on individual sites. The second scientifically measures and evaluates their effects. The third handles outreach and the visualization of effects across the watershed. The fourth builds collaboration with municipalities and the financial mechanisms. Led by the practitioners who carry out the on-the-groundwork, and through repeated practice and

Fig. 7 KuWP as a Catalyst: Mobilizing Public and Private Capital in Stages



verification, these are expected to develop into a permanent structure in the future as needed.

A key significance of the Kumamoto Water Positive Action is that it is positioned as a pioneering demonstration (pilot) within the policy materials of Kumamoto Prefecture's Groundwater Conservation Promotion Headquarters. In the prefecture's overall vision for groundwater conservation, the Action is positioned as a new means of recharge, in addition to existing efforts such as "paddy flooding," which floods off-season paddy fields in the middle Shirakawa basin to promote recharge[31], and the "Aso Guardians Fund for Nurturing Kyushu's Water," which protects the water-source recharge function of Aso's grasslands[33]. Moreover, the prefecture's "Second Kumamoto Area Comprehensive Groundwater Conservation and Management Plan" (formulated in March 2026) also sets out, as one of the measures to curb the decline of recharge areas, "undertaking research and study of rain gardens and the like." Through this demonstration, KuWP aims to provide scientific evidence that rain gardens can restore recharge capacity even in urban areas, and to connect those results to public policy.

Specifically, it links watershed conservation to policy through three stages. In the first stage, it establishes a method—based on pilot-project data—for calculating how much groundwater recharge a rain garden generates per unit area; KuWP aims to have this method incorporated into the prefecture's "Groundwater Recharge Guidelines." In the second stage, it uses that method to make it possible to examine how large an area of rain gardens must be installed in urban areas to restore lost recharge capacity. And in the third stage, for the Kumamoto region as a whole, it works toward being able to determine the scale of recharge areas that should be maintained and created to protect the watershed's groundwater—a target installation area, rain gardens included. In this third stage, moreover, KuWP aims to have rain gardens positioned as one of the recharge measures in the prefecture's next "Kumamoto Area Comprehensive Groundwater Conservation and Management Plan."

Toward the recharge-area targets thus identified, KuWP is advancing study of a mechanism through which the public and private sectors jointly trade recharge. If the phased mobilization of public and private funds is the pump-priming that supports the start-up period, the trading of recharge is the market that arises beyond it—one in which funds circulate autonomously. By giving economic value to efforts that maintain and create recharge areas and making that value tradable, the provision of funds for conservation becomes not a subsidy or an act of goodwill but "the acquisition of value," gradually forming a market into which private capital flows of its own accord. The "groundwater recharge credit" discussed later is envisioned as the culmination of this pathway and remains at the concept and planning stage.

Such efforts will not be realized in a single leap; they will proceed step by step. The immediate three years (FY2026–FY2028) are positioned as a period for first demonstrating effectiveness through rain-garden pilot projects and establishing evaluation methods and standard specifications. This start-up phase is supported by preparations to draw on institutional funds that back private public-interest activities and by pioneering contributions from the founding members. In parallel, KuWP will widen the circle of supporters who take on rain-garden installation, give concrete form to collaboration with municipalities through agreements, and make the effects visible across the whole watershed. Building on these foundations, it will begin to study financing mechanisms, including the trading of recharge. Throughout, KuWP will hold regular dialogue with the prefecture and municipalities, looking ahead to rain gardens being positioned within the prefecture's Groundwater Recharge Guidelines and the Kumamoto Area Comprehensive Groundwater Conservation and Management Plan and, in time, connected to the regulatory and subsidy frameworks of the prefecture and municipalities.


Photo: Prefectural University of Kumamoto

CHAPTER 06

Green Infrastructure — the “Rain Garden” — and Its Scientific Basis

The core technology underpinning the watershed efforts KuWP envisions is the "rain garden" (ame-niwa), a multifunctional form of green infrastructure (GI). The rain garden is a leading example of a nature-based solution (NbS) that weaves the functions of natural ecosystems into urban space; it is not merely a landscaping technique for visual improvement. It is the technology KuWP focuses on first, as a means of supplementing—in the new setting of built-up urban areas—the groundwater recharge that paddy flooding and forests have hitherto provided. Beyond water-source recharge, rain gardens can restore to urban areas the multifaceted natural functions lost to urbanization—flood mitigation, water purification, heat relief, and biodiversity conservation—setting them apart from conventional stormwater storage-and-infiltration facilities[5].

Fig. 8 The Many Functions of Rain Gardens

The foundation of the technology and knowledge surrounding rain gardens is a body of research by the laboratory of Distinguished Professor Yukihiro Shimatani and colleagues at Kumamoto Prefectural University. The laboratory has developed methods for installing rain gardens and for measuring rainwater infiltration during rainfall, accumulating test results over time. These findings have been systematized as the "Rain Garden Standard Textbook," which sets out the standard approach to planning and designing rain gardens[34]. The spread of rain gardens is not

KuWP's effort alone. In Kumamoto, with Kumamoto Prefectural University—also a participant in KuWP—as the hub, a voluntary body that loosely links citizens, companies, government, and financial institutions, the "Kumamoto Rain Garden Partnership," was launched in 2023, advancing the development and dissemination of rain gardens through training and certification based on this textbook[35]. KuWP works closely with the Partnership and takes on the role of spreading the standard design thinking set out in the textbook to the front lines of urban implementation.

The strategic value of rain gardens lies in their multifaceted ecosystem services and the scientific data that back them. The first value is "flood mitigation and restoration of the water cycle." By temporarily storing rainwater and letting it infiltrate slowly into the ground, a rain garden curbs sudden inflows into the sewer system and helps prevent urban flooding[36].

Demonstration tests by Distinguished Professor Shimatani's research group (including joint research with Kyushu University and others) have confirmed the high runoff-suppression effect

Fig. 9 How a Rain Garden Works

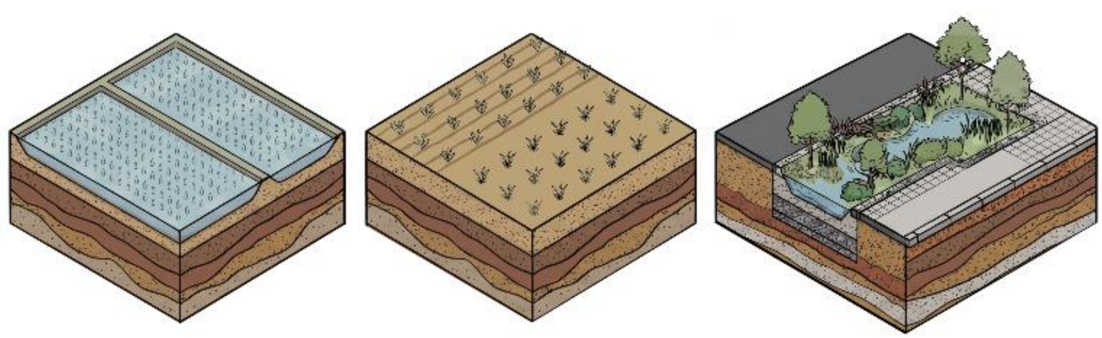
1 Collect from roofs and grounds Gutters and channels guide rainfall into the garden	**2 Hold water among multifunctional greenery** A basin about 30 cm deep holds stormwater while plantings purify water, cool the air, and shelter wildlife
3 Infiltrate and recharge Water soaks slowly through the soil, feeding the groundwater below	**4 Curb floods, drain only the excess** Eases the rush into sewers; only what the garden cannot hold drains away

of rain gardens. In a test at detached houses and other sites in Fukuoka City, during a downpour of 297.6 mm of daily rainfall, the actual runoff routed through the rain-garden system was held to just 0.24 mm, against an estimated runoff of about 7.9 mm under typical conditions[36]. In an on-site water-introduction test, outflow to the exterior per unit time was 0 mm, and against an estimated storage capacity of about 100 mm, more than 130 mm of rainwater was completely stored and infiltrated within the facility. These results show that rain gardens serve not only the long-term value of groundwater recharge but also as disaster-prevention and -mitigation infrastructure against urban water disasters such as inland inundation[36].

The "Rain Garden Standard Textbook" sets a depth of about 30 cm as standard, prioritizing safety: digging down 20 cm and piling the excavated soil around the perimeter to form a 10-cm rim, thereby securing storage-and-infiltration space without strain. As for area, when groundwater recharge is the main aim, the guideline is to secure at least 5% of the catchment area—the area, such as roofs and lots, from which rainwater is gathered into the rain garden via gutters and channels[34]. Moreover, demonstration experiments at Kumamoto Prefectural University have confirmed that the recharge per unit area of a rain garden reaches a level

Fig. 10 Annual Groundwater Recharge by Land Use

Paved land and buildings recharge almost nothing, so urbanizing recharge land strikes directly at the basin's water balance. The strategic value of rain gardens: they bring farmland-level recharge back to the city.



Paddy fields
High recharge via flooding
48–84k m^3/ha·yr
Flooded paddies pass water readily – the highest recharge capacity

Farmland
Natural infiltration through soil
–14k m^3/ha·yr
Rain percolates gently through the topsoil

Rain gardens
Urban restoration (field-proven)
–14k m^3/ha·yr
Restores farmland-level recharge even in urban areas

Note: Annual groundwater recharge per unit area, based on Kumamoto Prefecture's calculation formula. The rain-garden figure is from field trials.

equivalent to that of an average upland field in the Kumamoto region[37]. Because a rain garden is structured to gather and infiltrate rainwater from the surrounding impervious surfaces, this verified value implies that, even in urban areas, strategically placing rain gardens on part of a site can restore recharge capacity equivalent to the upland field shown in Chapter 4—about 14,000 m^3 per hectare per year[25]. In short, the rain garden is a realistic means of restoring a substantial part of the recharge function lost even on land converted to urban use.

The value of rain gardens is not limited to recharge and disaster prevention. Second is water purification and heat relief, and third is biodiversity conservation[5]. Stakeholders including the Shimatani laboratory have established demonstration fields within the Kumamoto region and continue verification—gathering data on these multifaceted functions to raise the reliability of evaluations of rain-garden effects.

The scientific evidence thus accumulated is not an end in itself but the foundation for connecting rain gardens to regional policy. KuWP positions the coming three years (FY2026–FY2028) as the period for consolidating that foundation. Specifically, it will engage diverse actors—local companies, government, and residents—and advance efforts to install rain gardens at sites across the Kumamoto region. From the rain gardens thus spread over a wide area, it will verify in practice the effects of flood mitigation and groundwater recharge and connect those results to the standardization of rain-garden effect estimation in the Kumamoto region. It then aims to reflect the resulting method for estimating recharge per unit area into Kumamoto Prefecture's "Groundwater Recharge Guidelines," described in the previous chapter. Once rain gardens are positioned in the Guidelines as a means of recharge, it will become possible to determine quantitatively, as a watershed-wide target, how large an area of rain gardens must be installed in urban areas to restore recharge capacity. These three years—accumulating locally rooted practice and scientific verification and connecting the results to policy—will be an important step toward making the rain-garden-centered Kumamoto model robust.

CHAPTER 07

The Potential of Nature Finance: From Voluntary Conservation to a "Groundwater Recharge Credit"

In response to the challenges described so far, what KuWP seeks to take on is, in effect, a catalytic role—moving the conservation of the watershed's water cycle forward in a way that meshes municipal policy with private investment. Concretely: first, to show scientifically the scale of the recharge areas that should be protected across the watershed and to support setting this as a policy target; second, to establish solutions that help meet that target and to evaluate their effects quantitatively; and third, to promote the phased mobilization of funds that underpins these.

First is the scientific underpinning of policy targets. Groundwater conservation has hitherto rested on the idea of a "water balance"—recharging and returning the volume that was abstracted. But against the loss of the very land that nurtures water, it becomes necessary to clarify, for the watershed, an area benchmark—the total amount of land to be protected—for "how much recharge area should be maintained." Through investigation and research that accounts for the watershed's geology, land use, and climatic conditions, KuWP will assemble the supporting data and evaluation methods. Such scientific grounding becomes a common foundation on which municipalities and other stakeholders can share watershed-wide conservation targets and translate them into concrete measures.

Second is establishing and evaluating the means to achieve the target. For green infrastructure such as rain gardens, which can restore recharge capacity even on already-urbanized land, KuWP scientifically quantifies the effects through pilot projects and systematizes them into reproducible evaluation methods. Showing reliably "which means produces how much recharge effect" is the precondition for turning conservation into an object of investment.

Third is mobilizing the funds that support these. Even when policy targets and the means to achieve them are in place, the effort will not be sustained unless funds flow continuously into the activities that carry out conservation. KuWP aims to function as a catalyst that links municipal policy, private-company investment, and financial-institution capital, promoting the mobilization of public–private funds and incentives toward the conservation of natural capital. One concrete culmination of this is the recharge-credit mechanism described next.

If the phased mobilization of funds described in the previous chapters is the "pump-priming" that supports start-up until the market matures, then beyond it lies an autonomous market that trades recharge itself. Behind the growing realism of this market is the change in the regulatory environment discussed in Chapters 3 and 4. Kumamoto Prefecture strongly asks newly arriving companies and the like, as a de facto compliance requirement, to "recharge 100% of their abstraction"[16]. However, if one also tries to make up for the recharge lost through the sealing of land surfaces, simply installing rain gardens on the developed site (on-site) makes it difficult, given area constraints, to restore recharge equivalent to that before the land was altered. The key, then, is the idea that a developer purchases recharge generated outside its own site to offset the decrease caused by its development.

Fig. 11 Recharge Trading Credits: An Early-Stage Concept

Applying the Mitigation Hierarchy to Recharge Trading Credits

The mitigation hierarchy is the international order of priority for addressing impacts on biodiversity, working from the top step down. The Kumamoto Model applies it to groundwater recharge.

4	**Offset**	LAST RESORT	Compensate for residual loss through off-site credits (third-party recharge)
3	**Restore**		Restore recharge capacity on site through rain gardens
2	**Minimize**		Minimize the extent of unavoidable conversion of recharge land
1	**Avoid**	FIRST PRIORITY	Avoid the conversion of recharge land wherever possible

ORDER OF APPLICATION

Proposed Design of the Recharge Trading Scheme

	Biodiversity Net Gain Act (UK)	Recharge Trading Credit Concept
Target	Loss of biodiversity	Loss of groundwater recharge capacity
What development is charged with	Decline in biodiversity units	Decline in recharge volume
Core principle	Net gain (improvement beyond the pre-development baseline)	Maintaining and restoring the water balance and recharge
Mitigation hierarchy	Avoid → minimize → restore → offset	Avoid → minimize → on-site recharge (rain gardens) → off-site credits (third-party recharge)
Role of compensation	Offsets as a last resort	Credits as a last resort (concept)
Off-site mechanism	Purchase of biodiversity credits	Purchase of surplus recharge credits
Measurement	Biodiversity metric	Rain-garden recharge evaluation
Certification & operation	Planning authorities audit compliance with the hierarchy	KuWP envisioned as third-party certifier
Status	In force since 2024	Planning & piloting stage

Note: The mitigation hierarchy (avoid → minimize → restore → offset) is the international framework for pursuing no net loss / net gain of biodiversity; offsets are a last resort, permitted only for impacts that remain after the higher steps are exhausted. The UK's Biodiversity Net Gain regime took effect in 2024. Kumamoto's concept applies the same discipline to groundwater recharge and is at the planning stage.

In examining this idea, we referred to England's "Biodiversity Net Gain (BNG)" system, which took effect in 2024. In principle it requires all new land development to achieve an improvement in biodiversity beyond the pre-development baseline, and it allows a developer to make up any shortfall it cannot achieve within its own site by purchasing, as "credits," biodiversity value generated off-site[38]. BNG, however, does not treat buying credits as an easy substitute. It presupposes the internationally established "mitigation hierarchy"—the order of priority by which one first avoids impacts on biodiversity, minimizes unavoidable impacts, restores as much as possible within the development site, and only then, for residual impacts alone, compensates off-site. Off-site compensation through credits is therefore clearly positioned as a "last resort," permitted only when higher-priority measures have been exhausted and the target still cannot be met; planning authorities confirm in the development-permit review that this order has been followed[38]. This disciplined way of thinking—quantifying impacts on nature and, after exhausting higher-priority measures, making up the residual impact through market transactions—can also be applied in the water domain.

The Kumamoto model envisions applying this mitigation-hierarchy thinking not to biodiversity but to groundwater recharge. This is at present an early-stage concept, but it places one basic principle clearly at the starting point of its institutional design: namely, it does not adopt the notion that "as long as you install a rain garden, you may develop freely." As in BNG, a developer is first required to avoid and minimize, as far as possible, the alteration of land that holds recharge function, and then to place rain gardens and the like to the maximum extent within the development site, doing its utmost to restore the lost recharge on its own site—this order of priority is set at the core of the concept. Trading in recharge is envisioned as a "last resort," permitted only when, even after exhausting such self-help, the site alone cannot reach the pre-development recharge. As a concrete mechanism, one possibility is to buy, as credits, the "surplus recharge" held by developers or municipalities that have installed rain gardens beyond their required amount, thereby making up the recharge that could not be achieved on-site. By presupposing that this order is observed with the same rigor as BNG, the aim is to prevent the credit market from becoming a license for easy development and to halt, for the watershed, the decline in recharge that each development brings. When such a market is realized, KuWP envisions serving—together with municipalities—as a neutral and rigorous third-party body, handling both the certification of recharge based on scientific protocols (including confirmation of compliance with the mitigation hierarchy) and the operation of the trading venue.

The Kumamoto model first aims to establish this trading of "groundwater recharge," and beyond that envisions adding, as co-benefits attached to recharge credits, the multifaceted value that rain gardens bring—runoff suppression (mitigation of urban flooding), enhanced biodiversity, and carbon storage. All of these remain matters for future study, but if such a mechanism takes shape, arriving companies could respond to both the nature-related risk disclosure that TNFD requires and their decarbonization targets at once, through investment in a single high-quality credit.

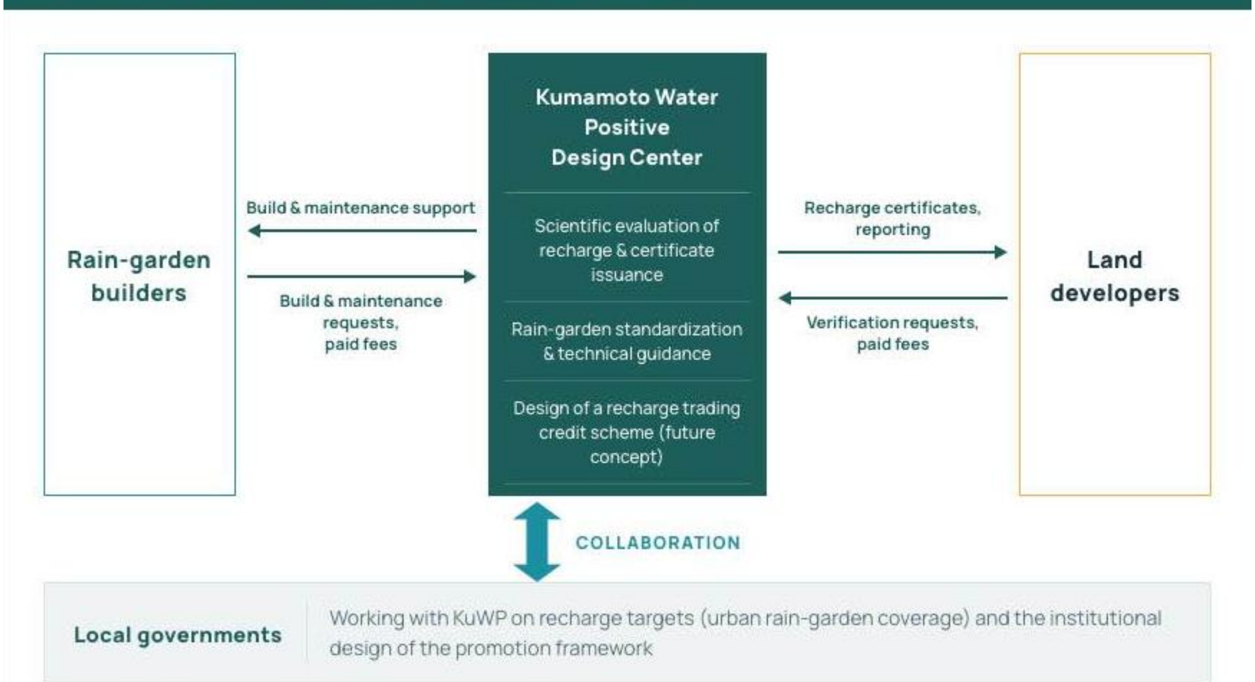
CHAPTER 08

Challenges to the Kumamoto Model's Self-Reliance, and a Question to the World

However excellent a governance concept or scientific approach may be, it cannot function over the long term if the organization that carries it lacks financial sustainability. KuWP positions self-reliant, self-sustaining operation—one that does not depend excessively on particular external funds—as an important task from the early stage of the concept. Yet its business foundation is not yet established. The financial design and global outlook described in this chapter are all early-stage concepts at present, to be tested through future demonstration and dialogue.

KuWP's financial design aims to establish, in stages, self-sustaining operation centered on a membership system and business revenue. In particular, it emphasizes setting up membership segments to draw in private funds and advancing the phased mobilization of public and private money. At the same time, it is designing the structure so that business activities themselves—technical guidance, impact evaluation and the issuance of certificates, and the future operation of an offset trading market—support the organization. The immediate task is to nurture, little by little, a sustainable cycle in which resources gained through these activities are reinvested to raise the reliability of the evaluation platform—strengthening human resources and building the system infrastructure for IoT automated measurement and data visualization—and in which that improved reliability draws in still wider activity.

Fig. 12 KuWP's Business Model: Built to Run on Its Own



Note: KuWP aims to run self-sufficiently on memberships and business revenue, with funds circulating through fee-for-value exchanges with each player.

KuWP envisions not only being a neutral certification and evaluation body but also providing functions—for developers and newly arriving companies that alter lands such as matching them with solution providers and communicating to society at large. The starting point for this is scientific evidence. As noted earlier, demonstration experiments at Kumamoto Prefectural University have confirmed that a rain garden has groundwater recharge capacity per unit area equivalent to that of an upland field[37]. By accumulating such findings one by one, KuWP aims to grow a reproducible green-infrastructure “prototype” that lets businesses secure revenue-generating floor area while meeting administrative requirements. If, in the future, this can be linked with the infrastructure plans of municipalities and the national government and positioned as “investment in compliance infrastructure,” it could help gradually broaden NbS-related funding—much of which currently relies on public money—toward private investment. These, however, are all future challenges, not complete mechanisms at present.

Beyond that, the Kumamoto model looks toward gradually shaping the knowledge gained from such practice into a form that can be shared with other watersheds around the world. Generally, for a market in environmental credits to hold together, both reliable data as the basis for transactions and an effective environmental target (a cap) that generates demand are said to be indispensable. In Kumamoto, prompted by the concentration of the semiconductor industry, a de facto cap—the “request to recharge 100% of abstraction” imposed on newly arriving companies—has taken shape. Furthermore, a conservation framework that looks beyond abstraction alone to the decline in recharge function accompanying land-use change is being explored within the overall picture of the government’s efforts. Whether KuWP, the industry–academia–finance collaboration, can support such conservation efforts from the side of scientific data and eventually connect them to a market mechanism—this is not an established achievement but a challenge now under way. If anything from this challenge proves useful to other regions, it will not be the individual technology of the rain garden. Rather, it will be the way of combining four elements—the “scientific visualization of a region’s unique natural capital,” the “integration of indigenous knowledge and advanced technology,” “connecting regulation (a cap) with a market mechanism,” and “forming a private-led driving body of industry, academia, and finance and collaborating with government”—a way of thinking that each region can reinterpret according to its own climate, culture, and institutions.

Fig. 13 Four Elements Any Watershed Can Adapt from the Kumamoto Model

What is transferable to other regions is not the rain garden itself but the combination of these four elements — an approach that each watershed can reinterpret in accordance with its own landscape, culture, and institutions.

01 Science-based visualization of local natural capital Quantify the state of the region's water resources and ecosystems, clarifying what is to be conserved and at what scale	**02 Integration of local knowledge and advanced technology** Combine long-established practices such as paddy-field flooding with IoT sensing, simulation, and other advanced technologies
03 Linking regulation (caps) with market mechanisms Connect regulatory environmental targets to a market framework in which private capital circulates autonomously	**04 A private-sector-led coalition in partnership with government** Establish a coalition of industry, academia, and finance that translates field practice into policy in collaboration with government

Note: Considered independently of the Kumamoto context, these four elements constitute a generalizable framework — a starting point for adapting the model to other watersheds.

From July 14 to 15, 2026, the "Global Nature Positive Summit (GNPS)," held in Kumamoto City, will bring together the world's top business leaders, decision-makers from financial institutions, and senior government officials from many countries[7]. The significance the Kumamoto model holds at this venue is not to unilaterally proclaim a new philosophy. It is to provide a verifiable example of implementation against frameworks the international community is already converging on. IPBES's BBA report positioned the loss of biodiversity as a systemic risk to the entire economic and financial system and called on companies to align economic activity with the conservation of natural capital and to engage inclusively, respecting the knowledge of local communities[6]. Yet a large distance remains between such recommendations and on-the-ground implementation. By showing a concrete picture in which industry–academia–finance actors with a stake in the watershed's sustainability pursue growth and conservation within the same decision-making—integrating indigenous knowledge and scientific measurement—the Kumamoto model can become a "living showcase" for verifying how the BBA's recommendations might function in a single region. Likewise, the landscape approach that TNFD recommends asks companies to assess nature-related dependencies and impacts at the watershed and landscape scale, beyond the level of individual sites[9]. But for many companies the challenge is not the etiquette of disclosure but implementation itself—what to do at the landscape scale. Kumamoto's attempt, in which multiple actors sharing a watershed build up actions on a common scientific evaluation base, explores one operational form of this landscape approach; the significance of putting this model to the world lies precisely in candidly sharing, at the GNPS, both that experience and the still-unsolved challenges, and submitting them to verification through dialogue with the world's watersheds and experts. What the Kumamoto Water Positive Action aims for is to seek a path that reconciles the regeneration of natural capital rooted in a region's unique climate and culture with economic growth. How far this holds outside Kumamoto has not yet been sufficiently verified. This white paper is one touchstone for posing that question to the world and placing it on the table for dialogue and verification.

CHAPTER 09

Lessons Emerging on the Ground in Kumamoto: Toward Dialogue with the World's Watersheds

The framework of the Kumamoto model presented in the previous chapters is not a completed methodology. Practice is only halfway, and much of the concept is still at the planning stage. Yet what holds value for the world's watersheds facing the same challenges is, rather than the presentation of a finished form, a candid sharing of what is being learned along the way. This chapter organizes six lessons emerging from the journey so far, together with the challenges being faced.

Fig. 14 Six Lessons Emerging from the Field in Kumamoto

1. **Identify changes not yet captured by existing institutions**
   Watershed governance begins with identifying the divergence between the water balance recognized by institutions and actual conditions in the watershed

2. **Implementation and data precede financial mechanisms**
   Market mechanisms can be established only on verifiable field data; transparent communication of each initiative's maturity is the foundation of trust

3. **Design voluntary standards suitable for government adoption**
   Develop evaluation methodologies as public goods that complement the role of government and can be incorporated into official policy

4. **Institutionalization rests on relationships, not approval**
   Sustained dialogue provides the pathway to institutional recognition; full disclosure of current status makes the process reproducible

5. **Regional finance reconciles growth and conservation**
   When the same financial institutions fund both growth and conservation, the apparent conflict is reconciled within a single investment decision

6. **Public–private alignment rests on a shared objective**
   Affirming a common goal — compatibility of growth and watershed conservation — enables collaboration across differences in position and time horizon

First lesson: the starting point is to find changes the system has not yet adequately captured.

In Kumamoto, abstraction is managed by ordinance-based regulation and recharge requests. Meanwhile, the loss of recharge functions accompanying land-use change had remained an area on which administration finds it hard to focus. Between the "water balance the system sees" and the "actual water balance of the watershed," a gap unique to each watershed exists. Identifying this gap is the first step in private-leading watershed governance. In Kumamoto, against such an area the system had not yet adequately captured, an industry–academia–finance coalition that makes the watershed's very sustainability its business foundation moved first, without waiting for regulations to be put in place. Not including government as a member from the outset was a design choice to secure agility and neutrality in making proposals to the administration.

Second lesson: implementation and the accumulation of data preceding finance. The concept of groundwater recharge trading (water credits) detailed in this white paper is a medium-term vision, at present at the planning stage. KuWP's immediate priorities are expanding the installation of rain gardens, broadening the base of the movement through residents' support, and developing standardized methods (guidelines) covering both construction and monitoring. A market mechanism can be built only upon the accumulation of verifiable implementation data. And honestly distinguishing the maturity stage of the concept is itself the currency for earning stakeholders' trust.

Third lesson: design voluntary standards in a form "the administration can adopt." The standardized methods KuWP is developing are not an end in themselves. They are designed with a view to being reflected, in the future, in policy documents Kumamoto Prefecture already has, such as its groundwater recharge guidelines, and to having the rain garden impact-evaluation method incorporated as one of the prefecture's official evaluation options. The point is to craft a voluntary effort as a public good that complements the supervisory role the administration plays in groundwater management. As discussion over the public recognition of voluntary standards advances internationally as well, this design philosophy is the key to letting private-led efforts build a bridge to institutions.

Fourth lesson: institutionalization begins not with "approval" but with building "relationships."

Kumamoto's journey can be organized as a pathway of eight stages.
1) discovering changes the system has not captured
2) forming a private-sector driving body
3) expanding implementation and the residents' movement
4) developing standardized methods
5) the administration's participation as an observer and regular dialogue
6) listing as a "pilot" in administrative planning documents
7) formalizing the evaluation method and reflecting it in policy documents
8) institutionalizing the market mechanism

Kumamoto is currently at stages 5) to 6). Local government participates as an observer in discussions and meetings, regular dialogue continues the aims of the effort and its expected outcomes, and the effort has come to be described as a pilot stage in Kumamoto Prefecture's official planning documents. It is still too early to call this "collaboration." Yet disclosing this current position accurately is not a confession of weakness but the most practical information there indicates the midpoint of a process reproducible in any watershed.

Fifth lesson: regional finance becomes the node that internalizes the trade-off between growth and conservation.

The “desirable environmental arrangements” that global frameworks depict do not, by themselves, reach the field. As IPBES’s BBA report notes, aligning economic incentives with the conservation of natural capital requires an actor that weaves science and local knowledge together at the site and watershed scale[6]. In Kumamoto, the actor playing this nodal role is the regional financial institution. A regional financial institution is both the “financial engine of economic development,” supporting the investment and funding needs of local firms that industrial concentration brings, and a “bearer of natural-capital conservation,” supplying capital and credit to KuWP and to groundwater-conservation funds. The actor that funds growth on the water-using side also supplies funds and legitimacy to the water-returning side. Because a single actor holds both roles, the “growth-versus-conservation” trade-off—which from outside tends to appear as a conflict—is internalized and adjusted within a single management decision. Furthermore, a regional financial institution combines multiple functions: connecting upstream conservation with downstream benefit through financial products that leverage the local trait in which depositors, beneficiaries, and watershed residents overlap; coordinating wide-area collaboration across administrative boundaries; gathering local data through the touchpoints of lending and transactions; and securing the “local legitimacy” that prevents global efforts from leaving the locality behind. The involvement of regional capital with a long-term stake in the watershed is one of the core conditions for deploying this model to other regions.

Sixth lesson: what connects the public and private sectors is not regulation or requests but a shared goal.

In Kumamoto, the administration and KuWP face the same direction— “reconciling economic growth with watershed conservation.” Confirming this single point has been the driving force that moves the relationship forward across differences of standpoint and time horizon. These lessons ultimately converge on a single question. Incentives for water stewardship truly function only when the following conditions are met.

1) a verifiable voluntary standard exists and can connect to the administration’s existing policy frameworks
2) the public and private sectors confirm a shared goal and local society participates as a bearer of the movement
3) regional capital with a long-term stake in the watershed is involved
4) the private sector respects the time horizon of administrative decision-making

Kumamoto’s practice is an ongoing attempt to satisfy this set of conditions one by one, and when the world’s watersheds face the same question in their own contexts, it should serve as material for dialogue.

References

1. Madani, K., Global Water Bankruptcy: Living Beyond Our Hydrological Means in the Post-Crisis Era, United Nations University Institute for Water, Environment and Health (UNU-INWEH), 2026.1(DOI: 10.53328/INR26KAM001), https://unu.edu/inweh/news/world-enters-era-of-global-water-bankruptcy
2. OECD Environmental Outlook to 2050: The Consequences of Inaction, OECD Publishing, 2012, https://www.oecd-ilibrary.org/environment/oecd-environmental-outlook-to-2050_9789264122246-en
3. Li, P., Yang, J., Islam, M. A. and Ren, S., Making AI Less “Thirsty”: Uncovering and Addressing the Secret Water Footprint of AI Models, Communications of the ACM (2025), https://cacm.acm.org/sustainability-and-computing/making-ai-less-thirsty/
4. A World-Class Pure Groundwater City Kumamoto,Japan, https://www.city.kumamoto.jp/kankyo/kiji00320455/5_20455_shiryou1_w5kd1hd3.pdf; Kumamoto Prefecture, “Efforts for Groundwater Quantity Conservation,” https://www.pref.kumamoto.jp/site/mizunokuni-kumamoto/224095.html
5. Establishment of the general incorporated association “Kumamoto Water Positive Design Center” (news release), Suntory Holdings, Higo Bank, MS&AD Insurance Group Holdings, Kumamoto University, and Kumamoto Prefectural University, 2026.5.28, https://www.suntory.co.jp/news/article/2026/15053.html
6. Summary for Policymakers of the Methodological Assessment Report on the Impact and Dependence of Business on Biodiversity and Nature's Contributions to People(Business and Biodiversity Assessment report SPM), IPBES, 2026(DOI: 10.5281/zenodo.15369060), https://doi.org/10.5281/zenodo.15369060
7. Global Nature Positive Summit 2026 (official site), Nature Positive Initiative / IUCN-J / ICLEI Japan, https://events.nikkeibp.co.jp/event/2026/GNPS_jp/
8. Nature-related issues in the technology sector: Dependence on water by the semiconductor and data centre industries(TNFD case study), TNFD, 2026.2, https://tnfd.global/wp-content/uploads/2026/02/Case-study_Water-dependency-of-the-tech-sector_DIGITAL.pdf
9. Additional sector guidance: Water utilities and services, TNFD, https://tnfd.global/wp-content/uploads/2025/06/Additional-sector-guidance-Water-Utilities-and-Services.pdf?v=1750760239
10. Doubling Down on Nature, https://www.nature.org/content/dam/tnc/nature/en/documents/d/o/Doubling_Down_on_Nature_State_of_NBS_2025.pdf
11. Map of priority and designated areas under the Groundwater Conservation Ordinance — Kumamoto Prefecture, https://www.pref.kumamoto.jp/uploaded/life/259333_786669_misc.pdf
12. Kumamoto, the City of Pristine Groundwater (explanation of the groundwater recharge mechanism in the middle Shirakawa basin), Kumamoto University,

International Education and Research Center for Groundwater Environment Leaders (GelK), https://www.fast.kumamoto-u.ac.jp/gelk/chousei.html
13. Hanaguri Ide, Kikuyo Town Cultural Heritage Tourism, "The Way of People, the Way of Water", https://www.kikuyotsu-rizumu.jp/en/hanaguri/
14. Groundwater conservation activities of the Kumamoto City Waterworks and Sewerage Bureau (overview of the Kumamoto Groundwater Foundation), Kumamoto City Waterworks and Sewerage Bureau, https://www.kumamoto-waterworks.jp/waterworks_article/34552/
15. Groundwater recharge (paddy-flooding projects in the Kumamoto region, etc.), Cabinet Secretariat, Water Cycle Policy Headquarters, "Groundwater Management Promotion Platform"(see also Ministry of the Environment, "Payments for Ecosystem Services (PES): Japanese Best-Practice Cases — Water Resources"), https://www.cas.go.jp/jp/seisaku/gmpp/activities/issues/issue05.html; archived at https://warp.ndl.go.jp/web/20230302125158/http://www.biodic.go.jp/biodiversity/shiraberu/policy/pes/water/water03.html (last accessed 19 June 2026)
16. Efforts for Groundwater Quantity Conservation (Activities), Kumamoto Prefecture, https://www.pref.kumamoto.jp/site/mizunokuni-kumamoto/224095.html
17. Awarded the 2013 UN "Water for Life" Best Practice Award (Water Management category), Kumamoto City, https://www.city.kumamoto.jp/kankyo/kiji00320467/index.html
18. TSMC's CEO indicates the introduction of 3 nm at its second Kumamoto fab, EE Times Japan, 2026.2, https://eetimes.itmedia.co.jp/ee/articles/2602/06/news047.html
19. Behind the scenes of semiconductor manufacturing: a vast water-treatment facility beneath JASM, Nikkei xTECH, 2026.1, https://xtech.nikkei.com/atcl/nxt/mag/ne/18/00001/00607/
20. Industrial water for semiconductor plants to be developed with Ryumon Dam as the source (announced at Kumamoto Prefecture's Groundwater Conservation Promotion Headquarters meeting), Nikkei (Nihon Keizai Shimbun), 2024.11, https://www.nikkei.com/article/DGXZQOJC280JH0Y4A121C2000000/
21. TSMC's Kumamoto plant: returning "three times" the water it uses, Nikkei ESG, https://project.nikkeibp.co.jp/ESG/atcl/column/00005/120400545/
22. On groundwater conservation efforts (JASM's recharge exceeding 100% of its abstraction; the middle Shirakawa basin paddy-flooding project), Kumamoto Prefecture, Environmental Model Prefecture Promotion Division(report to the Economy and Environment Standing Committee), 2023.10, https://www.pref.kumamoto.jp/uploaded/attachment/231649.pdf
23. Kikuchi, H., et al., An attempt to build an integrated surface-water and groundwater cycle model for the Kumamoto region (including estimation of recharge structure by land use based on the Kumamoto Area Comprehensive Groundwater Survey), Yachiyo Engineering, https://www.yachiyo-

eng.co.jp/case/papers/pdf/2012_25_kikuchi.pdf
24. Land-use change and changes in groundwater recharge in the Kumamoto region, Kumamoto Groundwater Foundation (abstract, Japanese Association of Groundwater Hydrology, 2025 Ogaki Meeting), https://kumamotogwf.or.jp/File/Conference_materials/Land%20use%20change.pdf
25. Kumamoto Water Positive Action launch-event briefing materials (including infiltration by land use and trial calculations of development scale and rain-garden effects), Kumamoto Water Positive Secretariat, 2025.3(internal document)
26. Characteristics of flood damage in Hitoyoshi City and Kuma Village from the July 2020 torrential rain, National Research Institute for Earth Science and Disaster Resilience (NIED), 2020.7, https://www.bosai.go.jp/info/saigai/2020/20200714_01.html
27. On the heavy rain beginning 10 August 2025, Kumamoto Prefecture, 2025.8, https://www.pref.kumamoto.jp/soshiki/39/243329.html
28. Farmland conversion in the Kikuchi area reaches 278 ha since autumn 2021 (report to Kumamoto Prefecture’s Agriculture, Forestry and Fisheries Standing Committee), Kumamoto Nichinichi Shimbun, 2025.12, https://kumanichi.com/articles/1936746
29. Future projection of groundwater levels in the Kumamoto region [preliminary] (FY2025 1st Kumamoto Prefecture Groundwater Conservation Promotion Headquarters meeting, Material 2), Kumamoto Prefecture, Environmental Model Prefecture Promotion Division, 2025.4.16, https://www.pref.kumamoto.jp/uploaded/life/263972_806612_misc.pdf
30. Kawasaki et al. (Suntory Global Innovation Center, Institute for Water Science, et al.): Development of a surface-subsurface integrated model for understanding and managing the groundwater resources through multi-stakeholder participation in Kumamoto Area, southern Japan (Part 1), AGU Fall Meeting 2023(poster presentation H31O-1674); and Kawasaki et al.: Use of simulations to evaluate the balance between recharge and pumping to contribute to the development of policies for sustainable groundwater use in the Kumamoto area, southern Japan, EGU General Assembly 2024
31. Efforts for Groundwater Quantity Conservation (Activities) (revision of the Groundwater Recharge Guidelines and strengthened operation toward recharging an amount equal to abstraction), Kumamoto Prefecture, https://www.pref.kumamoto.jp/site/mizunokuni-kumamoto/224095.html
32. On efforts to promote groundwater recharge (recharge requirements at the development stage under the revised enforcement rules of the Environmental Impact Assessment Ordinance), Kumamoto City, Environmental Policy Division, 2024.7, https://www.city.kumamoto.jp/kiji00355897/5_55897_413307_up_ZH10MUKN.pdf
33. Aso Guardians Fund for Nurturing Kyushu’s Water (support for activities that

maintain the water-source recharge function of Aso's grasslands and the like), Kumamoto Prefecture, https://www.pref.kumamoto.jp/soshiki/49/241676.html
34. Kumamoto Rain Garden Partnership (ed.), Rain Garden Standard Textbook, 2026 ed. (Amamizu Bunko), https://www.amazon.co.jp/dp/B0GTDVL6KT
35. Kumamoto Rain Garden Partnership, official website, https://www.kumamoto-ameniwa-partnership.com/
36. Ome, M., Taura, F., Moriyama, T., and Shimatani, Y., Development and effect verification of a runoff-suppression rain garden, JSCE Journal B1 (Hydraulic Engineering), Vol. 76, No. 2 (J-STAGE), https://www.jstage.jst.go.jp/article/jscejhe/76/2/76_I_799/_pdf/-char/ja
37. Shimatani, Y. (Kumamoto Prefectural University), lecture materials for the launch ceremony of the Kumamoto Water Positive Action, 2025.3.22
38. Understanding biodiversity net gain - GOV.UK, https://www.gov.uk/guidance/understanding-biodiversity-net-gain
39. FAQ on the rational use of groundwater and groundwater recharge (recharge edition) (method for calculating estimated recharge under the Groundwater Recharge Guidelines), Kumamoto Prefecture, Environmental Model Prefecture Promotion Division, https://www.pref.kumamoto.jp/soshiki/49/5515.html
40. GS SUSTAIN Biodiversity TNFD releases recommended disclosure metrics - Goldman Sachs, https://www.goldmansachs.com/pdfs/insights/pages/gs-research/biodiversity-recommended-disclosure-metrics/report.pdf
41. "A sustainable society starting from recovery centered on watershed-based flood management," regional co-creation hub (JST COI-NEXT), Kumamoto Prefectural University, https://www.pu-kumamoto.ac.jp/sys/wp-content/uploads/2021/12/kumamoto_pu_20211126043735.pdf

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