

Wetlands *and* Eco-DRR in Asia

*Case Studies of Traditional or Local
Ecosystem-based Disaster Risk Reduction (Eco-DRR)
Related to Wetlands in Asia*



Acknowledgements

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Wetlands and Eco-DRR in Asia

Case Studies of Traditional or Local Ecosystem-based Disaster Risk Reduction (Eco-DRR) Related to Wetlands in Asia

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Forward

Due to the impact of climate change and other factors, the number of disasters has increased worldwide. Especially, the Asian region is the most affected area in the world regarding the number of disasters, the number of deaths, and the amount of damage. As the number of disasters increases globally and the damage has expanded, Ecosystem-based Disaster Risk Reduction (Eco-DRR)” draws attention. This concept has been integrated into various international frameworks such as Sendai Framework, Sustainable Development Goals, Convention on Biological Diversity, Ramsar Convention etc.

In 2019, we began a project to examine traditional and local Eco-DRR related to wetlands in Asia and evaluate their effect. Asian experts conducted a field study and workshops to plan and create a format for case studies. The format was designed to select Eco-DRR cases and present in a manner by which they could easily be understood. By exchanging and sharing cases, the functions of DRR of wetlands are recognized and better understood. The collected case studies were compiled to this booklet and I thank the authors for their contribution.

Yukihiro Shimatani
Distinguished Professor
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Introduction

Wetlands International Japan implemented a project entitled “Role and Function of wetlands for climate change adaptation and disaster risk reduction in Japan and Asia” from April 2019 to March 2023. The project is supported by the Keidanren Nature Conservation Fund and this booklet is one of the results of the project.

As a background to the project, it was reported that the conservation status of coastal forests such as mangroves and sand dunes made a significant difference to tsunami damage in the affected areas during the 2004 Indian Ocean earthquake and tsunami, and there was a common understanding that research on the disaster prevention and mitigation functions of ecosystems is needed. Eco-DRR has also been receiving attention in international frameworks. The 12th Conference of the Parties (COP) to the Convention on Biological Diversity adopted Decision XII/20 Biodiversity and climate change and disaster risk reduction in 2014. The Sendai Framework for Disaster Reduction 2015-2030, adopted at the United Nations Conference on Disaster Reduction held in Sendai in 2015, also incorporated the concept of using ecosystem management for disaster prevention and mitigation. The Resolution XII.13 Wetlands and disaster risk reduction was also adopted at COP12 of the Ramsar Convention in 2015. The Sustainable Development Goals (SDGs) adopted in 2015 include efforts for disaster risk reduction regarding several goals and targets. In 2017, disaster risk reduction was one of the themes of the breakout sessions at the Asian Wetland Symposium 2017, and was incorporated into the Saga Statement, serving as the Declaration. While various ecosystems are relevant to disaster risk reduction, the Resolution XII.13 recognizes that healthy and well-managed wetlands reduce disaster risk and strengthen the ability of communities to recover from disasters.

This project aimed to examine traditional Eco-DRRs for wetlands that are still functioning in Japan and other Asian countries, and to evaluate their effects on disaster risk reduction, disaster mitigation, and climate change adaptation. We expected the exchange of information and sharing of case studies in Japan and other Asian countries to contribute to the recognition of the functions of wetlands for disaster risk reduction and climate change adaptation, and to the future conservation of wetlands and regional disaster prevention.

E20-008 case study sheet	The name of the site
<p>2. Gifts from nature</p> <ul style="list-style-type: none"> • Additional ecosystem services • Key species 	<p>Photo or figure</p>
<p>3. Traditional/local knowledge and practices</p> <ul style="list-style-type: none"> • Please write about the relationship between communities and people • Traditional knowledge, local knowledge, such as forest protection, till and industry that use the ecosystem 	<p>Photo or figure</p>
<p>4. Challenges</p> <ul style="list-style-type: none"> • Please write any current or future issues or challenges • Current problems • Problems that may occur in the future • Challenges for sustainability and better 	<p>Photo or figure</p>
<p>5. Lessons learnt</p>	<p>Photo or figure</p>

Editor : Worldwide International Journal
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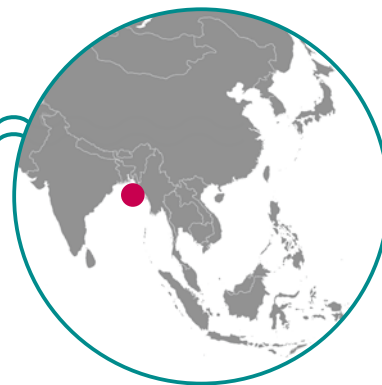
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St. Martin's Island

St. Martin's Island, Cox's Bazar, Teknaf, Bangladesh

20.6237° N, 92.3234° E



Background

St. Martin's Island is a small island that lies in the Bay of Bengal some 10 kilometers south of the tip of the largest Peninsula of Teknaf. The Island, which is 590 ha in area, has been considered as an ecologically sensitive area in its entirety. Bangladesh POUH facilitated conservation and plantation activity of screw pine.

System of disaster prevention

- » Screw pine (*Pandanus*) is the dominant vegetation and is distributed in small to large patches over the Island, growing both naturally and manually along the sandy beaches and is planted extensively as hedges around the homesteads.
- » It protects the entire island from tidal surges, wave, sands, strong winds, and other disasters.
- » In the course of time the screw pine and other vegetation faced threats from erosion and manmade destruction. By further planting screw pine and associated dune vegetation the disaster prevention effect increases.



Main Ecosystem

Beach Intertidal Ecosystem,
Sub tidal rocky habitat

Disaster



Tidal Surge

Eco-DRR Element

• Associated Ecosystem

Coast/Tidal flat/Coral reef/Lake and marsh/Forest/Rice paddy/Beach/Crop-land/Sand dune/Mangrove/Freshwater and brackish water lagoons/Intertidal rock/Mudflat

• Disasters

High tide/Erosion/Tidal surge/High wind

• Ecosystem Services

Tide prevention/Prevention of salt damage/Prevention of blown sand/Wind prevention/Reduction of flow velocity/Prevention of driftwood and wastes/Control of discharged sediment/Fisheries

• Other functions

Soil formation/Food production/Fuel/Material/Education/Recreation/House material/

• Traditional/local knowledge and practice

Natural fisheries, sea capture fisheries, coconut tree plantation and tourism etc.

Characteristics of this case

- It is included in the DRR plan.
- It is included in the environmental management plan.
- It is included in the spatial planning.
- It is included in the development plan.
- There are environmental degradations.
- There is funding for management of the ecosystem.
- Local people understand its disaster prevention and environmental functions.
- It is integrated into community activities.
- Other stakeholders understand disaster prevention and environmental functions.
- It plays a role in maintaining the community.
- It contributes to community development.
- There are mechanisms of local economic circulation in this case.
- It is used for environmental education.

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> Tidal surge protection Wind protection 	<ul style="list-style-type: none"> Tidal surge protection Wind protection
Regulating service	<ul style="list-style-type: none"> Prevention of blown sand Prevention of salt damage 	<ul style="list-style-type: none"> Prevention of blown sand Prevention of salt damage
Additional function	<ul style="list-style-type: none"> Binds sand dune vegetation and nests for turtles Shelter for wilds 	<ul style="list-style-type: none"> Binds sand dune vegetation and nests for turtles Shelter for wilds
Provisioning service	<ul style="list-style-type: none"> Fruits for birds 	<ul style="list-style-type: none"> Fruits for birds
Supporting service	<ul style="list-style-type: none"> Woods and materials for fences 	<ul style="list-style-type: none"> Materials for fence
Cultural service	<ul style="list-style-type: none"> Seedlings for sale and replantation 	<ul style="list-style-type: none"> Colorful ornamental fruits
Traditional Knowledge, Traditional Technique	Wide range of coastal and marine salt tolerant forests, based on natural and planted trees	

Gifts from nature

- » The site supports the dune ecosystem and nesting sites for globally threatened turtle species. The site lies on the East Australasian Flyway and Central Asian Flyway and provides a stepping stone for several globally threatened migratory waders.
- » The site is considered to be the only scenic screw pine forest in Bangladesh combined with high salt tolerant mangrove species.
- » Screw pine trees are used for house materials, the fruits for colorful decoration and are sprouted for plan-

tation for sand binding and to protect coconut trees and generate income from tourism and sale of indigenous small-bulbed onions produced from island.

- » Pandanus creates habitat for birds and crustaceans.
- » The marine site also supports fish, lobster, corals, associated species, crustaceans, mollusks, turtles and dolphin etc.
- » With locals, VCG (village conservation groups) is formed by POUSH to restore the vegetation and conserve St. Martin's Island.

Traditional/local knowledge and practices

The human population of St. Martin has been drastically growing day by day and demand for crop production is also increasing, the locals are utilizing: and also destroying, the *Pandanus* and side by side re-plantation is going on, considering its life support function for the islanders.

The reason for choosing the screw pine trees is that it has

a wide range of salt tolerant species in marine and coastal environments growing both naturally and manually along the sandy beaches, and is planted extensively as hedges around the homesteads. Year round it maintains the green wilderness in the site.

Challenges and lessons learnt

- » In recent years screw pine management seems to be poor and proper conservation, management and enforcement is needed to protect the screw pine.
- » In the near future the island might face different tidal

shocks.

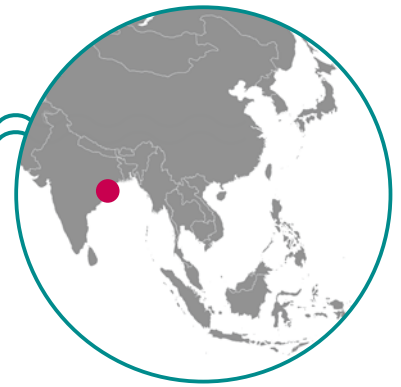
- » For tourism cottages and settlement purposes, due to the huge birth rate of islanders, the *Pandanus* has been clearing and burning by islanders and outsiders.



Tampara Wetland

Chatrapur, Ganjam District, Odisha, India

19°21'13.4"N 85° 00'06.5"E



System of disaster prevention

- » In the Ganjam district of Odisha, south of Rushikuliya River, at Tampara wetland, a collaborative approach is being developed to safeguard and restore wetland functioning to reduce water and weather related disaster risks through implementation of Eco- Disaster Risk Reduction (Eco-DRR) and Integrated Water Resource Management (IWRM).
- » Wetlands International South Asia, supported by local governance systems (Panchayats), CSOs, PfR consortium members and UN Environment Programme worked together to upscale community resilience towards water related disasters.
- » The objective is to promote participatory community risk reduction planning while blending ecosystem functioning with built infrastructure such as dykes and bunds along with inclusion of wetlands management within local development plans and sectoral plans including DRR.
- » Odisha government has developed a coastal shelterbelt (Casuarina Plantation, Jhau) along the coastal end of Tampara to safeguard against cyclones post Phailin in 2013.



Main Ecosystem

Coastal Freshwater Lake

Disaster



Cyclones



Floods



Seawater intrusion

Eco-DRR Element

- **Associated Ecosystem**
Coast/River/Floodplain
- **Disasters**
Flood/Draught/Cyclones
- **Ecosystem Services**
Freshwater flow regulation, wind attenuation, nutrient regulation
- **Other functions**
Food production/Recreation/Water Resource/Cultural services
- **Traditional/local knowledge and practices**
Fisheries/Kewra or Pandanus sp. collection/Essential oil extraction /Presence of community based traditional knowledge on early warning of cyclonic storms

Characteristics of this case

- There are environmental degradations.
- There is funding for management of the ecosystem.
- Local people understand its disaster prevention and environmental functions.
- It is integrated into community activities.
- It plays a role in maintaining the community.
- It contributes to community development.

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Regulation of water flows • Climate regulation • Decreased potential to buffer storms and cyclones 	<ul style="list-style-type: none"> • Regulation of water flows • Reducing impacts of cyclones
Regulating service		
Additional function	<ul style="list-style-type: none"> • Decreased groundwater recharge • Provisioning for freshwater • Decreased Fisheries • Aquaculture • Tourism • Habitat 	<ul style="list-style-type: none"> • Freshwater supply • Ground water recharge • Climate regulation • Fisheries • Aquaculture • Tourism • Habitat Provisioning
Provisioning service		
Supporting service		
Cultural service		
Traditional Knowledge, Traditional Technique	Resource use techniques for Fisheries and Kewra Community linkages with wetlands ecosystem	

Gifts from nature

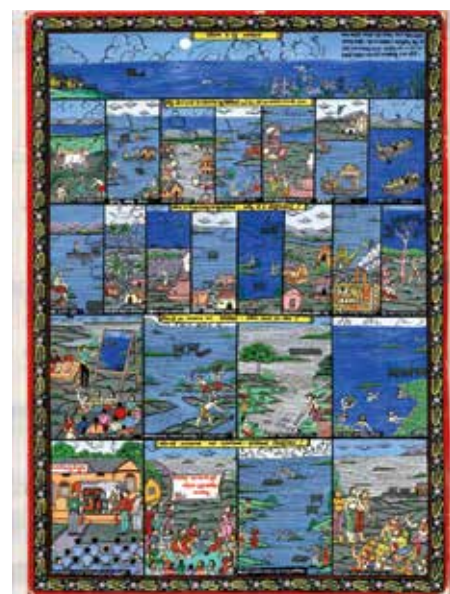
- » Tampara is a major freshwater source for communities living in the coastal belt.
- » Tampara acts as a shelter for the both migratory and residential birds in the winter season.
- » Provides livelihood through fisheries and aquaculture to almost 25,000 households surrounding the wetlands.
- » Ecological conditions around Tampara and its adjoining areas support livelihoods of many stakeholders including - *Kewra* or *Pandanus odoratissimus* L. flower collectors and water distilleries.
- » Small but extremely picturesque wetland holds a prominent position in the tourist map of Odisha for its beauty.

Traditional/local knowledge and practices

- » Wetland dependent community is closely associated with the wetlands resource and understands that sustaining ecosystem services is an integral part of building resilience towards recurrent disasters.
- » It is recognized that fisheries resource has declined within the wetland.
- » Wetland dependent community identifies the opportunities to conserve wetlands resources through the use of traditional fisheries approaches.
- » Presence of community based traditional knowledge on early warning of cyclonic storms.

Challenges and lessons learnt

- » Wetland-dependent community can play a major role in promoting the disaster risk reduction potential of Tampara.
- » Lopsided water management with a focus on hard engineering solutions, destruction of natural buffers such as wetlands upstream and a lack of integrated land and water planning have been major causative factors underlining the current trends of reduced DRR potential of the wetland.
- » Degrading water regime which has led to drying up of wetland tends to make the system unsustainable for the growing population.
- » Frequent livelihood disruptions and deepening poverty among the highly vulnerable are a major cause of concern.



Demak

Demak District, Central Java Province, Indonesia

6.802378 S, 110.558823 E



System of disaster prevention

In Demak, Central Java, a consortium of Indonesia – Dutch institutions develop permeable structures made of local materials such as bamboo, twigs or other brushwood placed in front of the coastline. These structures let sea water pass through, dampening the waves rather than reflecting them. As a result, waves lose height energy before reaching the coastline and mud can settle behind the structure. Once the erosion process has stopped and the shoreline starts accreting, mangrove can re-establish naturally without being washed away. Over time, the mangroves themselves will attenuate waves and trap the sediment again thus further preventing erosion.

Gifts from nature

In a good and well performed ecosystem, mangroves form natural coastal defence, provide mitigation and adaptation capacity for a resilient coastal and local communities living dependently on mangroves and other coastal ecosystems, including coastal protection, sea-based hazards control and also food resources. Naturally, mangrove traps sediment and forms a sea wall to defend from high winds and big waves. Healthy mangrove mud coasts are in a dynamic equilibrium; waves take sediment away and tides bring sediment in. The mangrove root system helps to capture and stabilize the sediment. In addition, healthy mangroves provide good fisheries catch, and habitat for endangered species such as Milky Storks.



Main Ecosystem

Coastal Wetlands

Disaster



Sea-based Erosion

Eco-DRR Element

- **Associated Ecosystem**
Coast/Tidal flat/River/Fish ponds
- **Disasters**
High tide/Flood
- **Ecosystem Services**
Wind prevention/Reduction of flow velocity/Prevention of soil erosion/Control of discharged sediment/Coastal prevention
- **Other functions**
Food production/Education/Recreation/Cultural services
- **Traditional/local knowledge and practice**
Fisheries

Characteristics of this case

- It is included in the spatial planning.
- It is included in the development plan.
- There are environmental degradations.
- There is funding for management of the ecosystem.
- Local people understand its disaster prevention and environmental functions.
- It is integrated into community activities.
- Other stakeholders understand disaster prevention and environmental functions.
- It plays a role in maintaining the community.
- It contributes to community development.
- There are mechanisms of local economic circulation in this case.
- There are conflicts between Eco-DRR and other functions.
- It is used for environmental education.

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Abandoned fishponds • Project intervention: <ul style="list-style-type: none"> » Semi-permeable Dam » Green belt » Mixed-mangrove Aquaculture 	<ul style="list-style-type: none"> • Mangroves • Rice Paddies
Regulating service		
Additional function	<ul style="list-style-type: none"> • Destroyed wetlands service • Project intervention: to return the service & protect coastal areas 	<ul style="list-style-type: none"> • Main staple/rice • Fisheries • Firewoods • Coastal protection • Biodiversity • Cultural/religion
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	The semi-permeable dams built using both local and introduced techniques	

Traditional/local knowledge and practices

The Village government released a regulation preventing people from catching or shooting birds. There are village regulations to manage coastal protection, overfishing and protection of mangroves.

Challenges and lessons learnt

Mangroves are among the most threatened ecosystem. Along the coastlines of Indonesia, they are suffering serious destruction or even disappeared due to mangrove cutting for fire and construction woods, city-expansion and most visibly for the development of fish ponds during the 1980s. Soon after the mangrove forests disappeared from coastal areas, coastal erosion was experienced, especially in the North Coast of Java. Worsening by the land subsidence resulted mainly by excessive ground water extraction, rising sea level and severe storms are taking their toll as well.

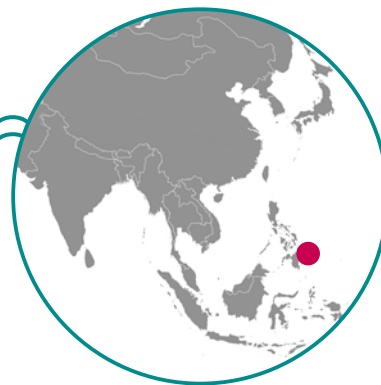
Thus, mangrove forests no longer exist to hold back the water, and as the result, several kampongs have been swallowed up by the sea. Life has been getting more difficult for the villagers as their villages are becoming lower than the water surface, and more investments are required to make their houses still liveable. In addition, fish ponds are no longer lucrative livelihoods once the bunds are eroded and the production is rapidly decreasing as a result of the use of chemical foods and antibiotics.



Agusan Marsh Wildlife Sanctuary

Agusan del Sur, Mindanao, Philippines

8°27'N, 125°47'



Background

The Agusan Marsh Wildlife Sanctuary is in the middle part of the Agusan River Basin in the northeastern Mindanao, Philippines. The Agusan Marsh 110,000 hectares and the water level increases with the rainy season.

System of disaster prevention

The Agusan Marsh acts as a sponge, preventing severe flooding downstream in Butuan City. The system of disaster prevention is adaptable building structures of people living in the Marsh. Floating houses are built with bamboo poles that float on the water and are tethered to trees and logs so that they can rise with the level of the water. School houses are also built this way or are built on stilts high above the water level, even during the inundation (flooding period) in the marsh. With this design, the inside of the houses are kept dry and not flooded. (This design of floating houses is being considered in the Netherlands to face sea-level rise.)



Main Ecosystem

Freshwater wetland, marsh

Disaster



Flood

Eco-DRR Element

- **Associated Ecosystem**
River/Peatland/Floodplain
- **Disasters**
Flood
- **Ecosystem Services**
Tide prevention/Reduction of flow velocity/Prevention of soil erosion/Control of discharged sediment
- **Other functions**
Food production/Material/Water purification/Weather modification/Education/Recreation/Cultural service

Characteristics of this case

- It is included in the DRR plan.
- It is included in the environmental management plan.
- It is included in the spatial planning.
- It is included in the development plan.
- There are environmental degradations.
- Local people understand its disaster prevention and environmental functions.
- It is integrated into community activities.
- Other stakeholders understand disaster prevention and environmental functions.
- It plays a role in maintaining the community.
- It contributes to community development.
- There are mechanisms of local economic circulation in this case.
- It is used for environmental education.

Eco-DRR	Present	Past
Disaster prevention function	School houses are built on stilts, high above the water line even during the flooding season. Children access the rooms through stairs.	In the 1970s, the Manobo Indigenous People settled in the Marsh (Sitio Panlabuhan). They built floating houses.
Regulating service		
Additional function	The Agusan Marsh provides food from fish, shells, and frogs. In addition, it is the natural capital eco-cultural tourism.	The Agusan Marsh provides food and materials for shelter. Fishing is the main livelihood.
Provisioning service		
Supporting service		
Cultural service		

Gifts from nature

The Agusan Marsh has 7 major habitat types that provide habitats for a rich biodiversity, especially of birds. There are 127 species of birds, belonging to 47 families, of which 24% are considered endemic (e.g., Oriental Darter, *Anhinga melanogaster*, Philippine hawk eagle, *Spizaetus philippensis*). It is also the stop-over habitat of migratory bird species

from Siberia and East Asia during November to March each year. More than 200 species of birds were observed during the migratory season, including egrets and herons. The purple heron (*Ardea purpurea*) migrate in the thousands from Japan, China, and Russia to the Marsh.

Traditional/local knowledge and practices

The Manobo people are dependent on the Marsh for water and food supply and livelihood from fishing. Fish are eaten fresh or dried under the sun for consumption later. Using the hyacinth, the women dry the plants and use the fiber as material for bags and footwear. Some women make use of

a fruit and make it into jam. The Philippine Government has promoted eco-tourism in the mid-1990s and this economic activity is slowly growing for bird-watchers and people who are interested to observe culture and nature.

Challenges and lessons learnt

Habitat destruction, water pollution, introduction of exotic fishes (tilapia, janitor fishes) are the current problems that are experienced by the Manobos. The Department of Environment and Natural Resources, Agusan River Basin Management Council, and Wetlands International are working

together to address this in an Integrated River Basin Management Plan. Climate change impacts (more hot days, more extreme storms) will affect the ecosystem services of Agusan River for the people in the Marsh and along the Agusan River.



Bang Krachao

Phra PraDaeng District, Samut Prakarn Province,
Thailand

13.68436, 100.56984



Background

Bang Krachao (almost 16 sq.km) is one of the largest remaining green areas near Bangkok. The area is located across the Chao Phraya River opposite Bangkok is referred to as the 'Green Lung of Bangkok' and was named the 'Best Urban Oasis of Asia' by the TIME Magazine in 2006. Bang Krachao was declared as an 'Environmentally Protected Area' in March 2019.

System of disaster prevention

For over 9 months per year, the southwest monsoonal wind coming from the Gulf of Thailand brings oxygen and moisture passing Bang Krachao before reaching Bangkok. This urban green area and its vast variety of plants and forest trees act as the 'Lung of Bangkok', provide climate buffering services by helping reduce air temperatures, trap particulate matters and air pollutants, and purify and forward the fresh air to Bangkok. In the face of global warming, this area helps absorb and store over 6,000 tons of carbon dioxide per year (Thailand Greenhouse Gas Management Organization and Kasetsart University, 2011).



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Main Ecosystem

Urban Green Area
River Mouth & Estuary, Freshwater
& Brackish Swamp Forest, Man-
grove Forest, River, Ponds

Disaster



Global Warming



Heat Waves



Air Pollution



Airborne Pandemic

Eco-DRR Element

- **Associated Ecosystem**
River/ Stream/Mangroves/Oasis/Urban green space
- **Disasters**
Air pollution/Heat/Climate change/
Global warming/Heat waves/Airborne pandemic
- **Ecosystem Services**
Local climate stabilization/Biodiversity conservation
- **Other functions**
Food production/Material/Weather modification/Education/Recreation/
Community building/Retaining and replenishing water and moisture/Air purification/Weather mitigation/Carbon storage/

Characteristics of this case

Administration: Samut Prakarn Province and the Royal Forest Department
Stakeholders: local communities, civil societies, academics, universities, Samut Prakarn Province, the Royal Forest Department, GOs, NGOs, IOs
Funding resources: GOs, public and private sectors

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> Air purification Local climate stabilization Carbon storage Mitigation of climate change and variability (heat and extremes) 	<ul style="list-style-type: none"> Wind breaks Local climate stabilization
Regulating service		
Additional function	<ul style="list-style-type: none"> Biodiversity conservation Recreation Nature education Natural refuge for city people 	<ul style="list-style-type: none"> Sources of timber, food plants, fish, aquatic resources
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	Wetlands are natural infrastructures, stabilizing local climate and mitigating climatic change and extremes.	

Gifts from nature

Bang Krachao is full of natural and scenic beauty and has high biodiversity (over 600 species of flora and fauna). There are numerous attractions worth to visit and ecotourism activities.

Visitors jog, cycle along several bike paths, study ecosystems and biodiversity, observe a wide variety of plants, participate in bird-watching, boat rides, feeding fish, visit beau-

tiful Sri Nakhon Khuean Khan Park and Botanical Garden, Bang Krasop Cork Tree Forest Park, Gallery of Siamese Fighting Fish *Betta splendens* and other fish species, experience the simple lifestyle of villagers and local foods/desserts, visit lively riverside weekend markets, old temples, Herbal Incense Sticks Home, watch fireflies, or just relax in a peaceful and quiet environment.

Traditional/local knowledge and practices

Bang Krachao area is composed of 6 sub-districts (Bang Krachao, Bang Korbua, Bang Nam Phueng, Bang Krasop, Bang Yo, and Song Khanong) with a relatively small population. Local communities maintain simple ways of life, integrated agriculture farms (based on the King Rama IX Philos-

ophy of Sufficiency Economy), fruit orchards (e.g. mango, banana, coconut, rose apple, etc.), and ornamental plant farms. Local communities' conservation efforts include planting trees for forest rehabilitation.

Challenges and lessons learnt

Recognizing the values and importance of existence, maintenance and conservation of urban green areas like Bang Krachao, there has been continuous significant effort and cooperation of various sectors (e.g. Chaipattana Foundation, Royal Forest Department, IUCN-ARO, APFNet, Petroleum Authority Thailand, Kasetsart University, academics, community groups, etc.) aiming at strengthening urban forest management, biodiversity conservation, nature education, awareness raising, and promotion of ecotourism activities. For better quality of life and more sustainable living of urban people, urban green areas need to be maintained, conserved, and well-managed. Urban green areas will even play more important roles and provide highly significant ecosystem services in the future to help urban people living

and coping with climate variability and extremes.

Amidst rapid urbanization, transportation and infrastructure development, industrialization, land use change in surrounding Bangkok and Samut Prakarn, and global warming, Bang Krachao remains unspoiled green space helping urban people of Bangkok and its vicinity cope with rising temperature, heat waves, and increasing air pollutants (particularly PM 2.5). Wetlands and urban green areas are natural infrastructures for mitigating climate variability, heats, and extremes. Since 2020, facing with Covid-19 Pandemic, lockdown situation, limited activities and social distancing, urban green space like Bang Krachao also significantly acts as 'natural refuge' for city people.



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Fai Nam Pook

Ban Nam Pook, Khun Kuoun sub-district,
Pong district, Phayao province, Thailand

4700653917, UTM 2124062



Background

Deforestation has been a big problem in the upper watersheds of Thailand. Repeated droughts and forest fires often occur seriously during dry season. "Fai" (a Thai name for small check dams) are inexpensive traditional/local wisdom-based structures which local communities built by themselves since ancient times to help mitigate problems of droughts and forest fires in the upper watersheds.

System of disaster prevention

Fai Nam Pook is an over 120 years old wooden check dam designed and built by local communities. Major steps of establishing a "Fai" include: selecting an appropriate site on a stream; laying foundation wooden posts vertically in lines across the stream (depth of posts and number of lines depend on characteristics of the stream e.g. slope, stream-base materials); connecting foundation posts with wooden posts horizontally by woods or bamboo canes; placing more woods or bamboo canes or stones to seal the connected points; and filling up the structure with branches, twigs, grass and reeds. Fai Nam Pook slows down the water flows and raises water levels of the stream. Water is kept longer and at a higher level within the stream channel. Water can percolate down around the site. Adequate moisture is kept in the surrounding forest areas during dry season. Fai Nam Pook helps preserve water and moisture within the watershed and helps mitigate droughts and forest fires.



Main Ecosystem

Streams, upper watersheds

Disaster



Eco-DRR Element

- **Associated Ecosystem**
River/Forest/Stream/Watershed
- **Disasters**
Drought/Fire
- **Ecosystem Services**
Mitigating droughts and forest fires/
Reduction of flow velocity/Control of
discharged sediment
- **Other functions**
Food production/Weather modification/
Recreation/Water resource/Cultural
service
- **Traditional/local knowledge and practice**
Water and soil conservation/Watershed
management/Water resources manage-
ment

Characteristics of this case

- It is included in the DRR plan.
- It is included in the environmental management plan.
- It is included in the development plan.
- The ecosystem biodiversity is managed properly.
- There is funding for management of the ecosystem.
- Local people understand its disaster prevention and environmental functions.
- It is integrated into community activities.
- Other stakeholders understand disaster prevention and environmental functions.
- It plays a role in maintaining the community.
- It contributes to community development.
- It is used for environmental education.
- It is managed by local communities and sub-district administration organization.

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Retaining and replenishing water and moisture • Mitigating droughts • Reducing forest fires • Trapping sediment 	<ul style="list-style-type: none"> • Water and soil conservation
Regulating service		
Additional function	<ul style="list-style-type: none"> • Water use • Water supply and irrigation • Biodiversity conservation • Environmental education on watershed management 	<ul style="list-style-type: none"> • Water use • Water supply • Sources of food plants, fish, aquatic resources
Provisioning service		
Supporting service		
Cultural service		
Traditional Knowledge, Traditional Technique	Pilot model and example of traditional local wisdom-based community-based water and soil conservation and watershed management.	

Gifts from nature

Fai Nam Pook helps maintain moisture and water, enhance functions of the stream in the upper watershed, bring back fertility of forest vegetation and biodiversity, and support wildlife. Fai Nam Pook helps enrich the stream as an important food source of aquatic plants, fish and aquatic resources. Fai Nam Pook is a major source of water for more than 180 households and supplies water for a rice

farming area of 500 – 1,000 rai (1 rai = 1,600 sq.m.). The site is important for environmental education on water resource conservation and watershed management.

Villagers of Ban Nam Pook are paying their respect to the water and forest spirits and giving thanks for water availability and natural abundance.

Traditional/local knowledge and practices

Fai Nam Pook is one of the three ancient check dams designed, built, maintained, managed and used by villagers of Ban Nam Pook (Nam Pook village) for water preservation. Based on local wisdom, villagers have used their own methods and natural materials (fallen woods, branches and twigs, bamboo canes, grass and reeds, stones) easily found locally to build, repair and maintain this traditional structure. Management roles and responsibility are shared and participated in by village committee, villagers, the elders and youth, staff of sub-district administration organi-

zation, and forest officers. The structure of Fai Nam Pook has been checked regularly and repaired by villagers during March-April before the rainy season. Traditional culture and practices related to water uses still remain. Villagers hold 2 important yearly events to pay respect to water and forest spirits: at the start of rice growing around May-June to ask for permission to bring water to be used in their rice growing plots; and at the end of rice harvesting around December to thank for water use.

Challenges and lessons learnt

“Fai” or small-size check dams have gained much attention from the public in Thailand and raised public awareness of the importance of forest, water and soil, and nature conservation. Check dams are being promoted and widely built by local communities as well as many public, private and business sector as Corporate Social Responsibility (CSR) activities at various sites on the upper watersheds. Key factors to be carefully considered to achieve the long-term benefits from check dams are a holistic view of the

watersheds, geographic conditions, ecological conditions, appropriate site selection and design, sizes, and materials to suit the purposes, localities, interest and need of local communities. A traditional small-scale check dam like Fai Nam Pook may bring great benefits to local households, while structures of modern types requiring high construction cost may dramatically change local livelihoods and overall ecosystems.



sites.google.com



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www.thaigoodview.com

Bung Nong Bon

Eastern Bangkok, Thailand

13.69370, 100.66185



Background

Bangkok has been facing more frequent and bigger floods due to urban growth, over capacity wetlands and waterways, and poor drainage systems. Based on the Royal Initiatives of H.M the King Rama 9, lakes and ponds have been serving as vitally important ecosystem-based flood mitigation structures since 1988.

System of disaster prevention

Bung Nong Bon was a natural pond restored during 1993–1999. Currently, it has become a semi-natural urban wetland, comprising 3 connected big lakes, having a total area of 644 rai (1 rai =1,600 sq.m.), average depth of 10m., and a total water storage capacity of over 5 million cu.m. During wet season, Bung Nong Bon receives floodwater and surplus water from nearby canals and its vicinity, and acts as a water retention lake. When the sea water level recedes and canals' water level lowers, floodwater gradually drains out. Bung Nong Bon helps prevent floods in 3 districts of eastern Bangkok, namely Suan Luang, Praves, and Phrakanong districts.



news.thaibps.or.th



travel.trueid.net



Sansanee Choowaew

Gifts from nature

Bung Nong Bon has now become a public park in eastern Bangkok. The site is famous and popular for recreation, being the 1st Water-sports Center of Bangkok where people can enjoy sailing, kayaking, wind-surfing, canoeing, and bicycling along a 4km cycling lane. A Water Management Learning Center is located at Bung Nong Bon, providing nature and environmental education for the public, children and youth.

Main Ecosystem

Lake, Pond, Wetlands

Disaster



Flood

Eco-DRR Element

- **Associated Ecosystem**
Lake and marsh/River
- **Disasters**
Flood
- **Ecosystem Services**
Floodwater retention/Control of inundation flow
- **Other functions**
Food production/Education/Recreation/Cultural service
- **Traditional/local knowledge and practice**
Living with nature/Living with floods/Wetlands are natural infrastructures, slowing down flows, storing floodwater, mitigating floods, and lessening flood damage.

Characteristics of this case

- It is included in the DRR plan.
- It is included in the environmental management plan.
- It is included in the spatial planning.
- It is included in the development plan.
- There is funding for management of the ecosystem.
- Local people understand its disaster prevention and environmental functions.
- It is integrated into community activities.
- Other stakeholders understand disaster prevention and environmental functions.
- It plays a role in maintaining the community.
- It contributes to community development.
- It is used for environmental education.
- It is managed by Bangkok Metropolitan Administration.

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Floodwater retention • Reducing flood • Pushing out saline water back into the sea 	<ul style="list-style-type: none"> • Water storage • Reducing flood
Regulating service		
Additional function	<ul style="list-style-type: none"> • Recreation • Water-sports Center • Environmental education on water management 	<ul style="list-style-type: none"> • Water use • Sources of food plants, fish, aquatic resources
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	Wetlands are natural infrastructures, slowing down flows, storing floodwater, mitigating floods, lessening flood damage.	

Traditional/local knowledge and practices

In the old days, Bangkok was a water-based city, full of canals, waterways, lakes, ponds, marshes and swamps. Bangkokians used to 'live well with water'. Due to urban growth, water storage and absorption capacity reduced from 85% in the past to less than 15% at present. Floods are occurring more frequently, with greater severity, with deeper water levels and longer flood duration. A flood control project for Bangkok was initiated by H.M. the King Bhumibol Adulyadej (King Rama 9), following his observation on monkeys' eating habit (monkeys always store bananas

in their cheeks and gradually eat them later). The project applies the "Monkey's Cheeks" concept to solve flooding problems, by storing excess water in wetlands serving as water storage areas before draining water out when the seawater level drops. Wisdom of practices include conserving existing wetlands; improving their water storage capacity; maintaining connectivity between wetlands, canals and waterways; freeing water flows; and gradually draining water out during low tides. Bung Nong Bon is among the first generation of "Monkey's Cheeks" of Bangkok.

Challenges and lessons learnt

Bangkok sits on a lowland flat area at the same or lower than the mean sea level, having little slope and poor drainage capacity. During the mighty mega-flood in 2011, 36 districts of Bangkok were inundated and over 4.43 million people suffered. Bangkok Metropolitan Administration (BMA) has realized the significant role of "Monkey's Cheeks" for flood mitigation and increased the number of such water retention areas. At present, Bangkok has a total number of 25 "Monkey's Cheeks" in 12 districts, having a total water

storage capacity of more than 13 million cu.m.. Those water retention areas are managed by several different agencies/organizations of both the public and private sector. "Monkey's Cheeks" are now being introduced and extended to many other areas in the perimeter of Bangkok and country-wide. The BMA is continuing to increase the number and capacity of these wetland-based flood mitigation structures and has already included this objective in the Master Plan for Water Resource Management.



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Sansanee Choowaew



Sansanee Choowaew



Sansanee Choowaew

Bamboo Sea-wall

Khok Kham sub-district, Muang district,
Samut Sakhon province, Thailand

13.48412, 100.32266



Background

The coastline of the Upper Gulf of Thailand has faced serious problems of land subsidence, coastal erosion, and sea level rise for several decades due to mangrove loss, land use change, and groundwater exploitation. The bamboo sea-wall was first built in 2007 in front of the coastline of Khok Kham sub-district of Samut Sakhon province following the coastal communities' attempt and efforts, trial and error, to bring back land and mangroves, mitigate coastal erosion, and restore the abundance of coastal natural resources.

System of disaster prevention

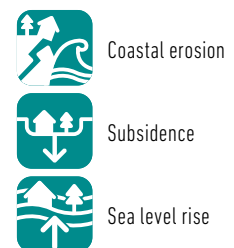
The bamboo sea-wall is built by manually pushing bamboo canes into the coastal soil to at least 2m in depth, and leaving the canes over the water level at least 3m high. Groups of bamboo canes are fixed in line, not straight but in a series of triangle patterns. The base is 2m wide and the length from the base to the tip of triangle pointing into the sea is 2.50m. This triangular shape of the bamboo wall is designed to change the wave direction, reduce the wave force and action, and facilitate sediment trapping. Bamboo canes can be used for 6 – 7 years before being fixed or replaced. For around 5 years, once sediment is trapped and accumulated, mangrove seedlings (e.g. *Avicennia* and *Rhizophora* species) are planted. After mangrove trees are established and growth is ensured, the 1st line of bamboo wall is removed. Then the 2nd line is built at 100m seawards, and mangrove seedlings are planted again. Establishment of another line of bamboo wall and mangrove re-plantation is repeated. The bamboo wall helps reduce wave forces and actions, trap sediments, form new land, restore mangroves, reduce coastal erosion and subsidence, and prepare for coping with sea level rise.



Main Ecosystem

Coastal wetlands
Mangroves, Shallow sea

Disaster



Eco-DRR Element

- **Associated Ecosystem**
Coast/Mangroves/Shallow sea
- **Disasters**
Land subsidence/Coastal erosion/Sea level rise
- **Ecosystem Services**
Mitigating land subsidence, coastal erosion & effects of sea level rise
- **Other functions**
Soil formation/Food production/Education/Recreation/Community building
- **Traditional/local knowledge and practice**
Local wisdom-based infrastructure/Local initiatives, self-learning and experiments via trial and error, self-capacity building/Local participatory attempt and efforts in Eco-DRR practices

Characteristics of this case

- It is included in the DRR plan.
- It is included in the environmental management plan.
- It is included in the spatial planning.
- It is included in the development plan.
- There is funding for management of the ecosystem.
- Local people understand its disaster prevention and environmental functions.
- It is integrated into community activities.
- Other stakeholders understand disaster prevention and environmental functions.
- It plays a role in maintaining the community.
- It contributes to community development.
- It is used for environmental education.
- It is managed by Local communities, sub-district administration organization, and Department of Marine and Coastal Resources

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Reducing wave forces and actions • Reducing land subsidence • Reducing coastal erosion 	<ul style="list-style-type: none"> • Not available
Regulating service		
Additional function	<ul style="list-style-type: none"> • Trapping sediment • Building new land • Restoring mangroves • Enhancing coastal resources abundance • Biodiversity conservation • Environmental education 	<ul style="list-style-type: none"> • Not available
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	Pilot model and example of local wisdom-based infrastructure for coastal protection and preparedness to cope with sea level rise.	

Gifts from nature

After the establishment of the bamboo sea-wall at Khok Kham sub-district, the biodiversity and abundance of coastal resources has started to come back. Local livelihoods has been improved. Many other related projects, e.g. dolphins and whales conservation projects, nature study center, nature trails and boardwalks, are located here. The bamboo sea-wall at Khok Kham, Samut Sakhon has become a well-known and popular ecotourism site attractive to both local

and foreign visitors. The bamboo sea-wall of Khok Kham has also become an important educational site, regularly visited by students, practitioners, and the general public and people from various sectors. Large number of groups and representatives from nearby coastal communities from different parts of Thailand and from foreign countries have visited the site. Local wisdom, knowledge and experience have been shared and transferred.

Traditional/local knowledge and practices

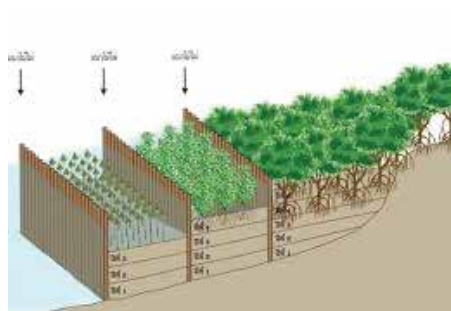
Community leaders and members expressed their concerns and made collective efforts, used local wisdom, did experiments on several possible methods, worked together, discussed and consulted among themselves, and ended up with the concept and adoption of the 'Bamboo Sea-Wall'. So far, the bamboo wall has been established for 2km along the coastline using community labor, with partial sup-

port of the Department of Marine and Coastal Resources, the Ministry of Natural Resources and Environment and the private sector. They have continuously recorded data and monitored the amount of sediment deposit and the survival rate of planted mangrove seedlings. Local communities aim at restoring 300m seawards mangrove strip by 2022.

Challenges and lessons learnt

The bamboo sea-wall is developed and adopted as a restoration technique helping local communities gain back the healthy coastal ecosystems and cope with the changing environment. According to the recorded monitoring data, the bamboo sea-wall has enhanced sediment deposit, led to successful mangrove restoration, and been proved to be fruitful and applicable for this specific part of the Upper Gulf of Thailand. In the future, once fertile mangroves are

fully brought back and well established, such bamboo wall may not be needed anymore. The concept of the bamboo sea-wall has now been widely adopted and applied to many other coastal areas in Thailand. Design, structural pattern, materials to be used, and the ways and means are adapted to suit specific localities. Attempt and efforts, trial and error, have to continue to cope well with future coastal change.



Igune

Osaki City, Miyagi Prefecture, Japan

38°36'45.0"N 140°57'38.5"E



Background

- » Cold weather has let to disaster in the Tohoku region, located in the northern part of Japan. Not only strong cold winds in winter, but also cold winds in summer. The “cold summer damage” has sometimes resulted in food shortages, such as years when rice could not be harvested.
- » Igune, a homestead woodland, has been protecting houses from disasters for more than 400 years. It is a traditional Japanese housing form designed as an ingenious way to enrich people’s lives.

System of disaster prevention

- » The “Igune” plays a role to protect houses from the cold winter monsoon and floods. Trees are planted around houses to surround the premises. Additionally, various plants for daily use are planted on the sites, which have been used as food, building materials, and daily goods.
- » Various foods and goods produced on the families’ premises are stored in many ways including pickles, as a preparation for life in the winter and famine.



Main Ecosystem

Homestead woodland

Disaster

-  Cold wave
-  Flood
-  Famine

Eco-DRR Element

- **Associated Ecosystem**
Others (Homestead woodland)
- **Disasters**
Flood/Storm/Others (Yamase (north wind))
- **Traditional/local knowledge and practice**
Igune/Homestead woodland

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none">• Wind prevention• Flood prevention	<ul style="list-style-type: none">• Wind prevention• Flood prevention• Famine• Stock for winter
Regulating service		
Additional function	<ul style="list-style-type: none">• Vegetables, fruits and other food production• Fertilizer• Habitat	<ul style="list-style-type: none">• Vegetables, fruits and other food production• Fertilizer• Fuel• Habitat
Provisioning service		
Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	Multipurpose use of plants Disaster prevention, building materials, fuel, pickles, diverse edible plants	

Gifts from nature

- » Igune includes many ingenious ways to maximize the use of ecosystem services.
- » To protect the houses from strong monsoon winds, durable trees such as cedar and trees that grow to short heights in dense formations are planted as necessary.
- » Approximately 300 species of plants grow in the area and have been used as food, building materials, and medicine.
- » It provides habitat for rare plants and animals and is a habitat for a diverse range of species. It maintains a stable natural environment, including the surrounding rice paddies.

Traditional/local knowledge and practices

- » Igune is a traditional Japanese homestead woodland that has been existing for 400 years. The structure of Igune-like woodland can be found throughout Japan, and each location has characteristics suited to the climate and disaster risk.
- » The woodlands surrounding the houses are set toward the mountain side where the winter monsoon blows, or toward the upstream side where the river floodwaters flow.
- » Traditional knowledge of Igune is diverse. By planting a wide range of plants, fruits and vegetables are harvested and used as preserved foods such as pickles, as medicine, as building material, and as firewood. The sites also shows ingenuity in the circulation of materials, such as using fallen leaves as fertilizer for vegetables.

Challenges and lessons learnt

- » The biggest challenge for Igune is the bearers.
- » The maintenance of Igune requires an enormous amount of daily management. However, due to a number of factors, including a decrease in the number of farmers, loss of routine management skills, aging of society, and cost, there are fewer “bearers” to maintain and manage Igune.
- » The local government is conserving and supporting the traditional agricultural system around Osaki City, including Igune, as a site of Globally Important Agricultural Heritage Systems (GIAHS). It is also promoting the management of volunteers to manage Igune and the use of Igune as a place for environmental and community education.
- » The primary role of Igune is to protect houses from the winter monsoon. However, the diversity of their plant species and the activity of making them available for fruits and other food, firewood, and building materials has led to diverse disaster preparedness and resilience.
- » The ecosystem in Igune is a knowledge base of sustainability, optimized for local weather and disasters, and coexisting with local nature.
- » Even traditional knowledge used for disaster risk reduction and food is in danger of loss due to changes in lifestyles. Therefore, it is necessary to take actions such as visualization of value such as GIAHS and value-added measures.



Kabukuri-numa

Osaki City and surrounding areas,
Miyagi Prefecture, Japan

38°38'13.0"N 141°06'16.9"E



Background

- » Around 400 years ago, the Kitakamigawa River flowed near Kabukuri-numa, and the area was a low marshy area frequently flooded by water for a long period of time. The Kitakamigawa River was replaced about 15 km to the east, and the frequency of flooding decreased, but the area was still flooded frequently.
- » Currently, the area is designated under the Ramsar Convention along with the adjacent Izu-numa and Uchinu-ma as one of the largest sites for migrating geese in Japan. The number of geese began to increase in the 1980s.

System of disaster prevention

- » Kabukurinuma is the confluence of the Oyamada and Kayakari Rivers. The land used as rice paddies has been turned into a marsh, and the surrounding area is embanked with levees to create a retarding basin and store floodwaters. There are three overflow dykes in the retarding basin of Kabukuri-numa. When the water level in Kabukuri-numa rises above a certain level, the floodwaters flow out of the overflow dykes, and the surrounding rice paddies are used as a retarding basin.
- » The rice paddies surrounding Kabukuri-numa are surrounded by levees, which control the extent of flood storage and have large drainage pump stations for rapid drainage.

Gifts from nature

- » Kabukuri-numa and the surrounding Izu-numa, Uchi-numa, and Kejo-numa are among the largest wintering sites for geese in Japan. The geese were endangered in Japan around 1970, but their numbers have recovered significantly as a result of designation as a natural monument and conservation of their habitat. These Ramsar Sites have contributed greatly to their recovery.
- » Aleutian cackling geese and swans also fly into Kabukuri-numa, and the marsh is a habitat for many plants and animals.

Main Ecosystem

Marsh

Disaster



Flood

Eco-DRR Element

- **Associated Ecosystem**
Lake and marsh/River/Rice paddy/
Floodplain
- **Disasters**
Flood/Storm
- **Ecosystem services**
Control of inundation flow
- **Other functions**
Education/Recreation/Others (Roosting
site for geese and others)
- **Traditional/local knowledge and practice**
Traditional flood control land uses

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Flood control • Retarding basin 	<ul style="list-style-type: none"> • Flood control • Flood plain
Regulating service		
Additional function	<ul style="list-style-type: none"> • Large stopover site for gees • Habitat for other wetland rare plants and animals • Education 	<ul style="list-style-type: none"> • Rice production • Fishing • Hunting
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	Using floodplains for flood control Using surrounding rice paddies for flood control	

Traditional/local knowledge and practices

- » Kabukuri-numa is a marshy area at the confluence of rivers that has been used as rice paddies for several hundred years.
- » The use of flood plains, which are often inundated by floodwaters, is wisdom that has been passed down in monsoon Asia since ancient times, along with the cultivation of rice.
- » Overflow dykes have been used in Japan for hundreds

of years. By lowering a part of a levee and hardening the surface, floodwaters overflow from a fixed point.

- » The retarding basin around Kabukuri-numa is divided by levees, which allow the floodwaters to be stored in a specific location. A ring levee, a levee that surrounds the community and prevents the inflow of floodwaters, has also been used.

Challenges and lessons learnt

- » The number of geese in Kabukuri-numa is steadily increasing, and their presence contributes to the local community through the sale of brand-name rice. In Kabukuri-numa especially, a visitor center has not been established, and the habitat of the wildlife and the lives of the local residents have been managed by not turning the area into a tourist destination.
- » Invasive alien species are spreading significantly, and fish species such as rosy bitterling, Kara-dojou, and other species are occupying the area.
- » Although there are large-scale drainage facilities in the surrounding retarding basin, there are long-term main-

tenance and management cost issues associated with maintaining pumps and other equipment because of the large maintenance and renewal costs required to maintain these facilities.

- » In the last 30 years or so, Kabukuri-numa has become an important roosting site for geese and the number of geese has recovered. Previously, they were endangered due to hunting pressure and habitat loss.
- » Kabukuri-numa was initially rice paddies on a floodplain. As a result of various consensus building efforts, the site was restored as a retarding basin for flood control and natural environment.



Adogawa Flood Prevention Forest

Takashima City, Shiga Prefecture, Japan

35.339220, 136.039045



System of disaster prevention

Bamboo forests and pine forests are placed along the levee and in the protected lowland. When floods overflow, sediment and driftwood are caught by passing through these forests. Moreover, the energy of overflowing water can be reduced. As a result, dyke break can be prevented and damage to the protected lowland can be reduced.

When combined with other flood control systems, they are highly effective.

Gifts from nature

It is said that the Adogawa flood prevention forest began with bamboo planted along the levee around the 1960s. By planting bamboo, the levee could be strengthened and used for agricultural materials and bamboo shoots. Furthermore, it was industrialized as bamboo from the Adosawa river boosts a 90% share of the bamboo used for Japanese fan frames.

A healthy environment is maintained by managing bamboo forest to some extent. Therefore, the use of bamboo leads to maintaining a good environment.

It provides a living environment for living creatures living near rivers as a riparian forest.

Traditional/local knowledge and practices

In addition to bamboo, red pine, camphor, and cedar can be seen in the forest trees. These trees are often used as they are resistant to flooding and easy to use.

Challenges and lessons learnt

Bamboo forest is no longer properly managed. When cutting out bamboo, people cut out all the bamboo at once.

A poorly managed bamboo forest can erode other environments.

Main Ecosystem

River, Bamboo forest

Eco-DRR Element

- **Associated Ecosystem**
River/Floodplain
- **Disasters**
Flood
- **Ecosystem Services**
Control of inundation flow/Reduction of flow velocity/Prevention of drift wood and wastes/Control of discharged sediment
- **Other functions**
Food production/Fuel/Material
- **Traditional/local knowledge and practice**
Flood restraining forest belt

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Reducing flood • Reducing scouring of levee, etc. • Catching sediment 	<ul style="list-style-type: none"> • Reducing flood • Strengthening levee • Catching sediment • Catching drift wood and garbage
Regulating service		
Additional function	<ul style="list-style-type: none"> • Providing bamboo material • Frame of Japanese fan • Agricultural use • Bamboo shoot • Riparian forest • Food for fish etc. • Corridor 	<ul style="list-style-type: none"> • Food (bamboo shoot) • Bamboo material • Frame of Japanese fan • Agricultural use • Use for living • Fuel
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	<ul style="list-style-type: none"> • Flooding cannot be stopped, but the energy of water can be reduced. • In addition to bamboo, there are also pine, camphor, and cedar. 	



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Shishigaki

Hira Mountain range of Otsu City, Shiga Prefecture

Disaster prevention system of Shishigaki in Satoyama

- » A fence built by local residents to prevent wild boars and deer from entering the village and ruining the fields and local ecosystems.
- » Many are located on the border between villages and forests, and they vary in length up to twenty or thirty meters.
- » The Arakawa Shishigaki is also used to prevent flooding and landslide disasters caused by the flooding of the Otani River, and is built around the village.

Ecosystem Services of Shishigaki

- » Stable and consistent farming practices can be achieved by preventing the damage caused by wild boar and deer on these sensitive areas.

Traditional ecological knowledge TEK

- » The main structure consists of stone walls, which are constructed based on the availability of local stone resources.
- » These stone walls are used in connecting villages, and are built on the borders between mountains and villages as measures against wildlife damage. Those that are built along rivers are in place as measures against flooding and sediment damage, which can occur during river flooding

Current issues regarding Shishigaki

- » A considerable infrastructure, including Shishigaki, was demolished during the post-war disturbance. During this time river revetment work and housing development progressed, impacting the satoyama environment.
- » Shishigaki is gradually being forgotten due to the changes in the relationship between nature and regional demographics, as well as the reliance upon more modern technology.



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Sanju Teibo

Hira Mountain range of Otsu City, Shiga Prefecture

Disaster prevention system

- » A set of three reinforced stone levees which are built on the south side of the Otani River flowing through Arakawa Village
- » Even if one levee broke, the second and third levees worked to respond to large-scale floods. They varied in size, with the first one being the longest: followed by the second, and the third levee being there in case the first two broke.

Ecosystem services SanjuTeibo

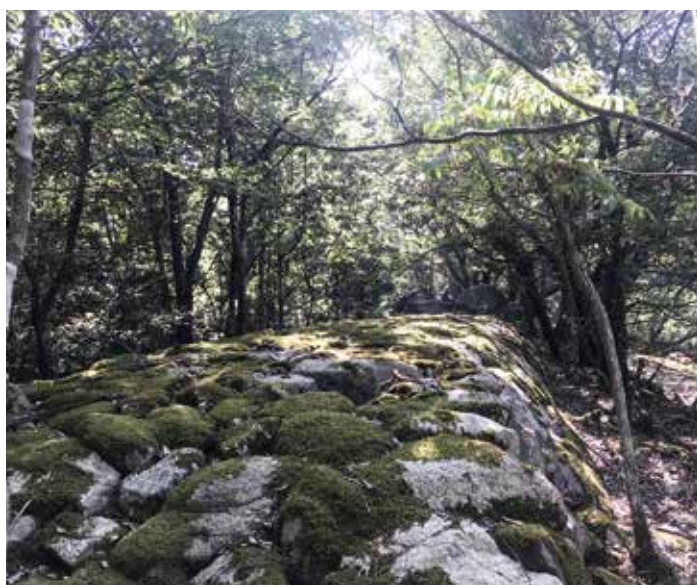
- » Local wood resources from the forest can be utilized as a renewable source of firewood. Over time, the riparian zones which experienced sediment deposition from flooding show evidence of succession, and we can find trees colonizing these areas.

Traditional Ecological Knowledge TEK

- » The bank along the river's edge is the longest, and therefore is more prone to natural disasters such as erosion and flooding, threatening villages which are downslope from it.
- » It is thought that the village of Arakawa was protected from flooding and landslides by building it in a place where the Otani River curves.

Current issues regarding SanjuTeibo

- » Some communities have said that it currently does not play a relevant disaster prevention role.
- » We must reconfirm how we can connect and evaluate the traditional disaster prevention functions which were utilized in the past. There is a disparity between how a set of three reinforced stone levees was seen in the past for its services, and how it is viewed now in light of disaster prevention.



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Hyakkenzutsumi

Hira Mountain range of Otsu City, Shiga Prefecture

Disaster prevention system

- » A stone wall with a length of about 100 ken (using the metric system it is about 200 meters) and a width of about 10 ken (about 18 meters), and a height of 3 to 5 ken (5.5 to 9 meters). It features an embankment consisting sand, that runs 1km or more downstream. This embankment is used to prevent flooding disasters.
- » During the Edo period, it was constructed over the course of five years and eight months, against the repeated flooding of the Yotsuko River which was threatening and damaging local villages at the time.
- » The Yotsuko River, which originates straight from the Hira Mountain range and gradually follows a rightward trend towards Biwako, naturally flows near local villages. When flooding does occur, the Hyakkenzutsumi is in place to guide the debris flow along the Yotsuko River, instead of flooding the area occupied by satoyama residents who live on the other side of it.

Ecosystem services Hyakkenzutsumi

- » The ecological benefits of the Hyakkenzutsumi being in place include not only disaster prevention, but also water availability for local agriculture systems. Sluice gates are in place to direct the flow of water at strategic points. Local residents take advantage of these by diverting some of this water for their agricultural practices.

Traditional ecological knowledge TEK

- » The residents living in the immediate riparian zone understood that it was impossible to completely prevent flood damage from occurring.
- » Residents understood that they were vulnerable to natural disaster damage when the embankment broke down, and so they designed their village areas to be protected from these recurrent natural disasters.
- » flooding and sediment damage, which can occur during river flooding

Current issues regarding Hyakkenzutsumi

- » Some communities have said that it currently does not play a relevant disaster prevention role.
- » We must reconfirm how we can connect and evaluate the traditional disaster prevention functions which were utilized in the past. There is a disparity between how Hyakkenzutsumi was seen in the past for its services, and how it is viewed now in light of disaster prevention.



Funagata-yashiki

Karatsu City, Saga Prefecture, Japan

33°21'49.9" N 130°01'23.7" E



Background

- » There are many alluvial fan-shaped landforms in Japan. The alluvial fans are often used to develop rice paddies because of the easy access to water, but they are also frequently affected by disasters such as floods and debris flows.
- » In such places, houses named Funagata-yashiki are seen and they are protected by stone masonry and homestead woodlands.

System of disaster prevention

- » In alluvial fans and other landforms, Funagata-yashiki set up homestead woodlands to protect their residences. Homestead woodlands are surrounded by stone walls in the direction of flood inundation and debris flows.
- » Bamboo groves along the river act as flood prevention forests, reducing the force of floodwaters hitting houses and stone walls.

Gifts from nature

- » Camellia and pine trees can be seen in the homestead woodland of Funagata-yashiki. The flood prevention forest along the river is planted with bamboo trees.
- » These plants have generally been used by Japanese farmers for daily living, although the specific uses of the plants have not been fully clarified. They are often used for fuel and agricultural materials.

Traditional/local knowledge and practices

- » It is not certain when Funagata-yashiki along the Matsuura River was built. However, there is a house in the same location on a map more than 150 years old.
- » There is a small shrine in the homestead woodland of Funagata-yashiki, which is considered an important place because it once had a meeting place. It is said that the bamboo grove along the river must not be lost as they serve as a flood prevention forest to protect houses and stone walls.

Main Ecosystem

Homestead woodland

Disaster



Flood



Debris flow

Eco-DRR Element

- **Associated Ecosystem**
River/Upstream/Others (Homestead woodland, alluvial fan)
- **Disasters**
Flood/Storm/Debris flow
- **Ecosystem Services**
Control of inundation flow/Reduction of flow velocity/Control of discharged sediment
- **Other functions**
Fuel/Material/Community building
- **Traditional/local knowledge and practice**
Stone walls around residential areas are used to disperse the force of floods and protect houses.

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Flood prevention • Debris flow countermeasures 	<ul style="list-style-type: none"> • Flood prevention • Debris flow countermeasures
Regulating service		
Additional function	<ul style="list-style-type: none"> • Agricultural materials • Habitat 	<ul style="list-style-type: none"> • Agricultural materials • Fuel • Meeting place • Small shrine • Habitat
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	<ul style="list-style-type: none"> • Stone masonry • Disaster prevention, building materials, fuel, local facilities 	

Challenges and lessons learnt

- » The biggest challenge of the Funagata-yashiki of Matsuura River is that they are completely unknown to local residents and others. Although the existence of stone walls, homestead woodland, and flood prevention forests have been handed down from generation to generation, the overall system of Funagata-yashiki is not well known even to the current residents. Similarly, the local government is not aware of this disaster prevention system.
- » Depopulation is continuing, and the aging of the population and the lack of human resources to carry on the house are obvious. Some places are vacant houses and lots.
- » Funagata-yashiki is a form of housing specifically designed to prevent flood inundation. By utilizing stone walls and homestead woodlands, and by understanding the direction from which the forces of disaster come, it is possible to disperse the forces of floods like the tip of a ship cutting through the water.
- » The establishment of local facilities, such as shrines and meeting halls, provided visible symbols of the importance of the land, and were contrived to ensure that it could be handed down from generation to generation.
- » Even good traditional knowledge concerning disaster prevention can be easily lost if the residents are not aware of it.
- » The stone walls surrounding the houses will soon collapse if they are not carefully maintained due to the growth of plants and trees.
- » Since a small shrine is considered a sacred place, it is often found that small shrines are established at key locations for disaster prevention.



Azame-no-se

Karatsu City, Saga Prefecture, Japan

33.339966, 129.993670



System of disaster prevention

This wetland was created for the purpose of restoration. It is designed that water flows in from the downstream end of the wetland when water is overflowed. This recreates the wetland environment of the floodplain. In addition, it has a flood control function to the downstream by reducing the flood flow to the downstream.

A flood restraining forest belt is planted upstream of the wetland to prevent destruction of the wetland due to flooding.

Gifts from nature

Azame-no-se is a place where a rice paddy was excavated to create a new wetland.

This has created an environment where bivalves and fish that prefer wetlands, diverse insects, wetland plants, water birds such as herons and kingfishers live, and environmental education is implemented.

Traditional/local knowledge and practices

- » Although this is a newly constructed wetland environment, it uses a design that applies traditional Japanese flood control technique.
- » The inflow entrance to flooded water is on the downstream side. It does not disturb the wetland environment greatly the flood flows slowly.
- » It utilizes flood restraining forest belt.
- » There is the Sari community and rice paddy on the opposite side of Azame-no-se. One of the traditional flood control techniques in Japan is to flood the opposite side of the place that needs to be protected.

Main Ecosystem

Middle basin

Disaster



Flood

Eco-DRR Element

- **Associated Ecosystem**
River/Moor/Rice paddy/Foot Zone
- **Disasters**
Control of inundation flow/Reduction of flow velocity/Prevention of soil erosion/Prevention of driftwood and wastes
- **Ecosystem Services**
Prevention of salt damage
- **Other functions**
Education/Recreation
- **Traditional/local knowledge and practice**
Open levee/Retarding basin/Flood restraining forest belt/Others

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> Flood control Temporary storage of flood 	<ul style="list-style-type: none"> Completion in 2008 Rice paddy
Regulating service		
Additional function	<ul style="list-style-type: none"> Biodiversity Bivalvia sp / Acheilognathinae / Insect Environmental education Draining a pond Walking use Lotus viewing 	<ul style="list-style-type: none"> Food (Rice, others) Fiber (straw) Biodiversity Loach / Catfish / Japanese rice fish / Grey-headed Lapwing / Harvest mouse / Red dragonfly Festival
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	<ul style="list-style-type: none"> Although it is a newly created environment, it is modeled on a traditional retarding based system. Flowing backyard and retarding 	

Challenges and lessons learnt

In the process of creating Azame-no-se, a manager and local communities have repeated more than 150 workshops.

It has been created and maintained through agreement and collaboration by dialogue. A major challenge is continuing this relationship in the future.



Photo: Keita Kitamura



Photo: Keita Kitamura



Okawano

Imari City, Saga Prefecture, Japan

33°18'32.7"N, 129°58'33.5"E



System of disaster prevention

- » Flood from the main stream is adjusted by slowly flowing it into the paddy field from the opening of the downstream bank (kasumitei).
- » Houses are located on a hill or surrounded by a ring levee.
- » The paddy field is located at the confluence of tributaries, thereby inundating the tributary floodplain and reducing the flood flow downstream of the main stream.
- » The flood area is used to produce water-resistant crops such as rice.
- » The embankment is protected by flooding water in the flood area.

Gifts from nature

- » Rice paddies as cradle for organisms
Rice paddies maintain a shallow water environment and provide spawning ground for catfish, loach, Japanese rice fish and others. There are also many insects and frogs such as dragonflies and larvae of dragonflies.
- » Evacuation site during flood
Many organisms evacuate to the retarding basin during floods. In the past, people looked for fishes and caught them during floods. Catfish, gibel, carp and others were caught in Okawano.

Traditional/local knowledge and practices

- » Making the flood overflow from the downstream. When the flood overflows in the upstream, it flows down and makes external force stronger. It also tends to destroy farm lands and buildings. When it overflows from the downstream, the flow becomes slow, making it harder to damage farm lands and other lands.
- » Rice will not wither even if it is immersed in water for one or two days completely. When flood overflows gradually, soil with nutrients comes into rice paddies and it fertilize the land.
- » Building levee around the community. Protecting the priority area.

Main Ecosystem

Rice paddy, Floodplain

Disaster



Flood

Eco-DRR Element

- **Associated Ecosystem**
River/Moor/Rice paddy
- **Disasters**
Flood
- **Ecosystem Services**
Control of inundation flow/Reduction of flow velocity
- **Other functions**
Food production/Fuel/Recreation
- **Traditional/local knowledge and practice**
Levee/Polder

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Flood control • Temporary storage of flood 	<ul style="list-style-type: none"> • Flood control • Temporary storage of flood • Protection of levee • Reduction of damage to farm land
Regulating service		
Additional function	<ul style="list-style-type: none"> • Food (Rice) • Biodiversity Loach, Catfish, Red dragonfly 	<ul style="list-style-type: none"> • Food (Rice, Others) • Fiber (straw) • Biodiversity Loach, Catfish, Japanese rice fish, Grey-headed Lapwing, Harvest mouse, Red dragonfly • Festival
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	<ul style="list-style-type: none"> • Flowing back ward and retarding • Rice paddies are flooded with water slowly • Ring levee 	

Challenges and lessons learnt

- » Due to modernization of agriculture, rice paddies become dry. It leads to making the habitat for organisms harder for living. In addition, rice farming cycle and life cycle of organisms is becoming misaligned.
- » Ponds are getting not used and managed.
- » Inheritance of traditional knowledge does not continue sufficiently.



Photo: Keita Kitamura



Niji-no-matsubara

Karatsu City, Saga Prefecture, Japan

33°26'45.8"N, 129°59'38.1"E



System of disaster prevention

- » A pine forest catches the wind from the sea and it reduces the adverse effects of wind, sand, and salt on field crops.
- » In the event of tsunami and high tide, it plays a role of tide prevention and reduces damage.
- » As time has passed, dunes have developed. By further planting trees, the disaster prevention effect increases.

Gifts from nature

- » It is counted as one of the three most scenic pine forests in Japan and designated as a natural park. It is popular as a beautiful coastal landscape.
- » Wood, fallen leaves, and pine resin that can be harvested from a pine forest are highly useful.
- » The mushroom called Shoro can only live in pine forests. Shoro manju (sweet bun) which imitates the shape of Shoro is a local specialty.
- » Natural recreation areas such as pine forest and beach have been created.
- » A community of local residents is formed for the purpose of restoration and conservation of the Niji-no-matsubara.

Traditional/local knowledge and practices

- » Along with development of new rice paddies in the Edo period, pine trees were planted to prevent wind, sand and salt damage. In the same time period, similar coastal forests were planted throughout Japan.
- » The reason for choosing pine trees as a coastal forest is that they grow well in wasteland. In addition, pine trees do not have fallen leaves in winter and have a great disaster prevention function.



Main Ecosystem

Pine forest

Disaster



Wind



Tidal

Eco-DRR Element

- **Associated Ecosystem**
Coast/Coast forest/Forest
- **Disasters**
Tsunami/High tide
- **Ecosystem Services**
Tide prevention/Prevention of salt damage/Prevention of blown sand/Prevention of tsunami/Wind prevention/Reduction of flow velocity/Prevention of driftwood and wastes/Control of discharged sediment
- **Other functions**
Soil formation/Food production/Material/Recreation
- **Traditional/local knowledge and practice**
Flood restraining forest belt/Others

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Wind prevention • Prevention of blown sand 	<ul style="list-style-type: none"> • Wind prevention • Prevention of blown sand
Regulating service	<ul style="list-style-type: none"> • Prevention of salt damage • Tide prevention 	<ul style="list-style-type: none"> • Prevention of salt damage
Additional function	<ul style="list-style-type: none"> • Food (truffle) • Shoro manju (sweet bun looks like a truffle) • Place for recreation 	<ul style="list-style-type: none"> • Food (truffle, pine mushroom) • Fuel (pine needles) • Special product (pine resin) • Wood • Shoro manju (sweet bun looks like a truffle)
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	<ul style="list-style-type: none"> • Coastal forest: It is based on trees planted in the 1600's 	

Challenges and lessons learnt

- » In recent years, management of pine needles is insufficient, and pine trees have been reduced due to transition to broad-leaved forests and death due to pine weevils.
- » In order to grow into fine pine trees, management by people by activities such as collecting pine needles and thinning needs to continue.



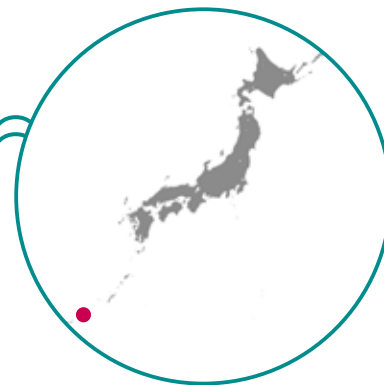
Photo: Keita Kitamura



Coral Reefs

Ishigaki City, Okinawa Prefecture, Japan

24°21'07.0"N 124°14'35.1"E



Background

- » The islands are scattered in a strip from the southern tip of Kyushu, the southern tip of Japan to Taiwan. Of these islands, the area between the Amami Islands and Hateruma Island includes many islands of coral reef origin. Coral reefs have developed on these islands.

System of disaster prevention

- » Coral reefs form a shallow sea. It is well known that the height of waves differs greatly between the inner and outer waters of the reef. Fishing was popular within the reefs of coral reefs, as fish and shellfish could be collected without being significantly affected by the weather.
- » Coral reefs reduce waves, therefore, seaside communities are less influenced by tidal waves. In addition, stone walls made of coral stone or Ryukyu limestone were used to surround houses and plants like Fukigi (*Garcinia subelliptica*) and other trees to protect them from typhoons and other storms.

Gifts from nature

- » Coral reefs form unique and rich ecosystems around the world. Corals themselves are valuable marine species, but the reefs are also homes to a variety of fish, shellfish, and others. These species provide an important food source for life on the islands.
- » Many islands of coral reef origin were formed by the uplift of coral reefs over the years of the earth's history. Produced Ryukyu limestone originates from coral stone and is used as stone material for various civil engineering structures such as castles, roads, and harbors.

Main Ecosystem

Coral reef

Disaster



Wave



Storm

Eco-DRR Element

- **Associated Ecosystem**
Coral reef
- **Disasters**
Storm/Others (Tidal wave)
- **Ecosystem Services**
Wind prevention
- **Other functions**
Food production/Material/Education/
Recreation/Cultural service/Community
building
- **Traditional/local knowledge and practice**
 - With regard to fishing on coral reefs, there have been many cultural anthropological and ethnographic studies, as they are unique and based on local cultures.
 - The underwater landforms within the coral reefs have detailed names, and a variety of fishing methods and practices can be seen in complex ways.
 - Coral stone walls can be seen in settlements on the island. Coral stone walls are highly effective for wind protection. There are many gaps between them, so they do not collapse in strong winds. It is also said that coral stonewalls are cooler than concrete block walls because they do not retain heat due to the many gaps in the stonewalls. On the other hand, habu (harmful snakes) can live in the gaps between the stone walls, and this is one of the aspects that is disliked by some people.

Eco-DRR	Present	Past
Disaster prevention function	<ul style="list-style-type: none"> • Vanishing waves • Prevention of wind 	<ul style="list-style-type: none"> • Vanishing waves • Prevention of wind
Regulating service		
Additional function	<ul style="list-style-type: none"> • Fishing • Stone wall materials • Habitat 	<ul style="list-style-type: none"> • Fishing • Recreation • Education • Habitat
Provisioning service Supporting service Cultural service		
Traditional Knowledge, Traditional Technique	<ul style="list-style-type: none"> • Traditional fishing • Traditional settlements (coral stone walls) 	

Traditional/local knowledge and practices

- » Fishing on the reefs has been passed down through the culture of the maritime people in Okinawa, and the various landforms in the sea have been given detailed names. There are also numerous records of traditional fishing, not only for food gathering, but also for shells

such as Akoya pearl oyster, which has been treated as currency.

- » Coral stone walls were also used in ruins around the 13th century on Ishigaki Island. Even today, coral stone walls can be seen in old settlements.

Challenges and lessons learnt

- » Coral reefs continue to be destroyed for various reasons, including coral bleaching and inflow of sediment.
- » Although environmental conservation efforts are ongoing through the institutionalization of tourism, the destruction of coral reefs has not been completely stopped.
- » Although the traditional use of coral stone walls has been replaced by concrete block walls, coral stone and Ryukyu limestone as resources continue to be consumed, and they are sometimes used in new houses in recent years.
- » Compared to coral reefs, there are fewer structural measures for the conservation of coral stones.

- » Coral reef islands are very valuable for their unique and rich natural environments. On the other hand, island cultures that have lived with coral reefs have taken advantage of the characteristics of coral reefs and have made good use of the different underwater topography and wave heights of different reefs. Furthermore, people have created disaster prevention measures and landscapes unique to coral reef islands, by means such as using coral stone walls to protect against the wind.
- » The unique natural landscape of a region is deeply related to human life, and through the ingenuity of human experience, people and nature live in harmony.



Wetlands and Eco-DRR in Asia

*Case Studies of Traditional or Local
Ecosystem-based Disaster Risk Reduction (Eco-DRR)
Related to Wetlands in Asia*

