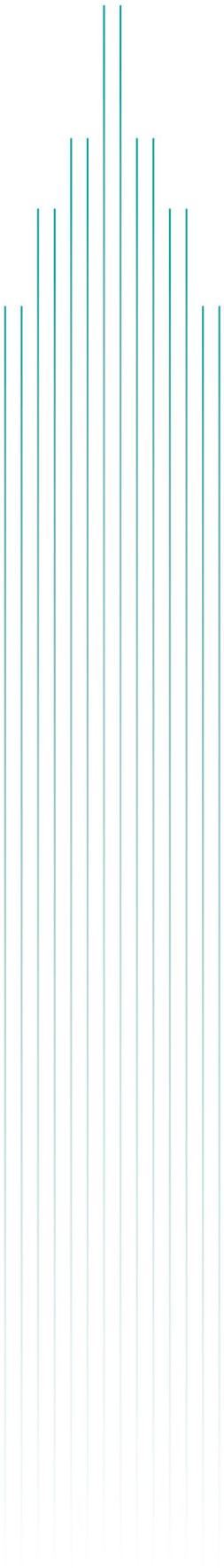
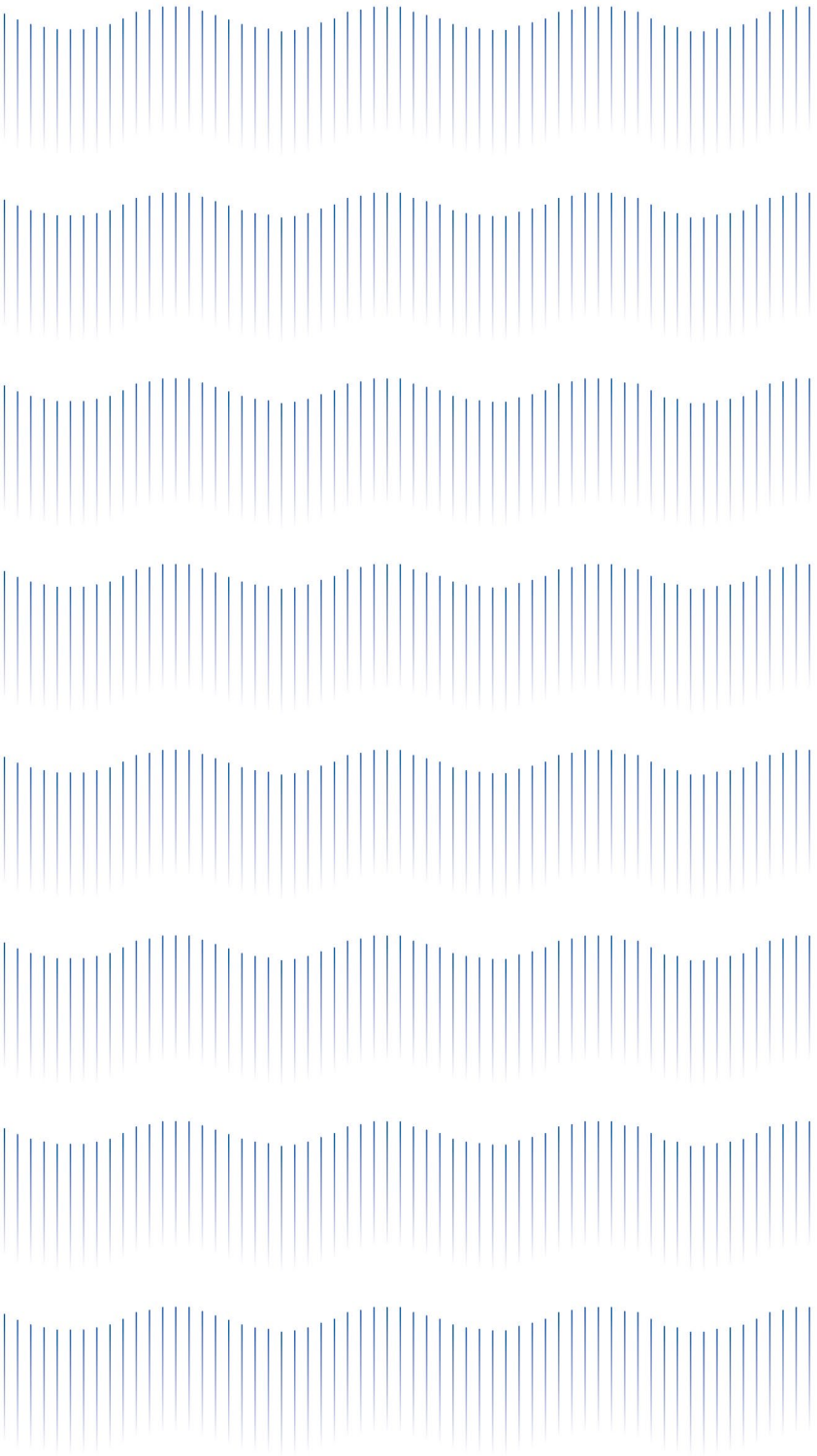
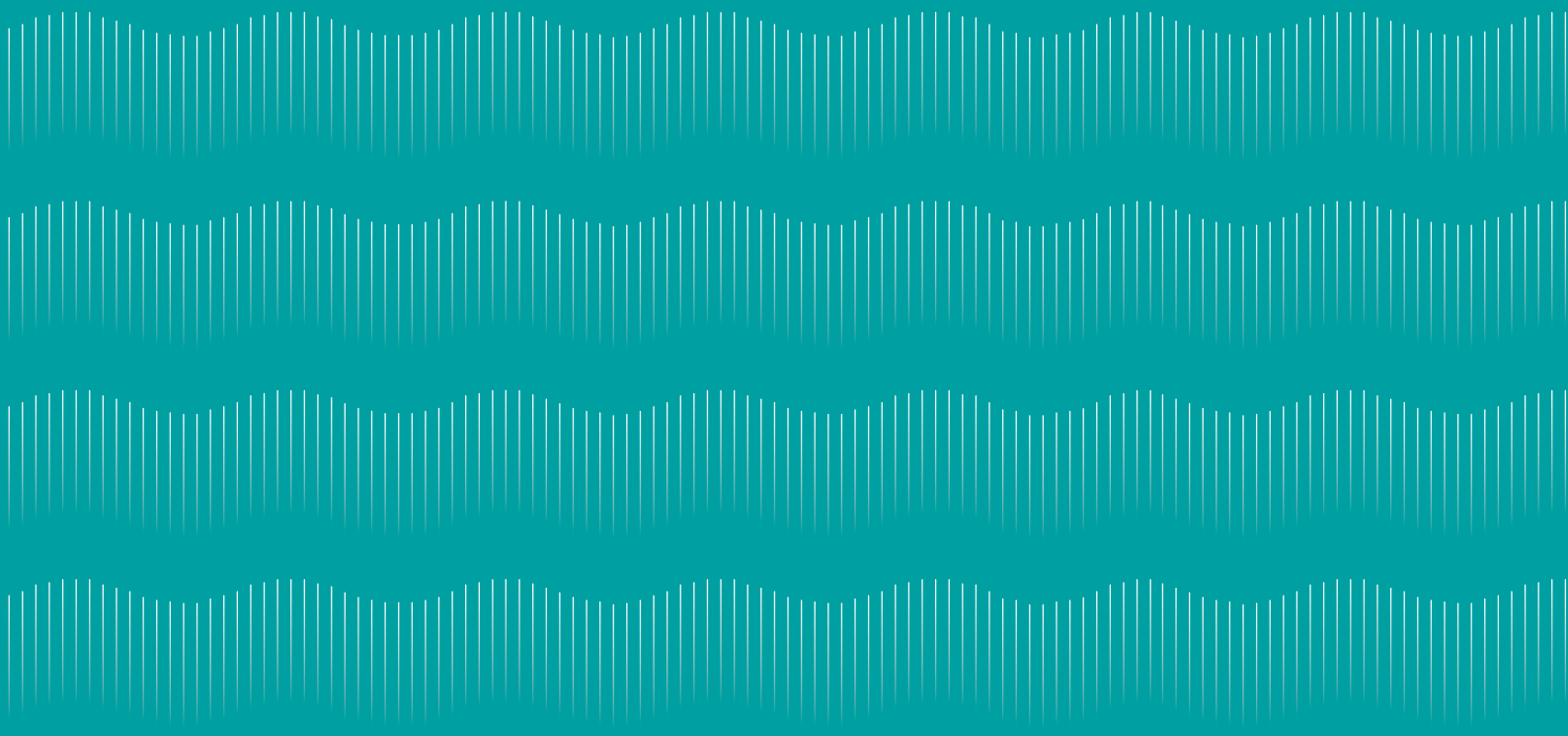
Building Resilient Water Environments

An Introduction to the Water Resources Agency





經濟部水利署
Water Resources Agency, MOEA



Core Missions

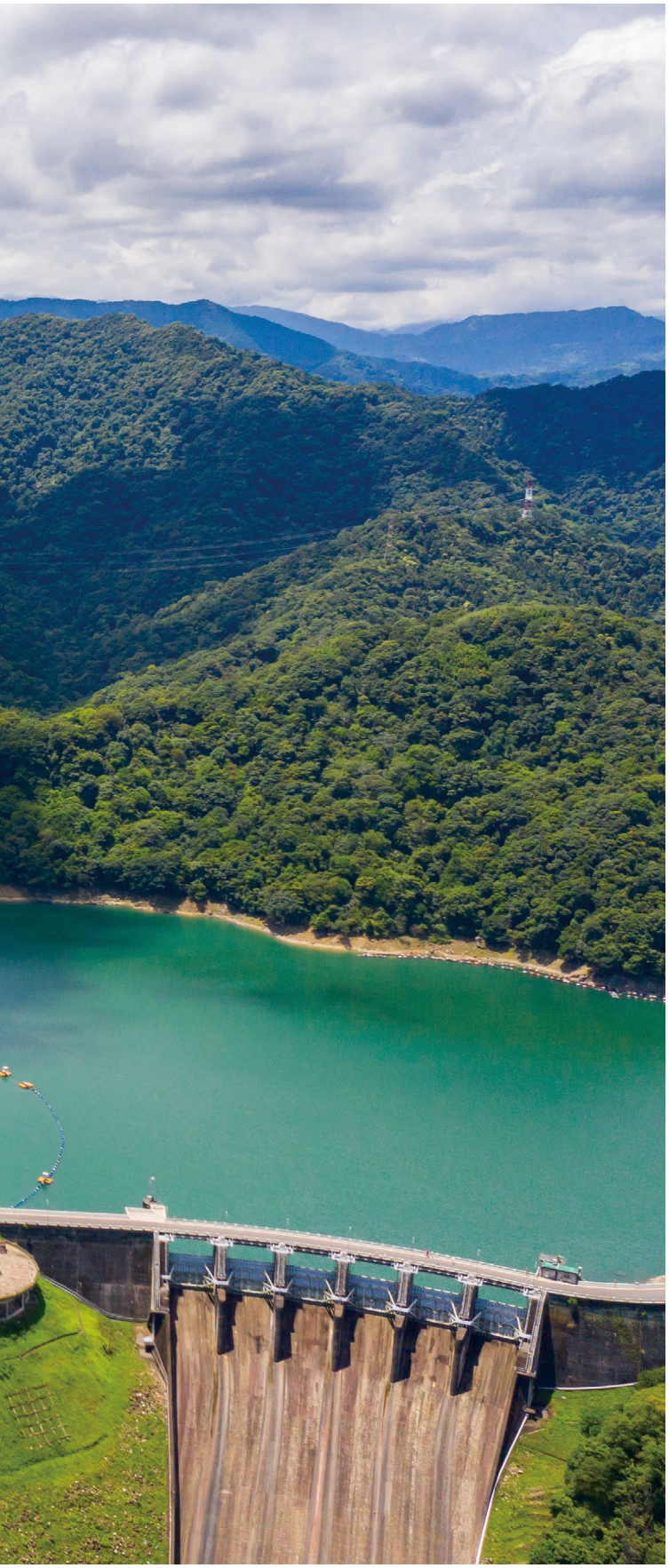
Ensuring Stable Water Supplies

Addressing social needs and climate change.
Enhancing emergency preparedness.

Improving Flood Resilience

Promoting holistic watershed management, enhancing land's flood-bearing capacity, and building resilient water-smart cities.

Photo / Shutterstock



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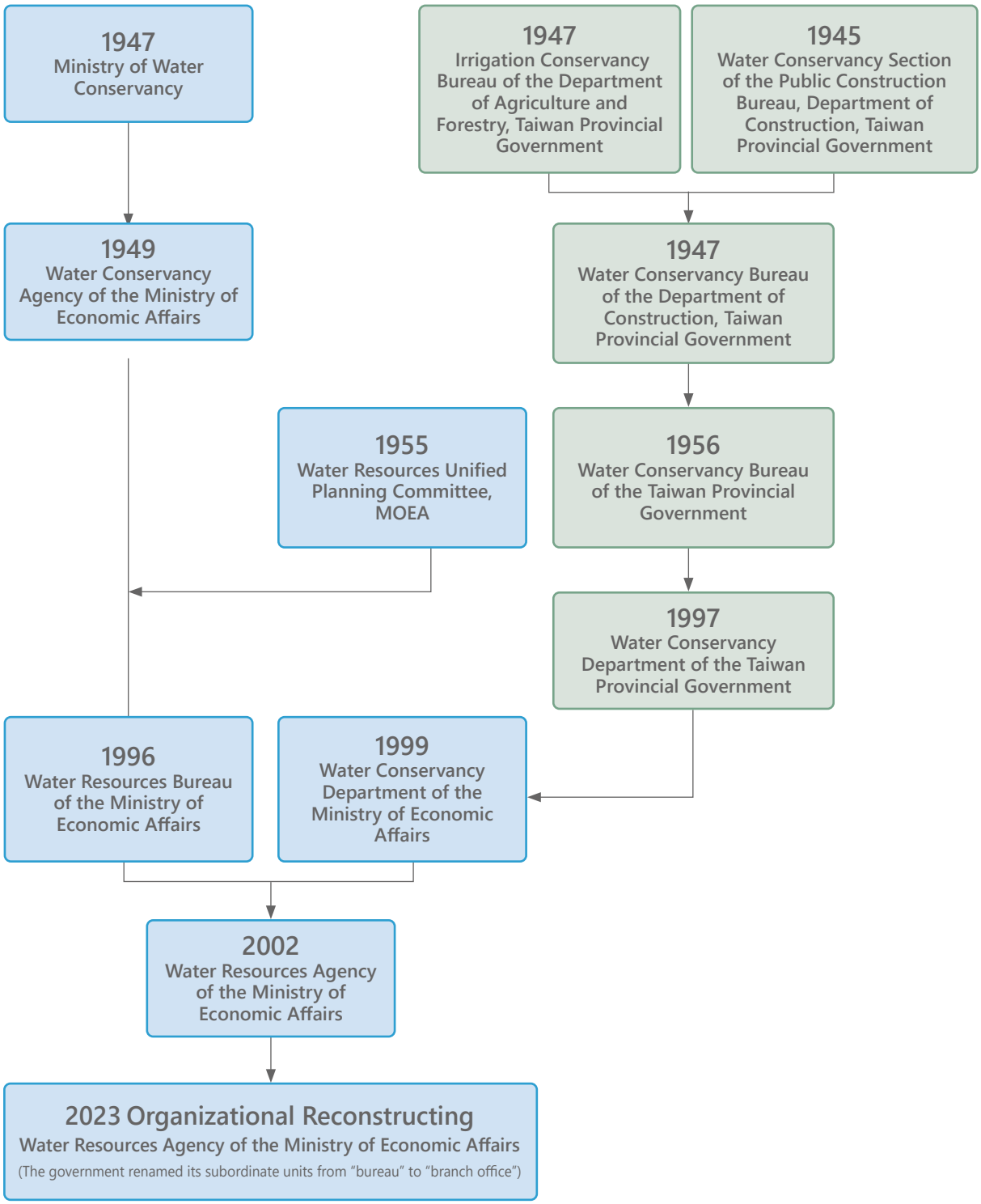
Chapter 1

Introduction to the Water Resources Agency

Organizational Development



Key Responsibilities

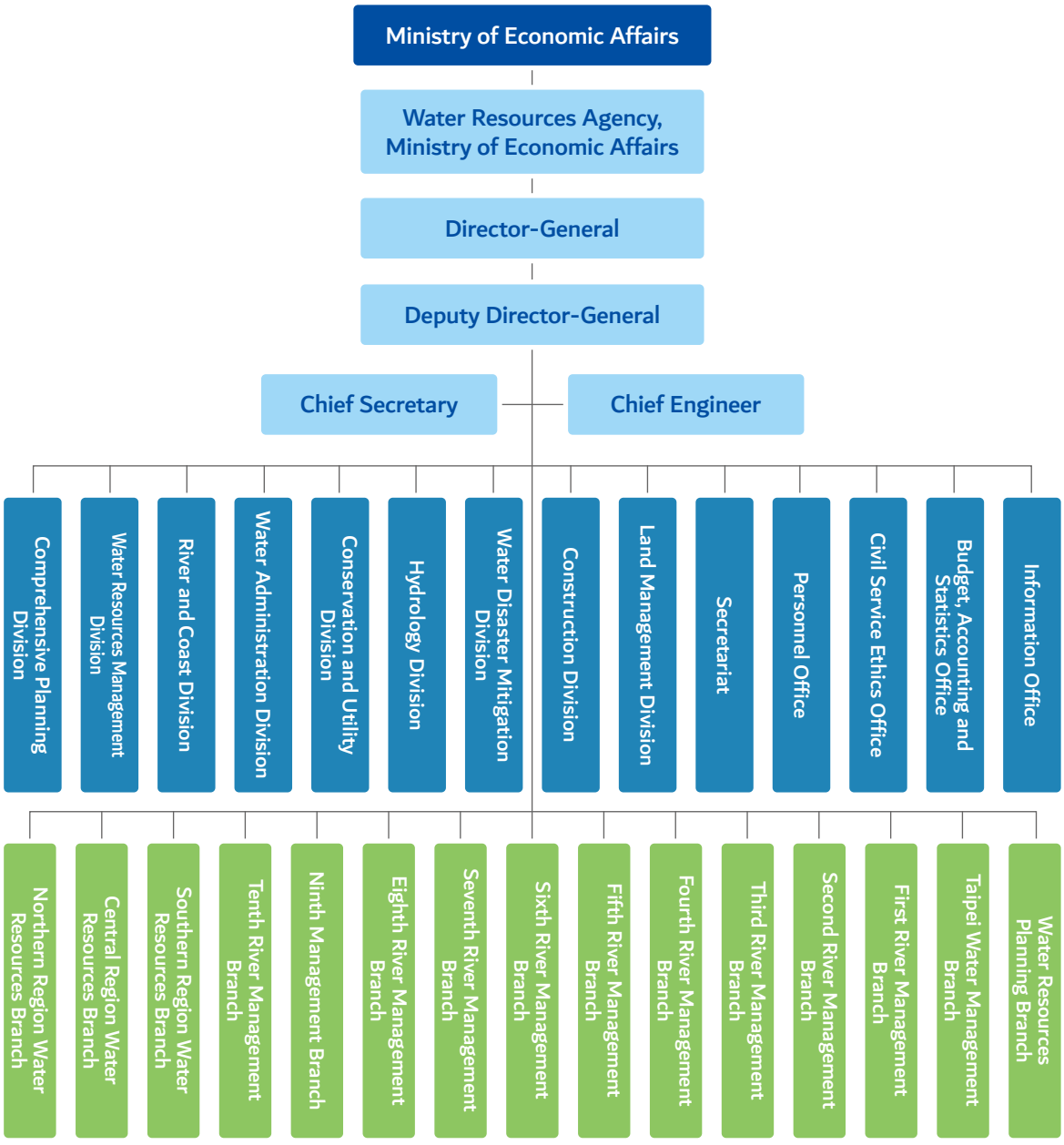
1. Formulation and promotion of policies and regulations for water work, water supply, reclaimed water, and hot spring management.
2. Development and utilization of water resources, water rights management, water allocation, and conservation of reservoir storage areas.
3. Protection and response measures to flood and drought; development of water resources industry; and quality management of hydraulic engineering.

Division and Duty

Organizational Structure

The Water Resources Agency is under the jurisdiction of the Ministry of Economic Affairs. The agency's headquarters has 9 divisions and 5 offices. It also oversees 15 branch offices.

Organizational Chart



Locations and Jurisdictions of the Water Resources Agency and Its Branch Offices

Tenth River Management Branch
Location : New Taipei City
Jurisdiction : Tamsui River System, Huang River

Northern Region Water Resources Branch
Location : Taoyuan City
Jurisdiction : From Hsinchu County northward to Yilan County and Hualien County in the east

Head Office
Location : Taipei City

Taipei Water Management Branch
Location : New Taipei City
Region : Northern Region
Jurisdiction : Chingtan water source, water quality and quantity reservation area of the Hsintien River

Second River Management Branch
Location : Hsinchu City
Jurisdiction : Fengshan River, Touqian River, Zhonggang River, and Houlong River

Head Office
Location : Taichung City

Third River Management Branch
Location : Taichung City
Jurisdiction : Daan River, Dajia River, Wu River

First River Management Branch
Location : Yilan City
Jurisdiction : Lanyang River and Heping River

Central Region Water Resources Branch
Location : Taichung City
Jurisdiction : From Miaoli County southward to Yunlin County

Water Resources Planning Branch
Location : Taichung City
Jurisdiction : Investigation, planning, experimentation, research and analysis of water resources engineering projects

Fourth River Management Branch
Location : Changhua County
Jurisdiction : Zhuoshui River

Ninth River Management Branch
Location : Hualien City
Jurisdiction : Xiuguluan River, Hualien River

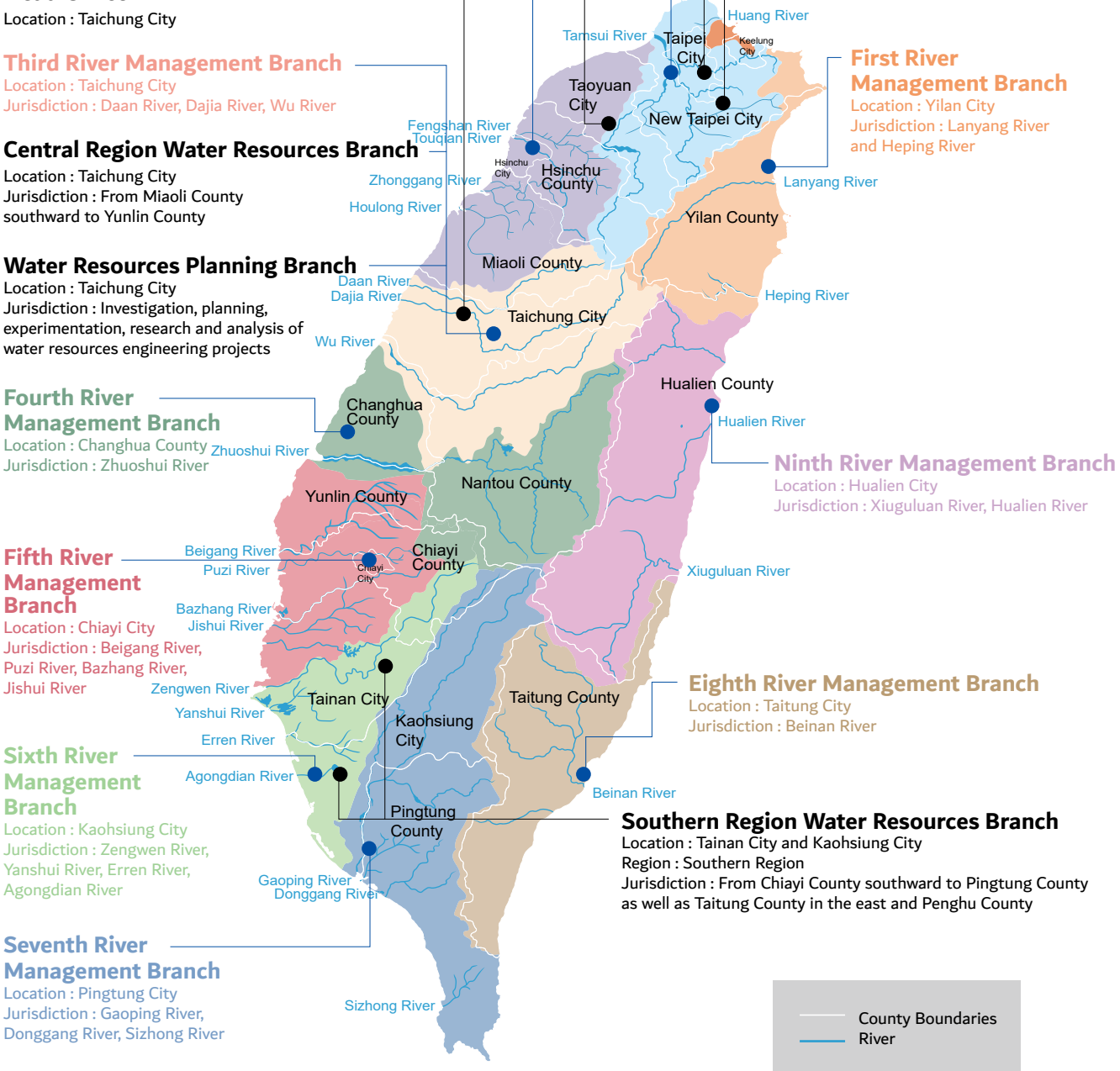
Fifth River Management Branch
Location : Chiayi City
Jurisdiction : Beigang River, Puzi River, Bazhang River, Jishui River

Eighth River Management Branch
Location : Taitung City
Jurisdiction : Beinan River

Sixth River Management Branch
Location : Kaohsiung City
Jurisdiction : Zengwen River, Yanshui River, Erren River, Agongdian River

Southern Region Water Resources Branch
Location : Tainan City and Kaohsiung City
Region : Southern Region
Jurisdiction : From Chiayi County southward to Pingtung County as well as Taitung County in the east and Penghu County

Seventh River Management Branch
Location : Pingtung City
Jurisdiction : Gaoping River, Donggang River, Sizhong River



Personnel Structure

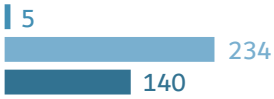
Agency Head Office 379 people

Unit : People

Gender

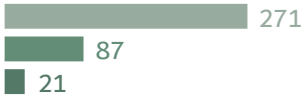
Male
Female

Age



Under 29
30-49
50 and above

Education



Master's degree or above
Bachelor's degree
Junior college, high school degree

Branch Offices 1135 people

Unit : People

Gender

Male
Female

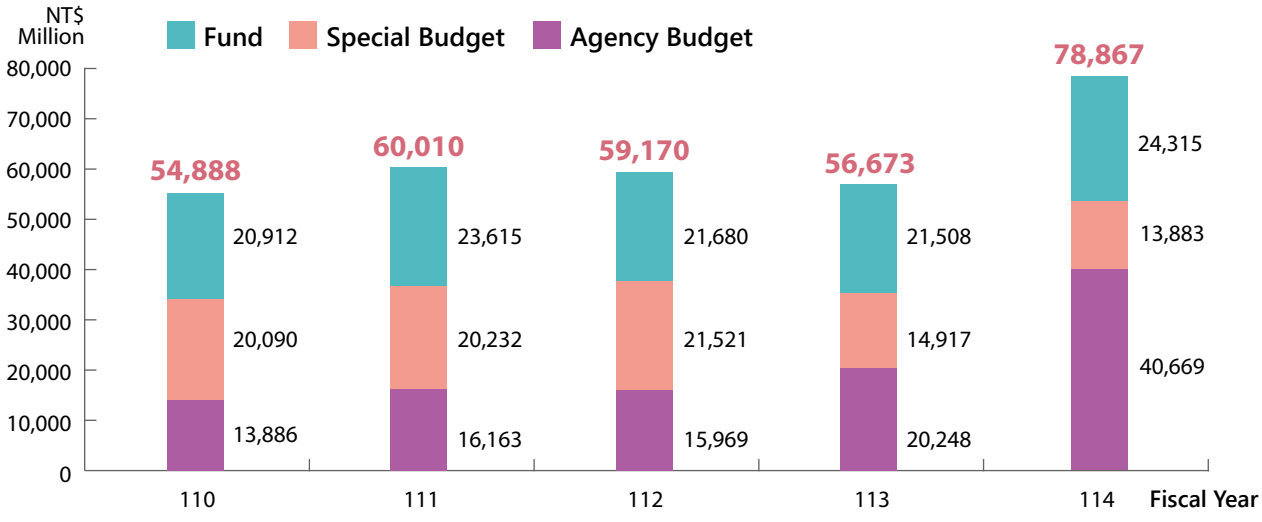
Age

Under 29
30-49
50 and above

Education

Master's degree or above
Bachelor's degree
Junior college, high school degree

Budget Execution



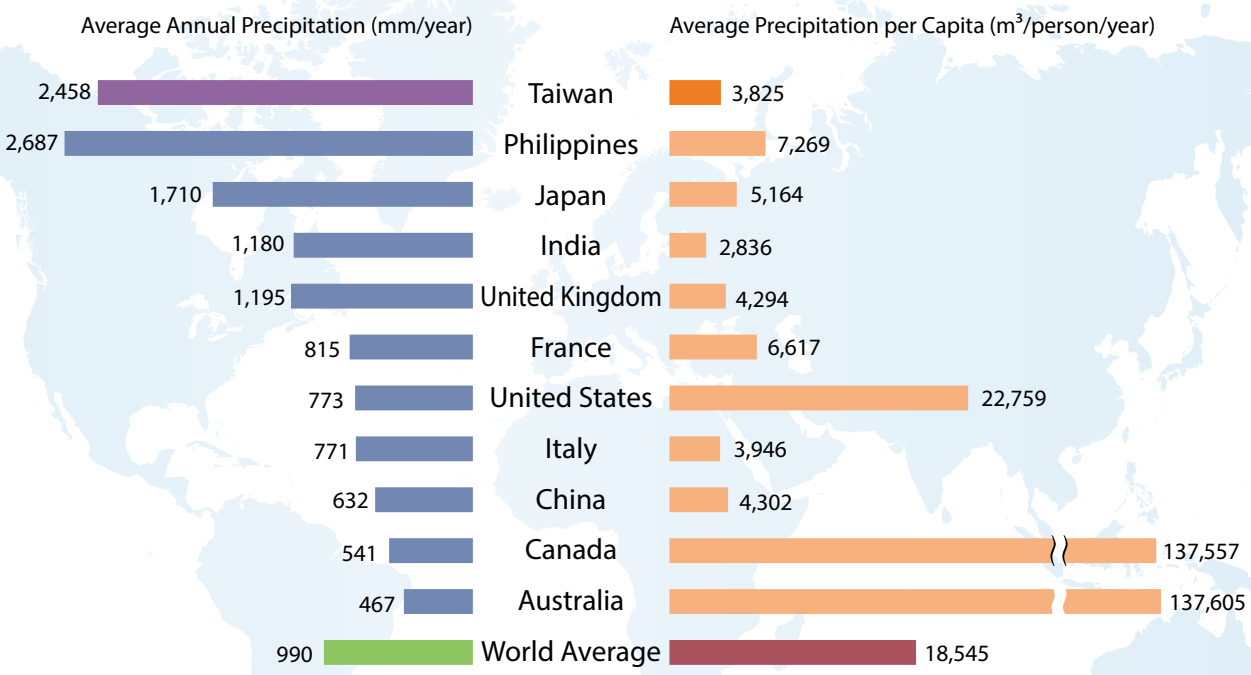
Chapter 2

Taiwan's Water Environment

Precipitation

Taiwan's average annual precipitation is around 2,458 millimeters, which is approximately 2.5 times the global average. However, due to the steep terrain and rapid runoff, 3/4 of the rainfall flows directly into the sea or evaporates, and coupled with the high population density, the per capita precipitation is only about 1/5 of the global average. Additionally, the precipitation is heavily concentrated in the wet season, with significantly less precipitation during the dry season.

Comparison of Taiwan's Average Annual Precipitation with Other Countries

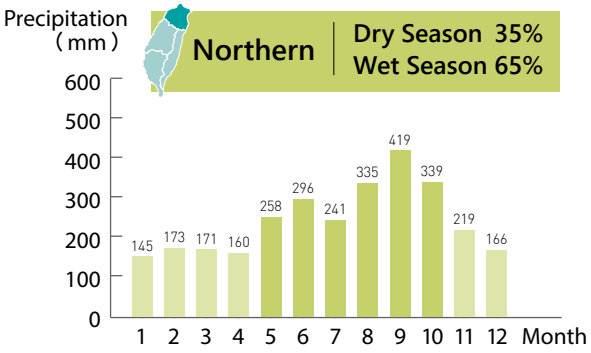


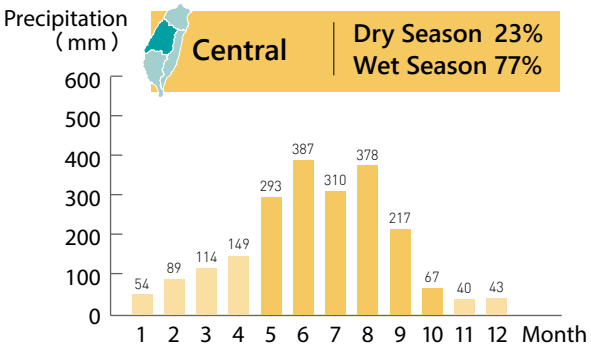
Source : Trading Economics

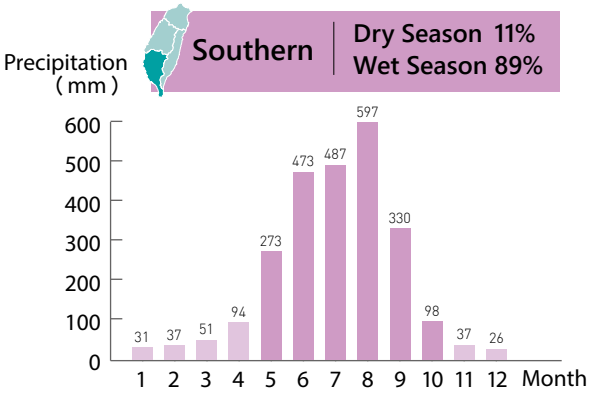
∗ Note: The values in the figure do not take evaporation into account.

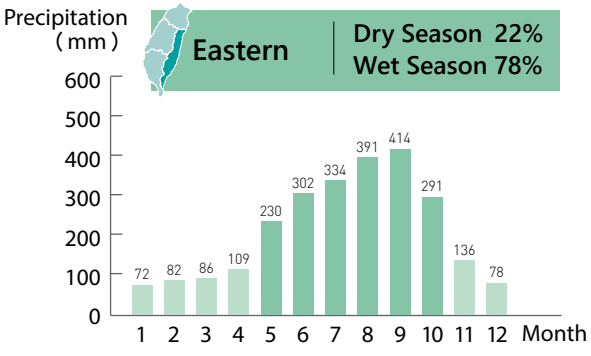
Taiwan's average annual precipitation during 1949 to 2023 was 2,495 mm.

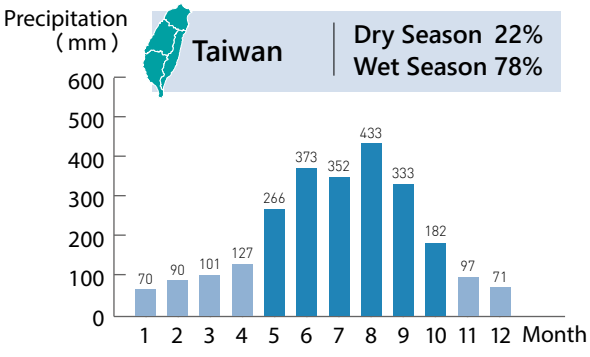
*Note: The wet season is from May to October, and the dry season is from November to April.

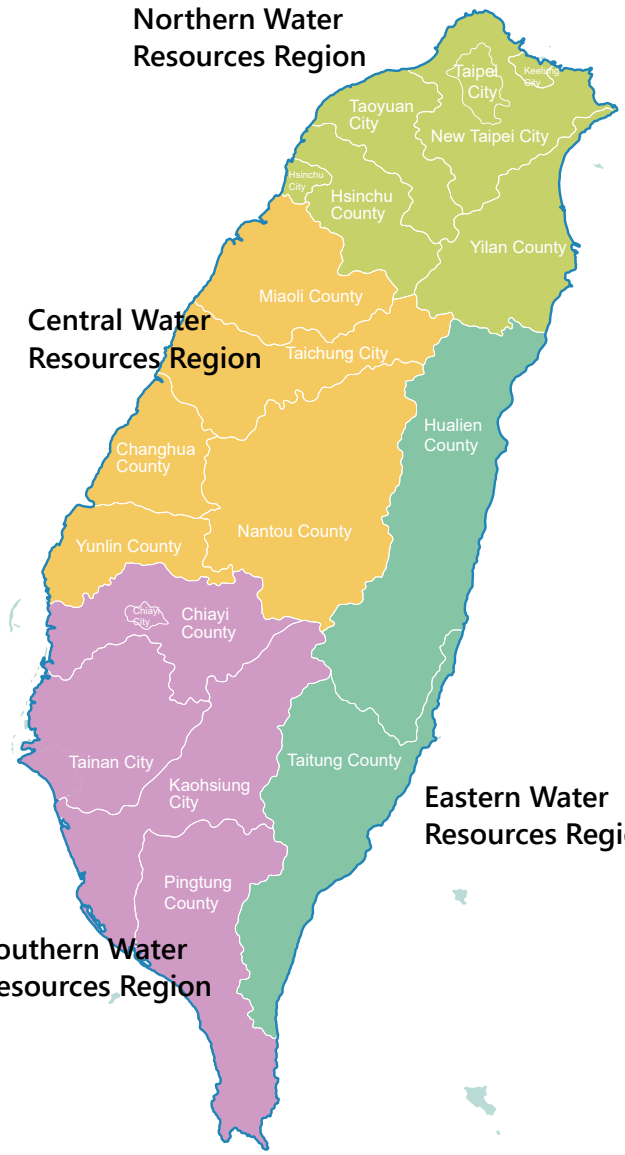












Rivers

The longest river in Taiwan is the Zhuoshui River, with a mainstream length of 186.6 kilometers. The largest river basin belongs to the Gaoping River, covering 3,257 km^2. However, due to the steep terrain and rapid flow, it is difficult to store and utilize water resources.

1 Huang Stream
Basin Area : 49 km²
Main Stream Length : 13.5 km

2 Tamsui River
Basin Area : 2,726 km²
Main Stream Length : 158.7 km

3 Fengshan River
Basin Area : 250 km²
Main Stream Length : 45.4 km

4 Touqian River
Basin Area : 566 km²
Main Stream Length : 63.0 km

5 Zhonggang River
Basin Area: 446 km²
Main Stream Length: 54.0 km

6 Houlong River
Basin Area : 537 km²
Main Stream Length : 58.3 km

7 Daan River
Basin Area : 758 km²
Main Stream Length : 95.8 km

8 Dajia River
Basin Area : 1,236 km²
Main Stream Length : 124.2 km

9 Wu River
Basin Area : 2,026 km²
Main Stream Length : 119.1 km

10 Zhuoshui River
Basin Area : 3,157 km²
Main River Length : 186.6 km

11 Beigang River
Basin Area : 645 km²
Main River Length : 82.0 km

12 Puzi River
Basin Area : 427 km²
Main River Length : 75.9 km

13 Bazhang River
Basin Area : 475 km²
Main River Length : 80.9 km

14 Jishui River
Basin Area : 379 km²
Main River Length : 65.0 km

15 Zengwen River
Basin Area : 1,177 km²
Main River Length : 138.5 km

16 Yanshui River
Basin Area : 343 km²
Main River Length : 41.3 km

17 Erren River
Basin Area : 350 km²
Main River Length : 63.2 km

18 Agongdian River
Basin Area : 137 km²
Main River Length : 38.0 km

19 Gaoping River
Basin Area : 3,257 km²
Main River Length : 171.0 km

20 Donggang River
Basin Area : 472 km²
Main River Length : 44.0 km

21 Sichong River
Basin Area : 125 km²
Main River Length : 31.9 km

22 Beinan River
Basin Area : 1,603 km²
Main River Length : 84.4 km

23 Xiuguluan River
Basin Area : 1,790 km²
Main River Length : 81.2 km

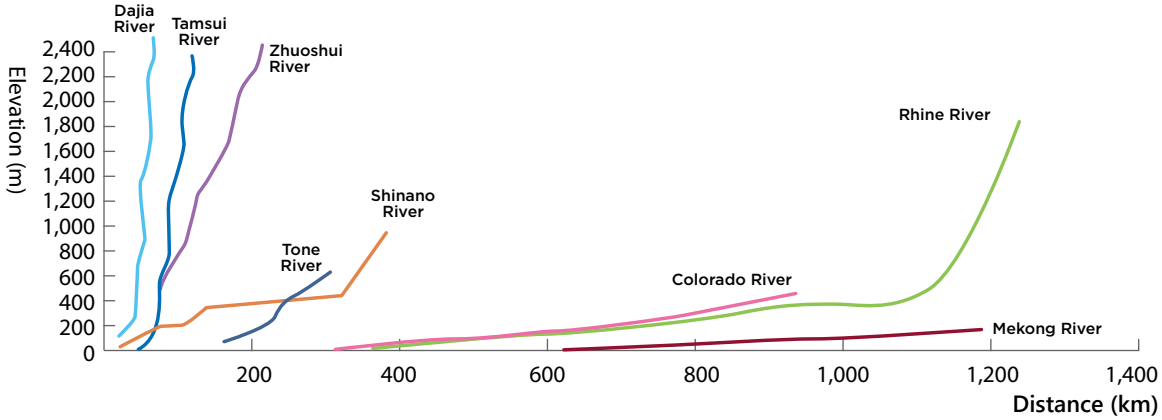
24 Hualien River
Basin Area : 1,507 km²
Main River Length : 57.3 km

25 Heping River
Basin Area : 561 km²
Main River Length : 50.7 km

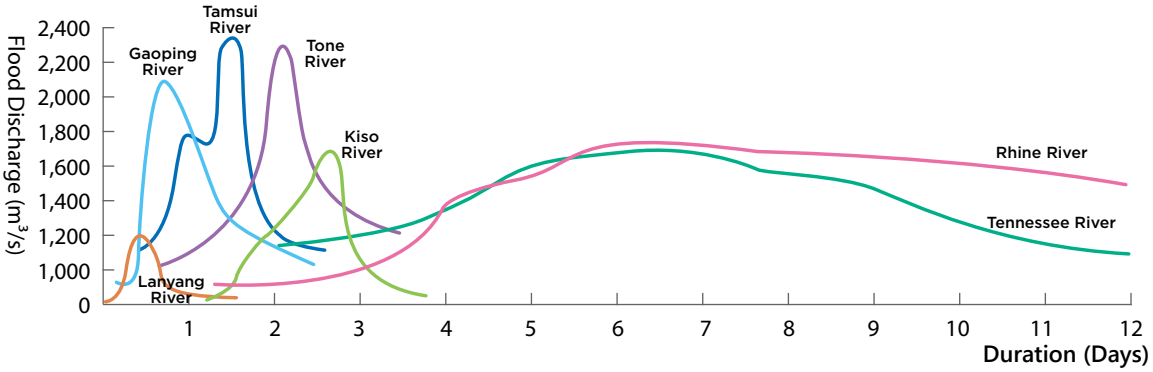
26 Lanyang River
Basin Area : 978 km²
Main River Length : 73.0 km


1 Huang River
2 Tamsui River
3 Fengshan River
4 Touqian River
5 Zhonggang River
6 Houlong River
7 Daan River
8 Dajia River
9 Wu River
10 Zhuoshui River
11 Beigang River
12 Puzi River
13 Bazhang River
14 Jishui River
15 Zengwen River
16 Yanshui River
17 Erren River
18 Agongdian River
19 Gaoping River
20 Donggang River
21 Sizhong River
22 Beinan River
23 Xiuguluan River
24 Hualien River
25 Heping River
26 Lanyang River

Comparison of River Gradients between Taiwan and the World



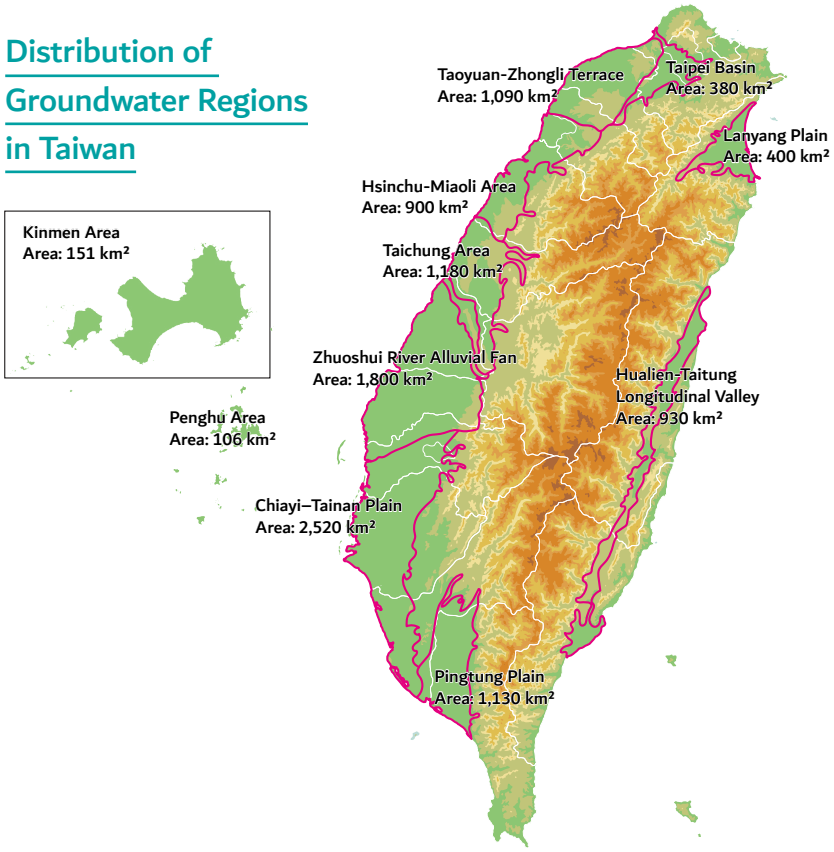
Comparison of River Flood Flow Hydrographs between Taiwan and the World



Groundwater

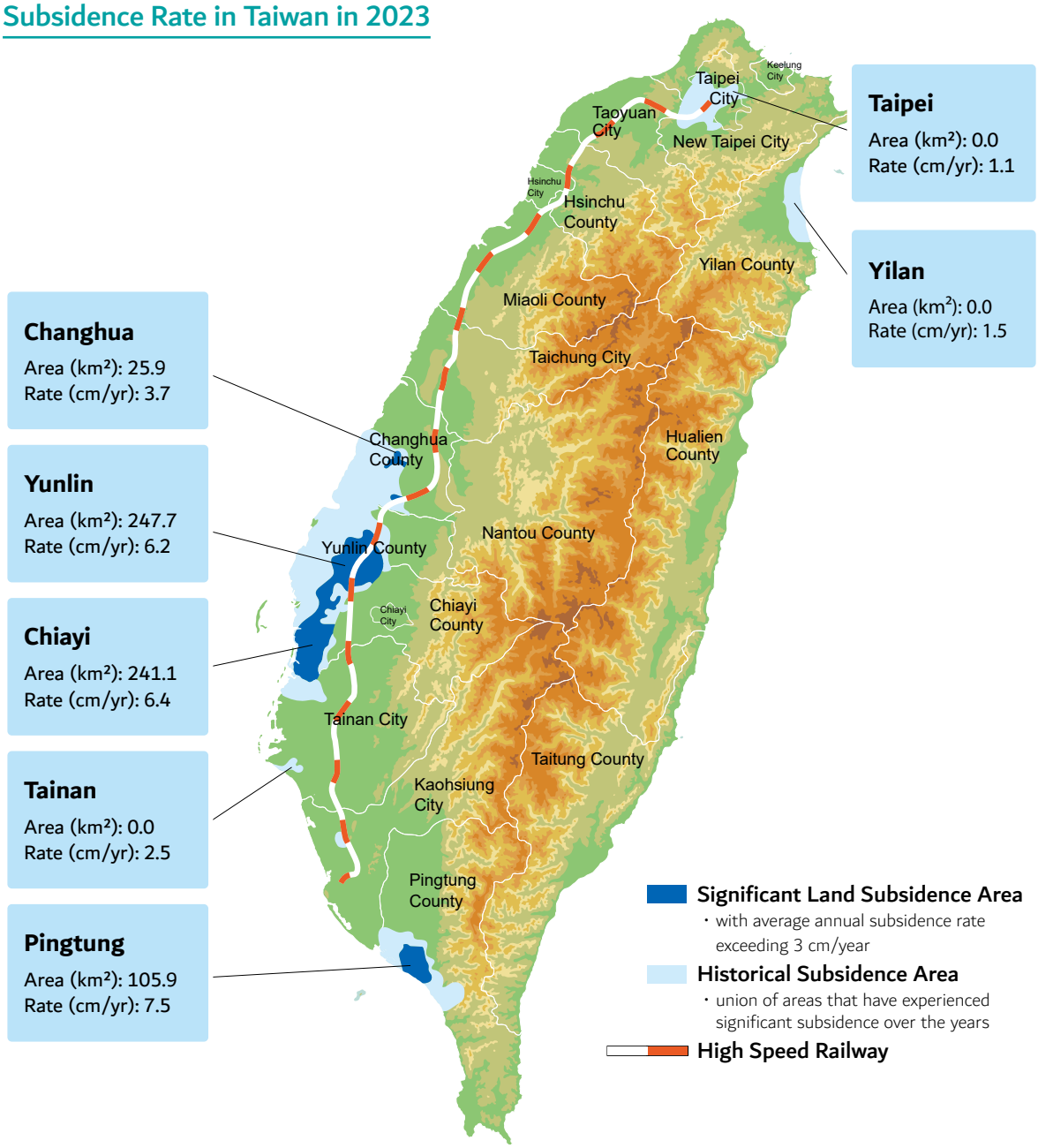
In Taiwan, there are 11 major regions with abundant groundwater resources, respectively, the Taipei Basin, Taoyuan-Zhongli Terrace, Hsinchu-Miaoli Area, Taichung Area, Zhuoshui River Alluvial Fan, Chiayi–Tainan Plain, Pingtung Plain, Lanyang Plain, and Hualien-Taitung Longitudinal Valley, as well as the offshore Penghu Area and Kinmen Area.

Distribution of Groundwater Regions in Taiwan



In the early days, some areas of southwestern Taiwan experienced land subsidence due to excessive groundwater extraction. To mitigate the issue, the central and local governments collaborated on control and prevention measures such as increasing surface water supply, reducing groundwater withdrawal, replenishing groundwater, and improving water well management. As a result of integrating resources and collaborative efforts, the area of significant subsidence in Taiwan, where the ground subsidence rate exceeds 3cm per year, was drastically reduced from 1,529 km² in 2001 to 310 km² in 2022. The overall subsidence trend has gradually slowed down. Although there was an increase in subsidence area in 2023 due to poor water conditions, surveillance data indicated a significant decrease in subsidence area in 2024, demonstrating the effectiveness of the mitigation efforts. In the future, the central and local governments will continue to work together to reduce the risks of land subsidence.

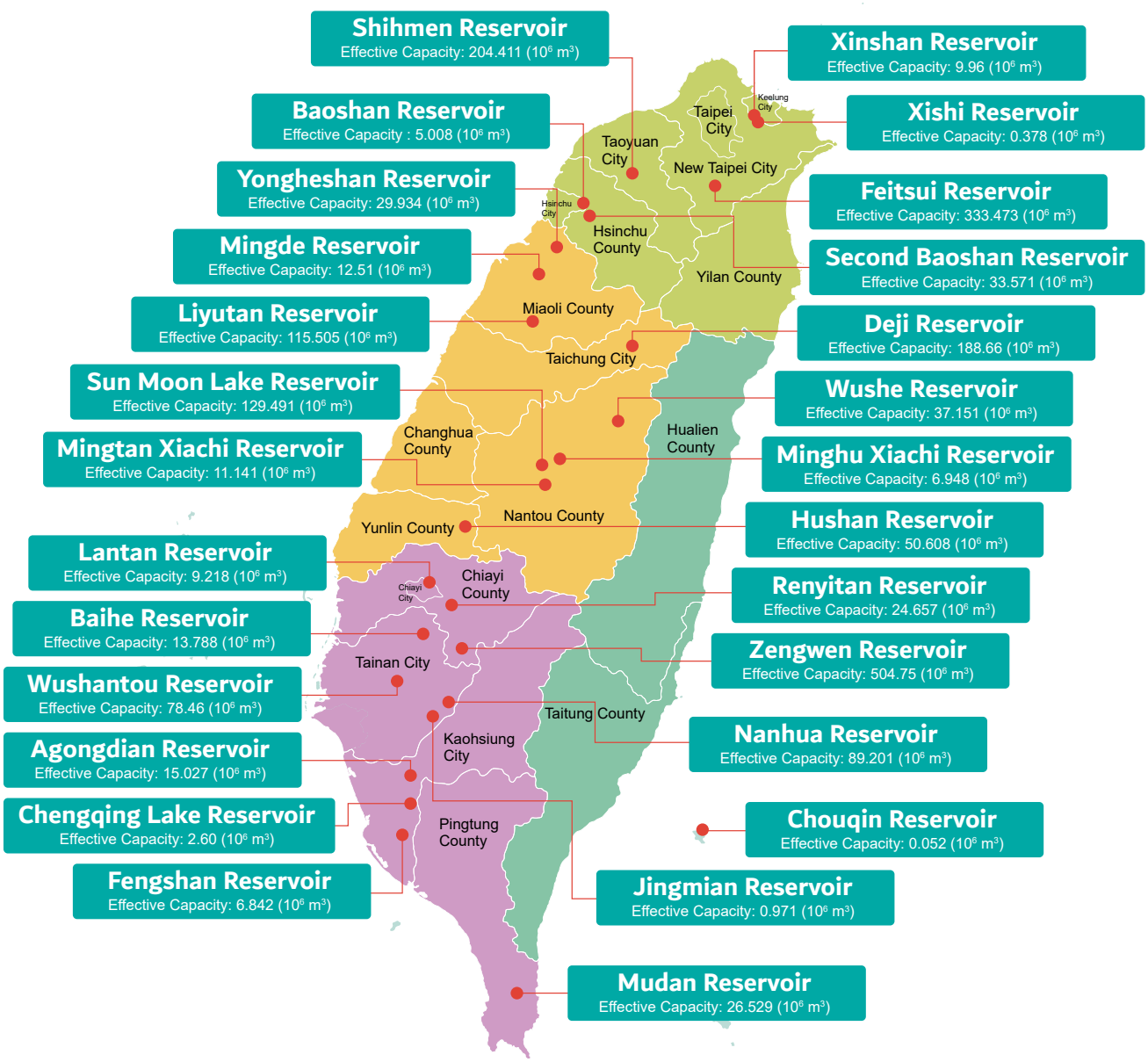
Significant Land Subsidence Area and Maximum Subsidence Rate in Taiwan in 2023



Major Water Supply Facilities

Taiwan currently has a total of 95 publicly announced reservoirs, with 66 located on the main island of Taiwan and 29 on the outlying islands. Among them, 27 are major water supply reservoirs, with the largest being the Zengwen Reservoir, which has an effective capacity of 504.75 million m³.

Effective Storage Capacity of Taiwan's Major Reservoirs

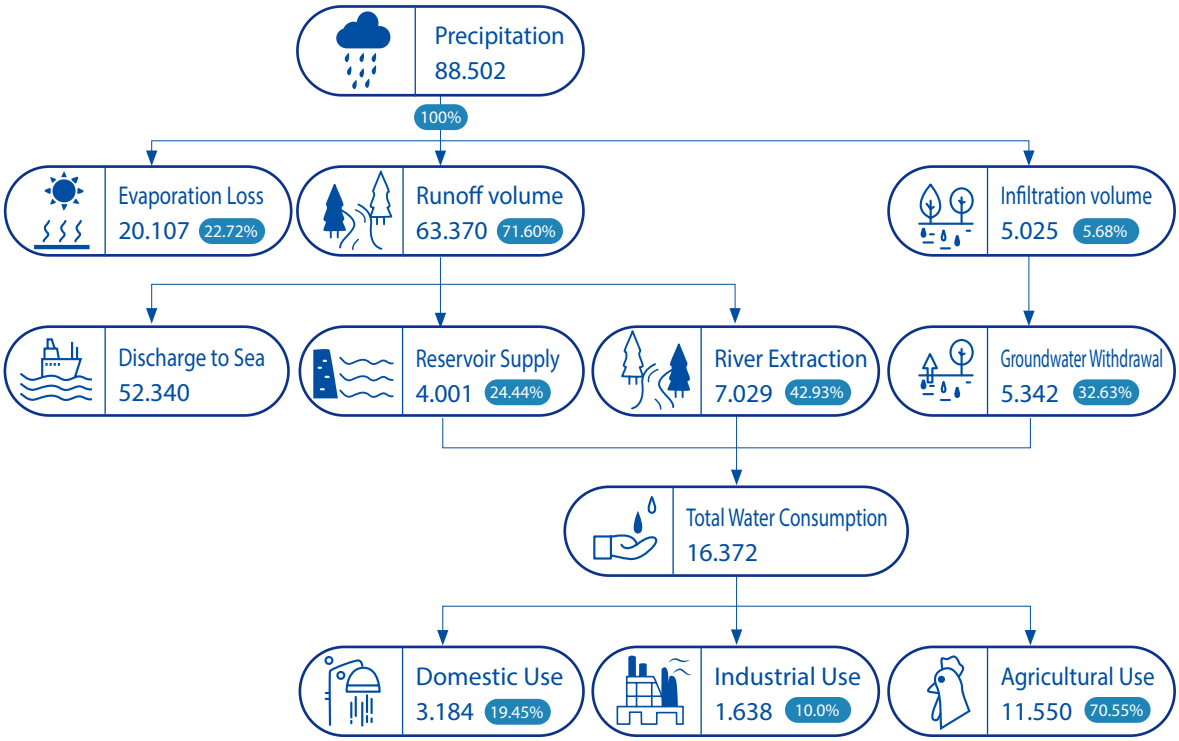


Water Resource Utilization

Taiwan's water supply is primarily sourced from rivers, accounting for around 43%, followed by groundwater at 33%, and reservoir water at 24%. In terms of water usage, agriculture accounts for approximately 70.55%, domestic use for 19.45%, and industry for about 10%.

Average Water Resources and Utilization during 2013-2022

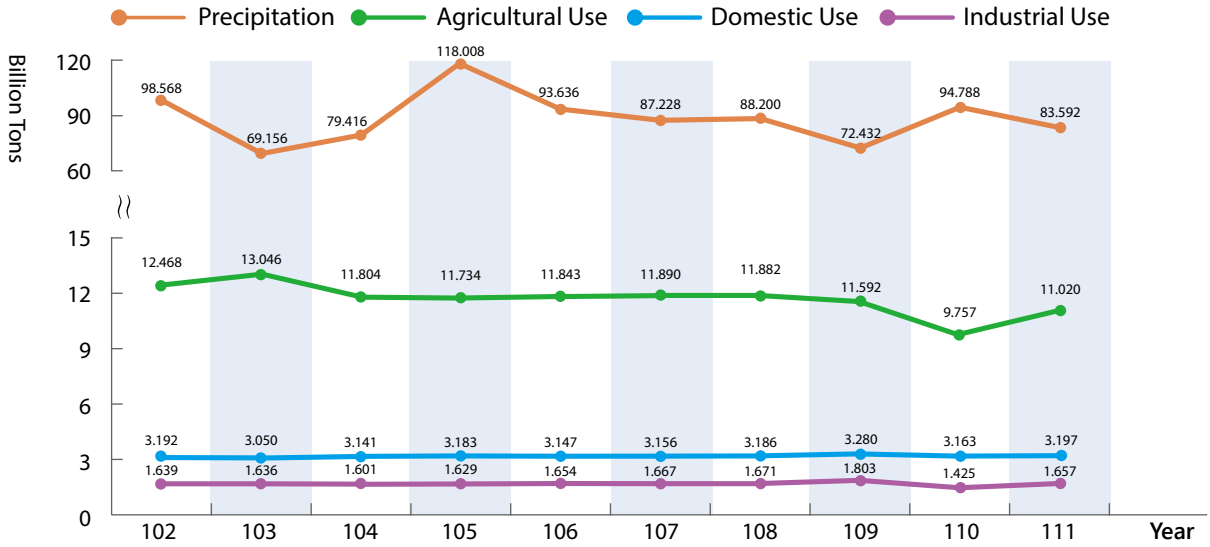
Unit: Billion Tons



Source: Compilation of Annual Water Consumption (2013-2022)

Comparison of Precipitation and Agricultural, Domestic, and Industrial Water Use during 2013-2022

Unit : Billion Tons

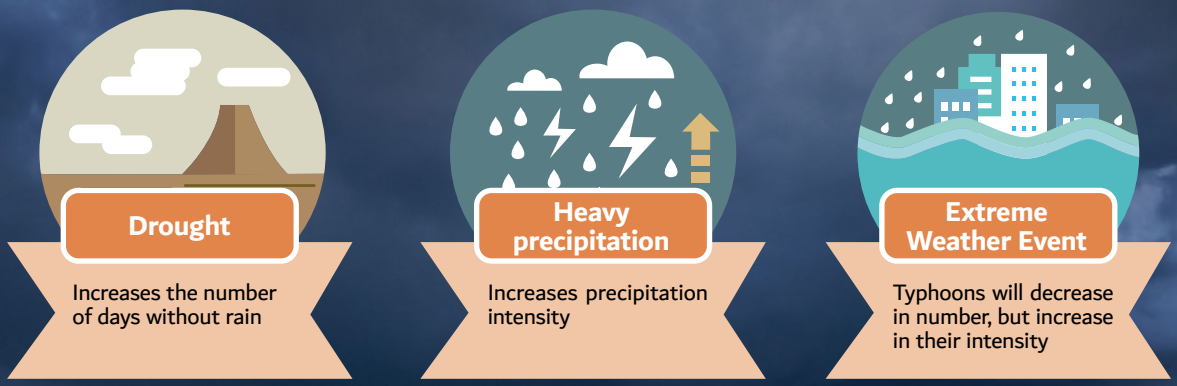


Source: Compilation of Annual Water Consumption (2013-2022)

Future Challenges

Challenge 1 : Climate Change

Climate change exacerbates uneven distribution of droughts and floods, increases frequency of drought events, and raises frequency and intensity of short-duration heavy precipitation events. Furthermore, future typhoons may decrease in number but increase in intensity. The risk of storm surges and flooding will also be heightened due to rising sea levels.



Under the impacts of climate change, Taiwan's seasonal water abundance and scarcity are becoming more extreme, with extreme weather events expected to occur more frequently in the future.

Taiwan

IPCC AR6
end of century

+41.3%

Simple daily intensity index

Photo / Shutterstock

Challenge 2：Increased Pressure on Water Supply Due to Industrial Development and Population Concentration

Population distribution is changing, gradually concentrating in the northern, central, and southern metropolitan areas, which results in increased pressure on water supply in these urban areas. In addition, the continued growth of high-tech industries is driving further increases in water demand.

Challenge 3：Increased Public Awareness of Water Environment

Public awareness on the conservation of river ecology and the improvement of water environment is rising. Therefore, water management efforts should put water quality improvement, river habitat preservation, environmental conservation, cultural landscape, and natural scenery into consideration. The goal is to enhance the vitality of water environments and create water-friendly, scenic, recreational, and ecologically sustainable water environments.

Chapter 3

Ensuring Stable Water Supply

Overall Situation

Regarding public water usage, the current water supply capacity in each county and city can meet the demand. The Master Plan for Water Resources Management in Every Region of Taiwan is continuously implemented to strengthen the three main management strategies outlined in the plan, including strengthening overall management of the river basin, developing the western corridor water supply network, and enhancing water production by technology. Various water resource plans will be reviewed and promoted to improve the water supply resilience in each region and meet the 2036 water demand growth target.

Strategies

To ensure a stable water supply and tackle the challenges posed by climate change-induced extreme weather, industrial development, and population concentration, water resource management strategies such as resource expansion, water conservation, allocation, backup systems, and management are adopted.

Strategy 1：Diversify Water Supply

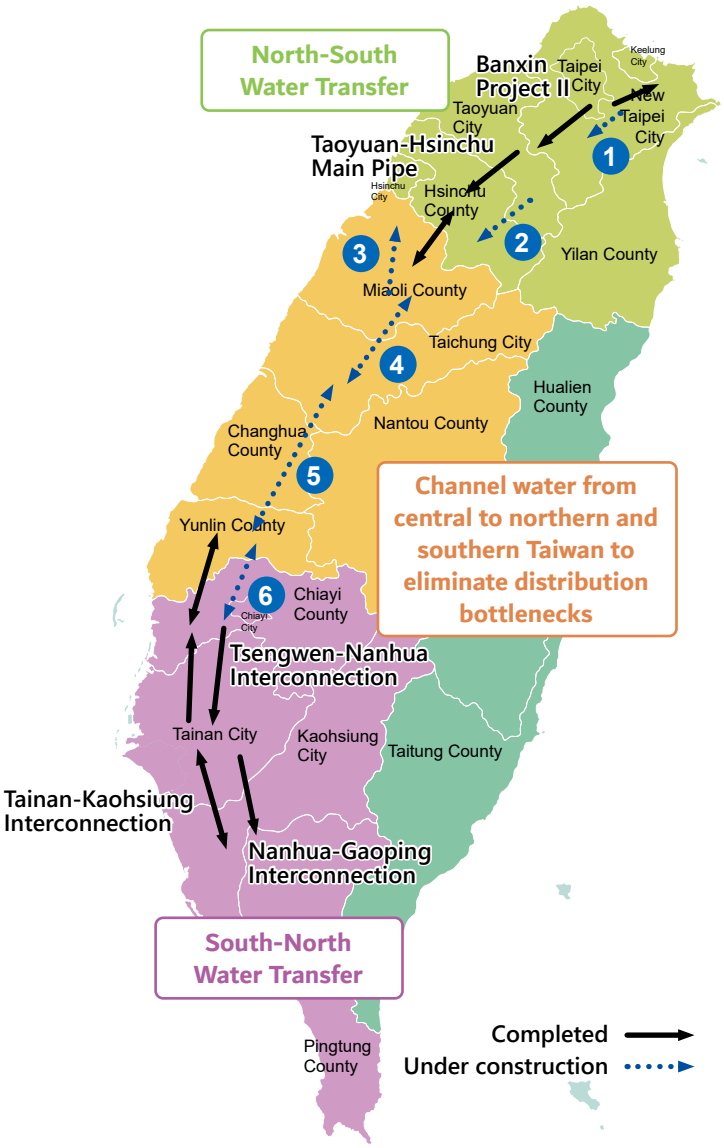
Developed diverse water sources through the promotion of reclaimed water, seawater desalination, and constructing artificial lakes for water storage. Reclaimed water has the advantage of being unaffected by natural precipitation. Taiwan plans to establish 16 reclaimed water plants in the future to maintain regional water supply stability. Seawater desalination is also unaffected by climate. In addition to the facilities on the offshore islands, desalination plants are also planned in Hsinchu and Tainan.

(Left) Niaozueitan Artificial Lake. (Right) Magong 6000-ton Desalination Plant.

Strategy 2：Water Conservation

To reduce water demand, the Water Resources Agency has adopted multiple water conservation strategies, such as promoting Water Efficiency Labelling, reducing tap water leakage rates, strengthening agricultural water conservation, and improving industrial water recycling. Additionally, Water Conservation Fee is imposed on high-volume water consumers to encourage corporate water conservation and implement water justice.

Strategy 3：Allocation
Interconnected water supply networks are built in the western corridor to enhance regional allocation capacity and support neighboring areas.



Northern Region

Unit:1,000 Tons/Day

Expand the southward diversion of water from Xindian River

① Improve water supply network in Sanchong and Luzhou areas（Phase 1 in 2028 +65, full completion in 2031 +200）

② Interconnection pipeline from Shimen Reservoir to Hsinchu（To be completed in 2028, Shimen Reservoir backup for Hsinchu +300）

Central Region

Eliminate bottlenecks in central Taiwan

③ Liyutan water transfer to Miaoli（To be completed in 2025 +120）

④ Daan-Dajia River Interconnection（To be completed in 2026 +255）

⑤ Water allocation pipeline from Taichung to Yunlin（To be completed in 2026, expected allocation Taichung-Changhua +200, Yunlin-Changhua +120）

Southern Region

Expand north-south allocation, improve water resource utilization

⑥ Interconnect Zhuoshui Main Line and North Main Line（To be completed in 2025, expected to increase utilization of Tsengwen and Wushantou Reservoirs by 11 million tons/year）

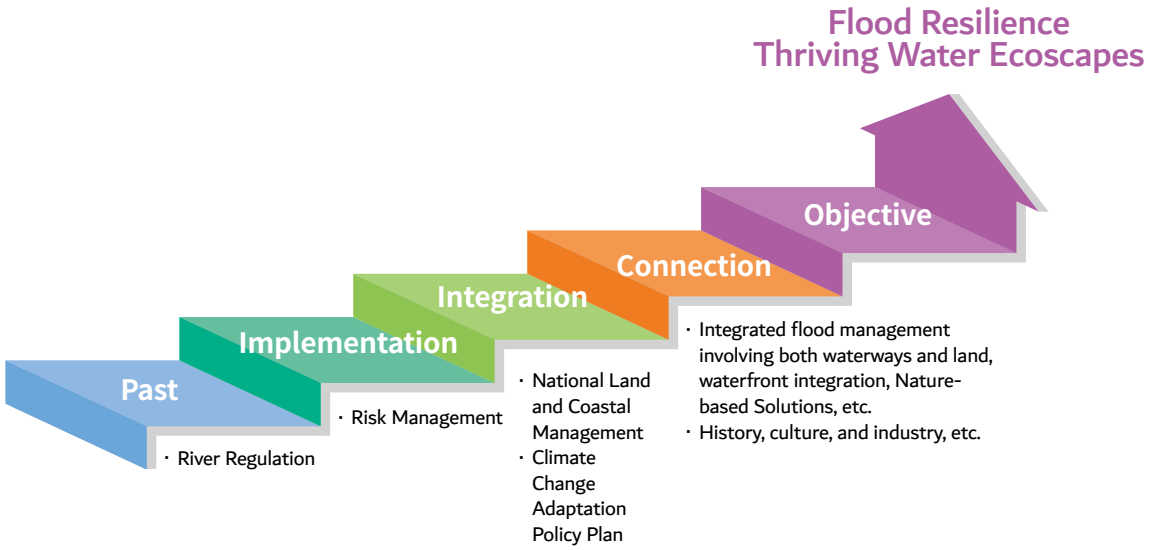
Strategy 4：Backup Systems
The construction of backup water supply systems, including subsurface water extraction and backup wells, is promoted to strengthen drought resilience.

Strategy 5：Management
Management measures such as water supply monitoring, reservoir sedimentation prevention and dredging are implemented to enhance storage capacity, watershed conservation and water source recharge, as well as to strengthen water demand management through usage planning.

Chapter 4

Improving Flood Resilience

In response to the increased frequency and intensity of heavy precipitation due to climate change, and to enhance flood adaptation capacity, we continue to evolve our river management approaches. In addition to traditional engineering methods, we are utilizing non-structural measures and digital governance, along with risk management strategies, to improve overall flood resilience.



Flood Prevention and Mitigation

Carry out improvements in rivers administered by the Central Government, regional drainage systems, levees, and drainage channels.

Central Government :

- 24 rivers administered by the Central Government, 2 inter-provincial rivers, with a management coverage rate of 90.55%
- 35 centrally-administered regional drainage systems, with a management coverage rate of 81%

Local Governments :

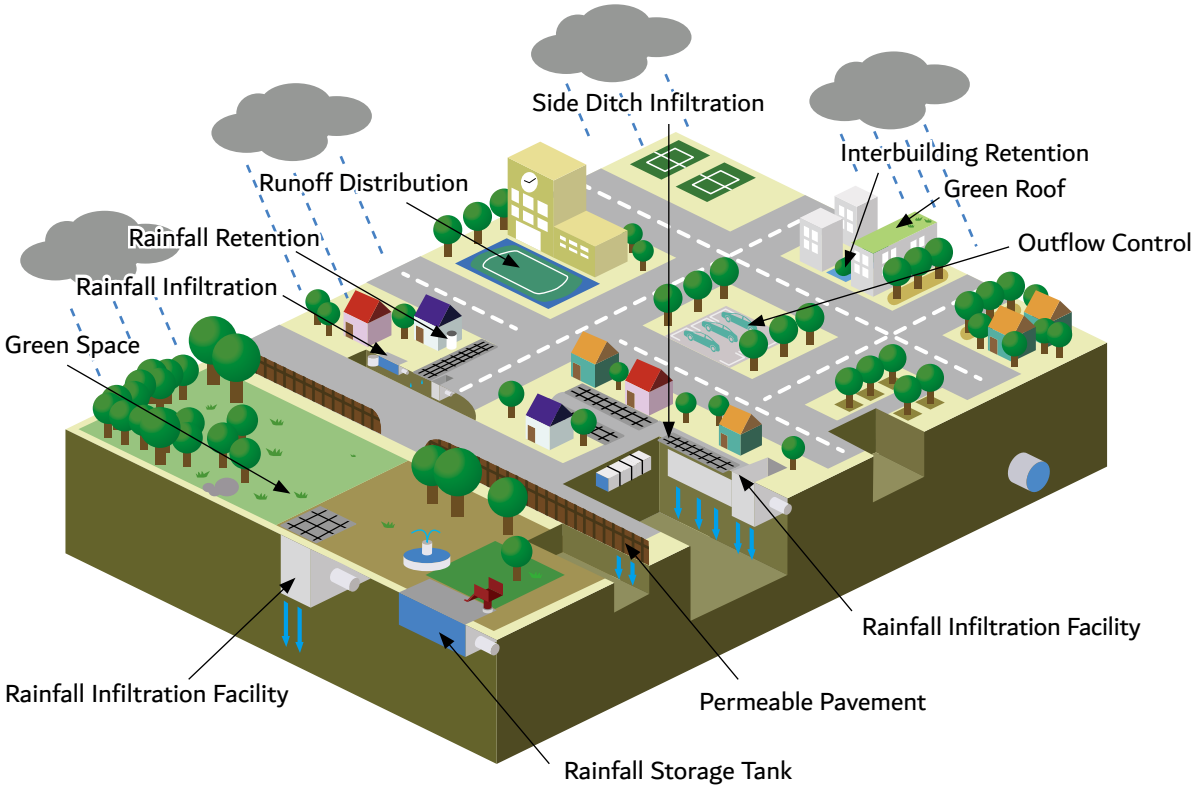
- 92 county/city-administered rivers, 1,663 county/city-administered regional drainage systems, with a management coverage rate of 42%

Note:

1. Rivers administered by the Central Government are under its jurisdiction and managed by the respective river management branches of the Water Resources Agency.
2. County/city-administered rivers are those designated by the Water Resources Agency to be under the jurisdiction of local county/city governments.
3. Data as of the end of 2023.

Runoff Distribution

By distributing precipitation runoff within the watershed through both waterways and land, the runoff burden could be shared and reduced. The enhancement of the land's flood resilience help mitigates risk as flood prevention doesn't solely rely on waterways anymore.

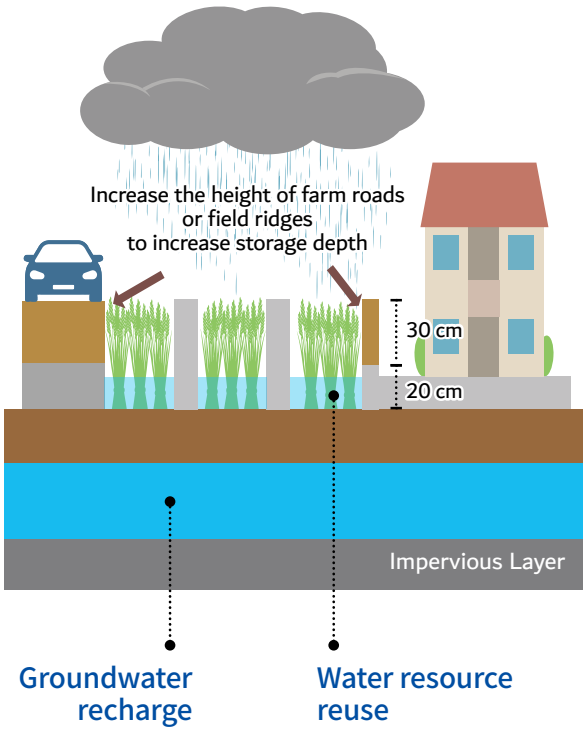


Outflow Control

The Water Resources Agency reviews development projects and regulates developers to take social responsibility by installing flood mitigation facilities on-site. This approach aims to manage flood risk collaboratively and avoid increased runoff from reduced permeable surfaces caused by land development.

In-situ Flood Detention

Raising embankments or road berms is used as a temporary flood control measure. By providing incentive and compensation, the Water Resources Agency encourages farmers to participate. Such constructions can help mitigate flood risks by retaining floodwater and reducing runoff which not only prevent flooding, but also replenish groundwater.



Asymmetric Warfare

Targeted measures are implemented to strengthen adaptation capacity in high-risk areas based on local flood risk levels. Resources are also focused on improving flood-prone areas to achieve maximum benefits.

Public-Private Disaster Prevention Collaboration

By promoting the Self-Precaution Community Against Flood Project and the flood-protection volunteer brigade, disaster losses can be mitigated through self-help and mutual assistance.

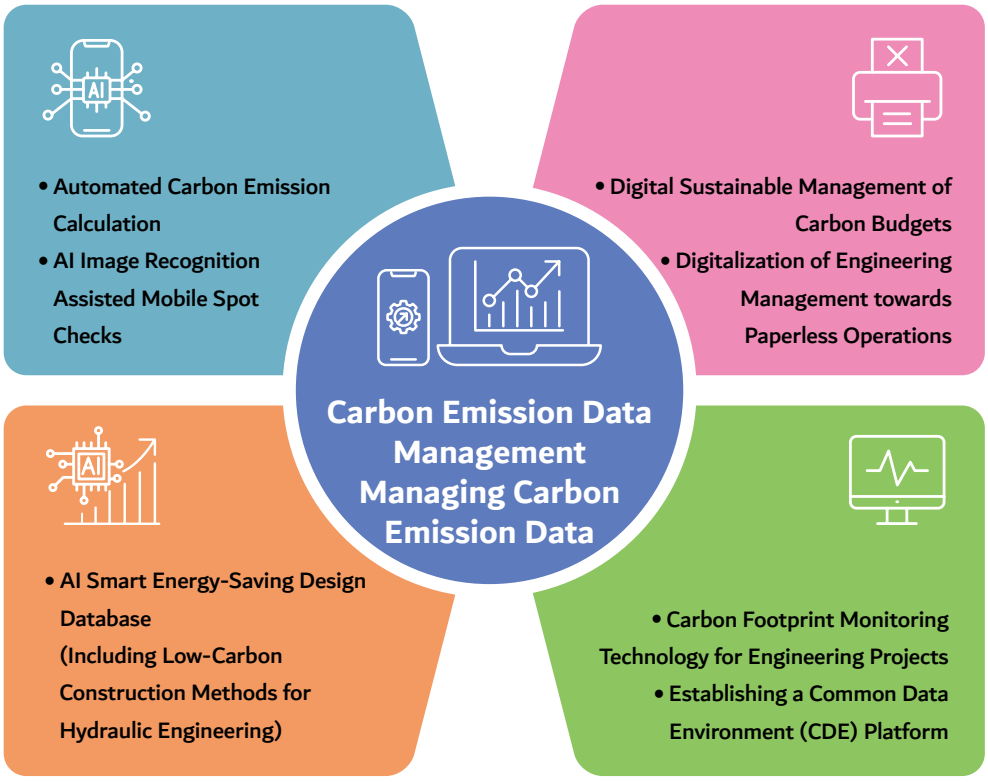
Chapter 5

Sustainable Water Future

Facing the increasingly severe extreme climate, the sustainable development of water is an important issue. In addition to the government's multi-pronged strategies, corporate ESG implementation is also needed to create a future where water and people coexist harmoniously.

Net-Zero Emissions

To achieve carbon neutrality, a smart carbon management platform is established. Its purpose is to strive for net-zero emissions across all project lifecycles, implement carbon reduction in projects, and combine tree planting for carbon sequestration.



Ecological Conservation

Through an ecological review mechanism, appropriately applying conservation measures such as avoidance, minimization, mitigation, and compensation in projects can reduce impacts on the environment and maintain a balance with ecological conservation. In addition, under flood prevention and disaster mitigation measures, adopting nature-based solutions (NbS) can maximize the effectiveness and minimize the risks of water management strategies. This not only sustains the water environment and increases biodiversity, but also enhances the land's flood resilience, bringing more benefits to the public.

Water-friendly Environment

The Water Resources Agency aims to create natural water-friendly spaces and ecological habitats that integrate water and greenery. On the premise of optimizing the water environment, ecological needs are also taken into account to restore the vitality of the waterfront, ensure the sustainability of the water environments, and attract the public to visit and relax.

Starting by removing concrete slabs from Yunlin River, the government aims to restore vibrant ecosystems and transform the area into an important site for public water recreation.

AI Applications

Using digital management of flood risk maps and inundation potential maps improves flood warning accuracy. Real-time inundation information is collected through flood sensors and cloud-based water status monitoring platforms with AI-powered image recognition. Additionally, the Water Status Mobile App and the Water Resources Agency's AI robot Diana enable disaster response personnel and the public to access disaster prevention and response information promptly and effectively.

AI is utilized to identify flood information.

Implementing ESG

In 2022, the Water Resources Agency signed an agreement with Micron Technology in Taiwan to collaborate on the dredging of Shihmen Reservoir, extending the reservoir's lifespan. In 2023, the WRA and Micron further signed an MOU to expand the scope of collaboration, focusing on the development of water resource restoration, river conservation, and coastal environment maintenance. In addition, the WRA signed a letter of intent with TSMC to initially address the windblown sand issues affecting the Zhuoshui River area. In the future, the collaboration will extend to projects such as afforestation, dust suppression, and coastal protection, with the aim of promoting flood control, water management, and water environment improvement.

International Cooperation

By actively exchanging and cooperating with countries such as the US, Japan, the Netherlands, and Germany, the Water Resources Agency expands the scope of international cooperation in water resources technology. The WRA also establishes international cooperation agreements and hires international consultants, while regularly hosting international water resources forums, inviting experts and scholars from multiple countries to participate and shape a better water future together.

International water forums are regularly hosted to promote opportunities for domestic and international exchanges.

Water management is an ancient public service,
woven through centuries.
Our goal is not to conquer nature,
but to face the severe challenge of climate,
and build a future that benefits both people
and the land for generations to come.

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