

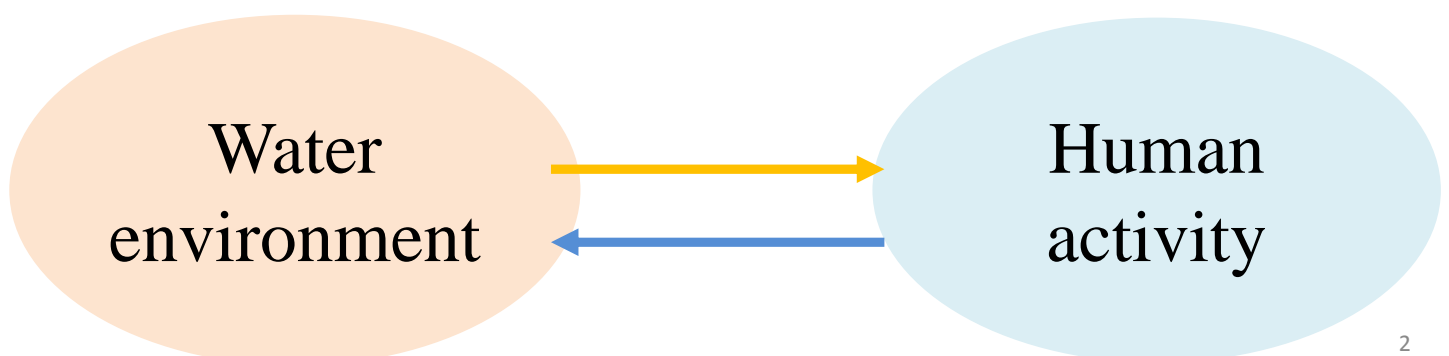
Water environment

Masaya Toyoda
Fenglan Wang
Suozhu
Chen Fang

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Lecture contents

- Water cycle
- Water use
- Water management
- Relationship between human activities and water environment



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Through this lecture

We expect that you can deepen the understanding of the following:

- What is water cycle and why it is important
- Water use and the related issues
- Importance of water management and water management strategies
- Relationship between human activities and water environment

Water Cycle

Water cycle on the Earth

- Small scale water cycle

It is a water cycle occurring in a single water area such as sea, river, lake or in a small water area of those.

Circulation in a single ecosystem

- Large scale water cycle

It is a water cycle occurring on intercontinental, oceanic, global scale etc.

Circulation across different ecosystems

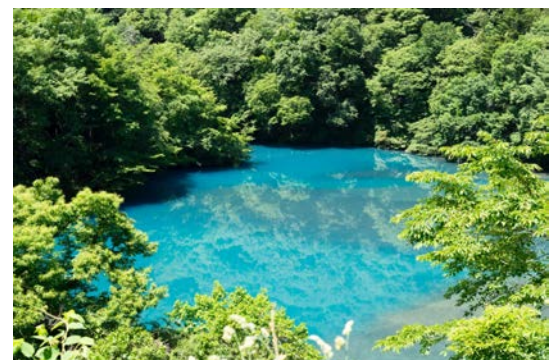
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Small scale water cycle

- Sea and River are dynamic and changing...
but water cycle is not only occurring on the surface.
- Lake looks calm ---- seems to be in a static state...
but water cycle is always occurring in the lake.

- ✓ Main factors affecting water cycle

- i. Water temperature
- ii. Rainfall
- iii. Outflow of water outside the basin
- iv. Evaporation



<http://www.kashiwaya.org/blog/wp-content/uploads/2016/06/DSC3886.jpg>

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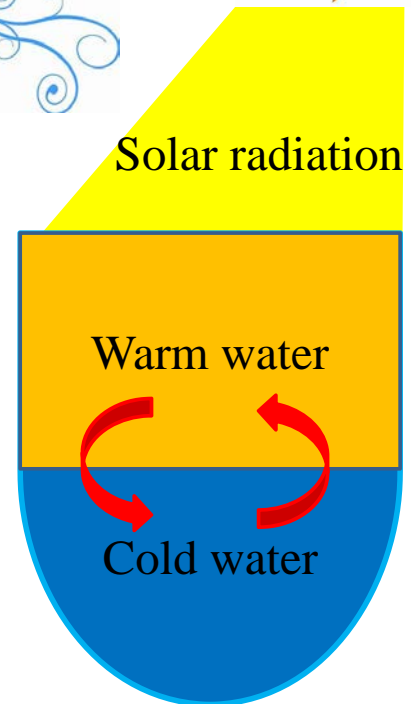
Concrete example of small scale water cycle

➤ Lake

- i. Boreal-circulation lake
- ii. Temperate lake (Two-cycle lake)
- iii. Subtropical lake (One-cycle lake)
- iv. Partial-circulation lake
- v. Tropical lake (Multi-circulation lake)

- ✓ Vertical circulation occurs in these lakes due to changes in water temperature.
- ✓ Changes in temperature are caused by solar radiation and wind blow.

Wind blow

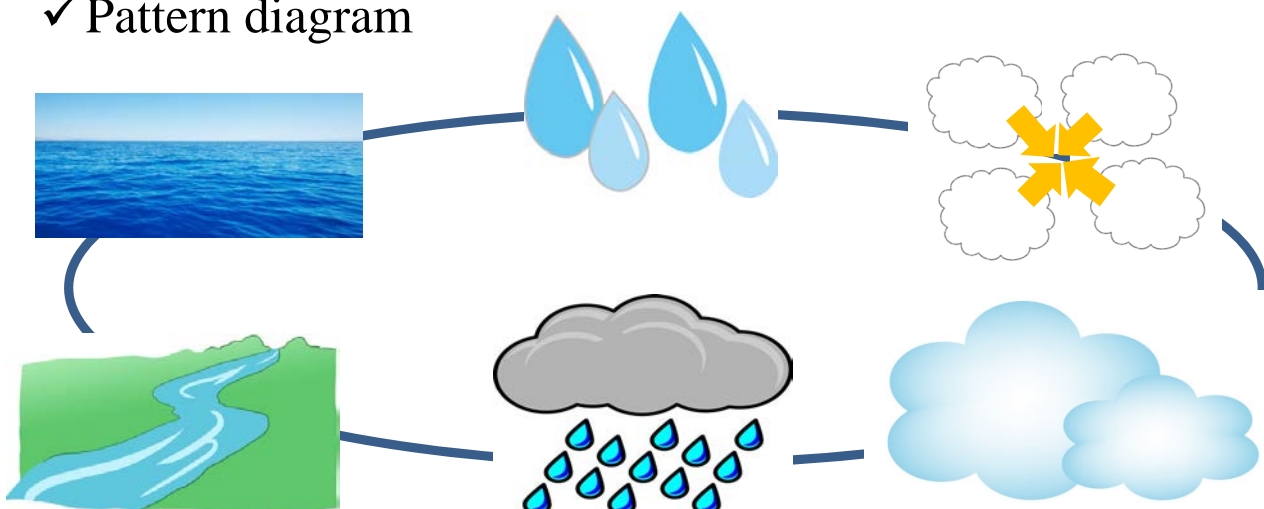


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Large scale water cycle

- It is a large-scale circulation, a global water movement.
- It is the continuous transfer of water between water bodies (mainly refers to the sea), the land and the atmosphere.

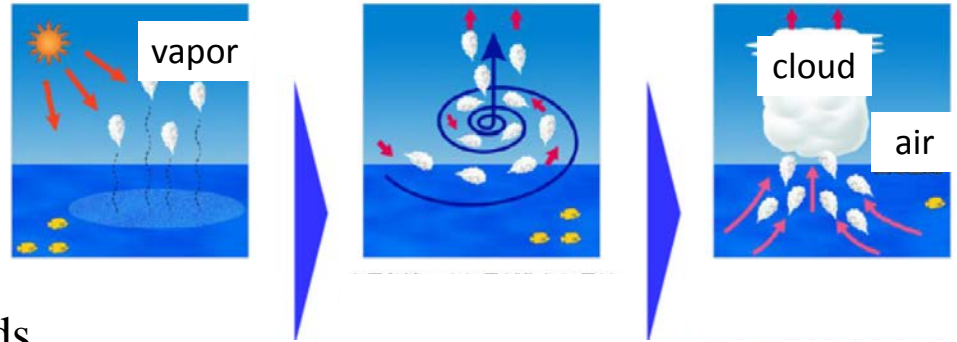
✓ Pattern diagram



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Concrete example of large scale water cycle

➤ Atmosphere



<https://news.mynavi.jp/article/20140912-a220/>

- i. A monsoon winds
- ii. Sea and land breezes
- iii. **Tropical cyclone**
- iv. Convectively mixed layer

✓ Has the effect of moving water from south to north

✓ Promote mixing of atmosphere and sea surface

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Concrete example of large scale water cycle

➤ Sea

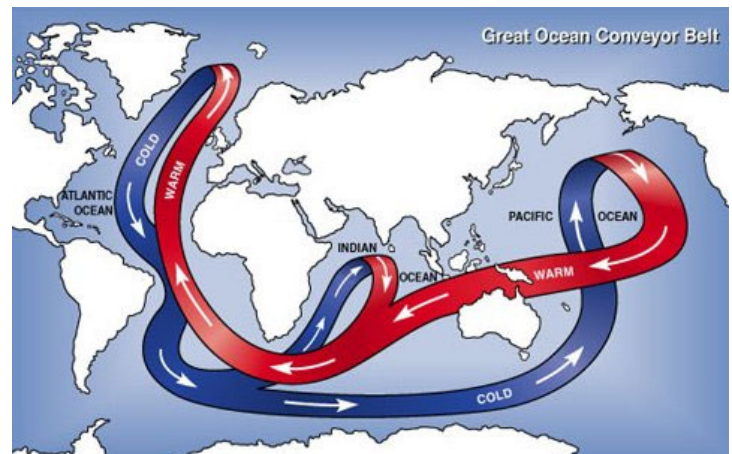
I. Surface water circulation --- “*Wind-driven circulation*”

It occurs at less than 1 km of the depth of the ocean.

The main cause is surface wind.

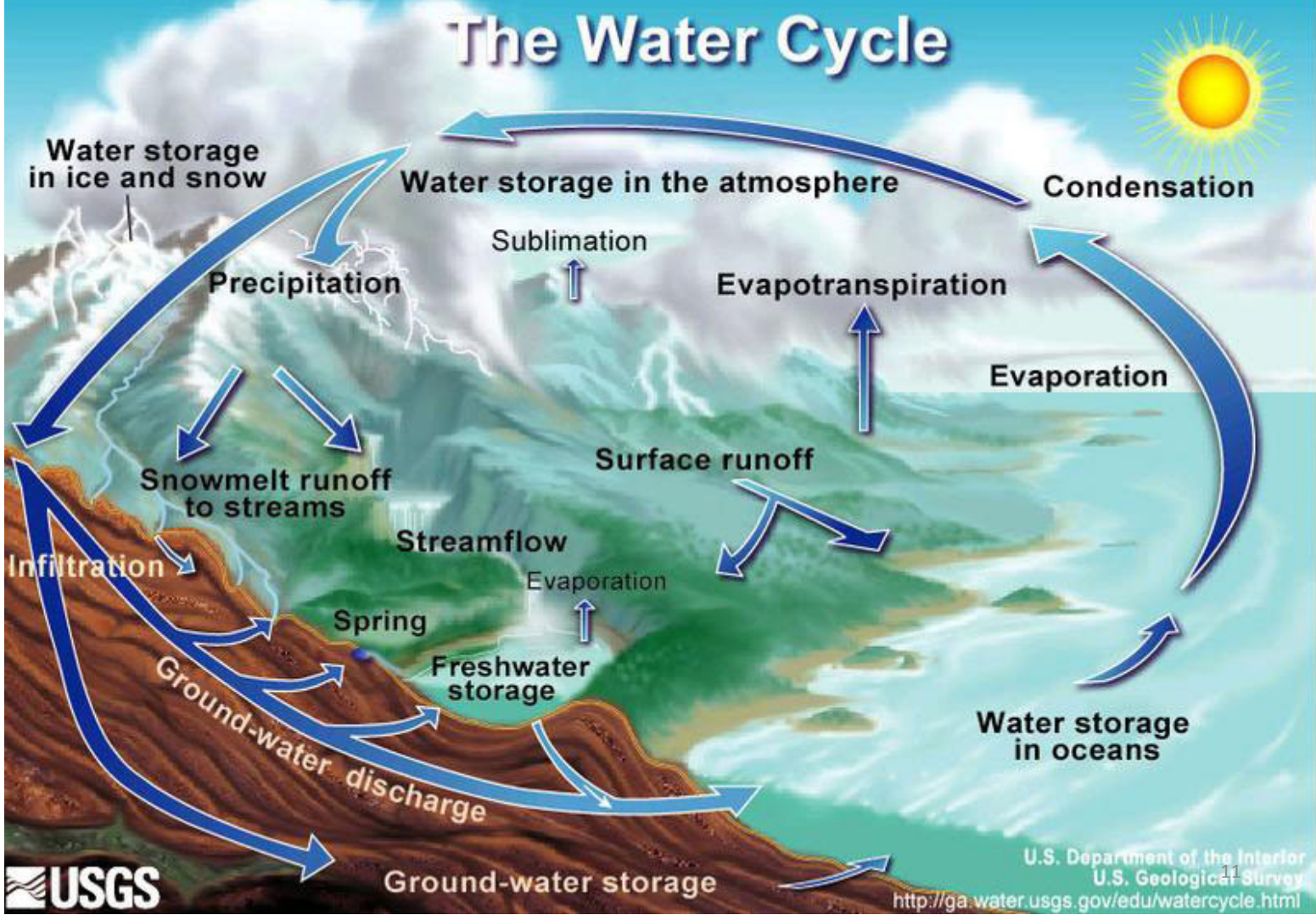
II. Deep water circulation --- “*Thermohaline circulation*”

It is phenomenon that the seawater subducted to the bottom of the sea in the high latitude region spread to the open ocean around the world.



<https://enviroliteracy.org/water/oceans/the-great-ocean-conveyor-belt/> 10

The Water Cycle



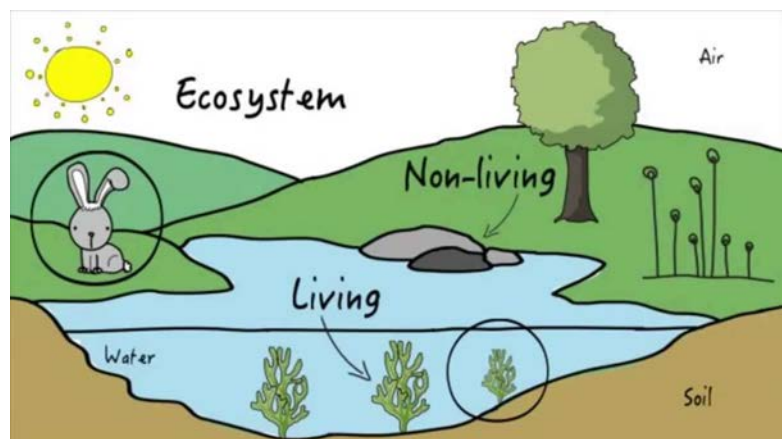
Water cycle and ecosystem

- A healthy water cycle system is a state in which the functions of water to fulfill human society's activities and conservation of the environment are secured together under an appropriate balance in the course of a series of water flow mainly in the basin.

(by Ministry of Land, Infrastructure and Transport)

- Structure of ecosystem

- I. Biotic: all living things such as animals, plants, microorganisms etc.
- II. Abiotic: all non-living things such as weather, soil, climate, atmosphere etc.



Water cycle and ecosystem

If we runoff wastewater to nature continuously...

- Pollutants come back through water cycle
- Cause deterioration of the natural environment; also interferes with human activities

- Minamata disease
- Itai-itai disease
- Acid rain
- Desertification etc.



http://www.kyoritsuwu.ac.jp/nichukou/sub/sub_gensya/Social_problem/environment_problem/global_environment_problem.htm

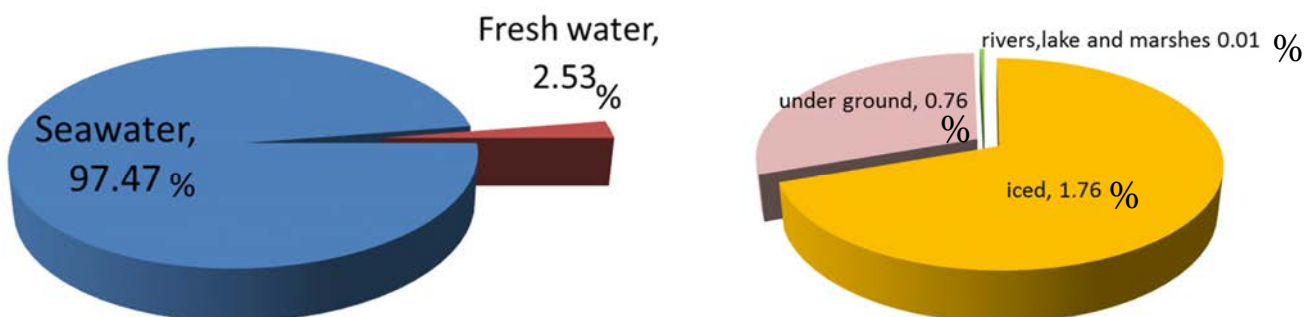
Therefore we must treat wastewater for clean water cycle

Water on the Earth

Our earth is also called “planet of the water”.

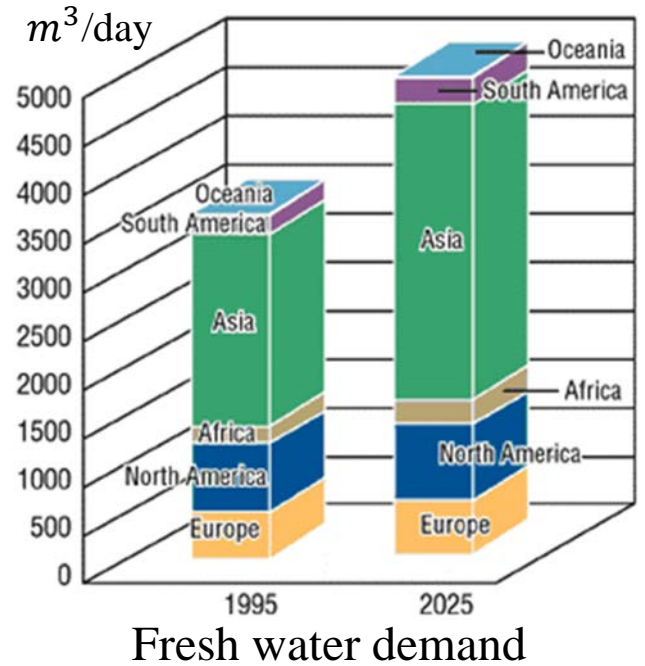
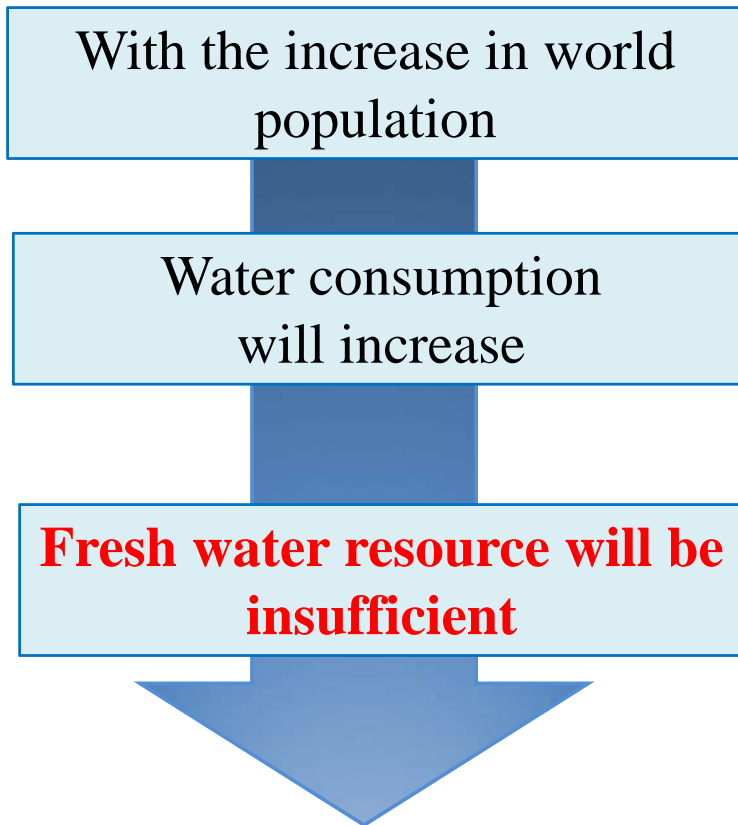
Total water : 1,351 million km^3

We can use right now : **0.1 million km^3**



We can use directly **Only 0.01%**

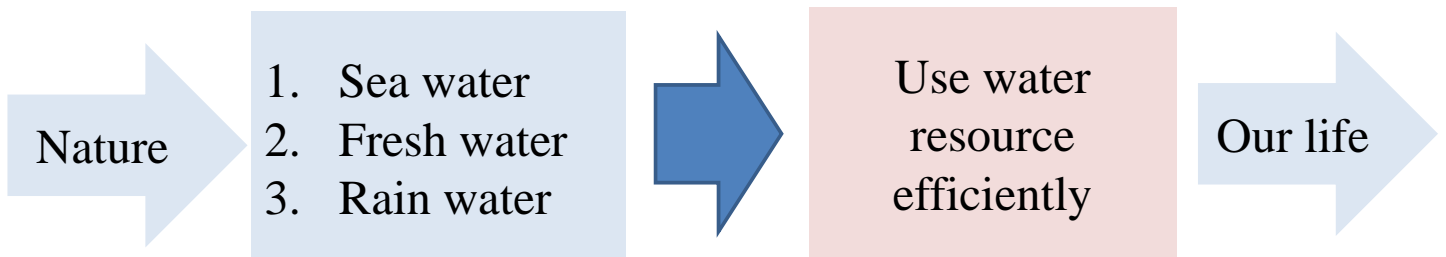
Fresh water resource



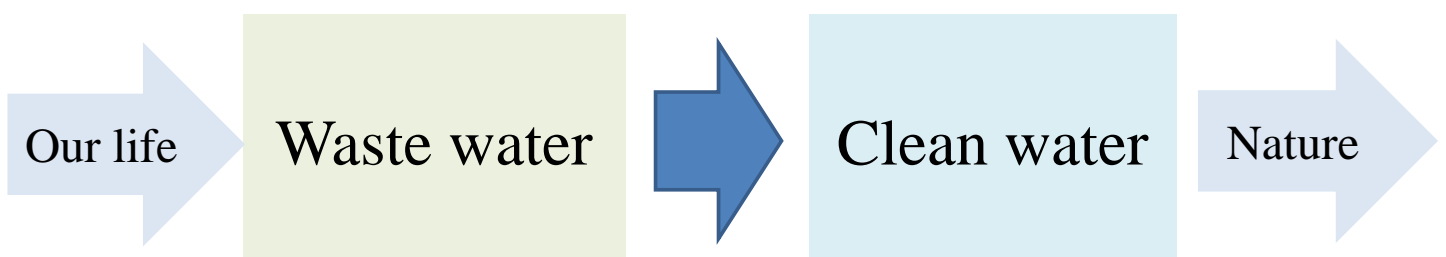
Source: Assessment of Water Availability in the World¹⁵

Water use

- We need to use water efficiently.



- We also need to manage wastewater effectively.



Brief summary of the lecture

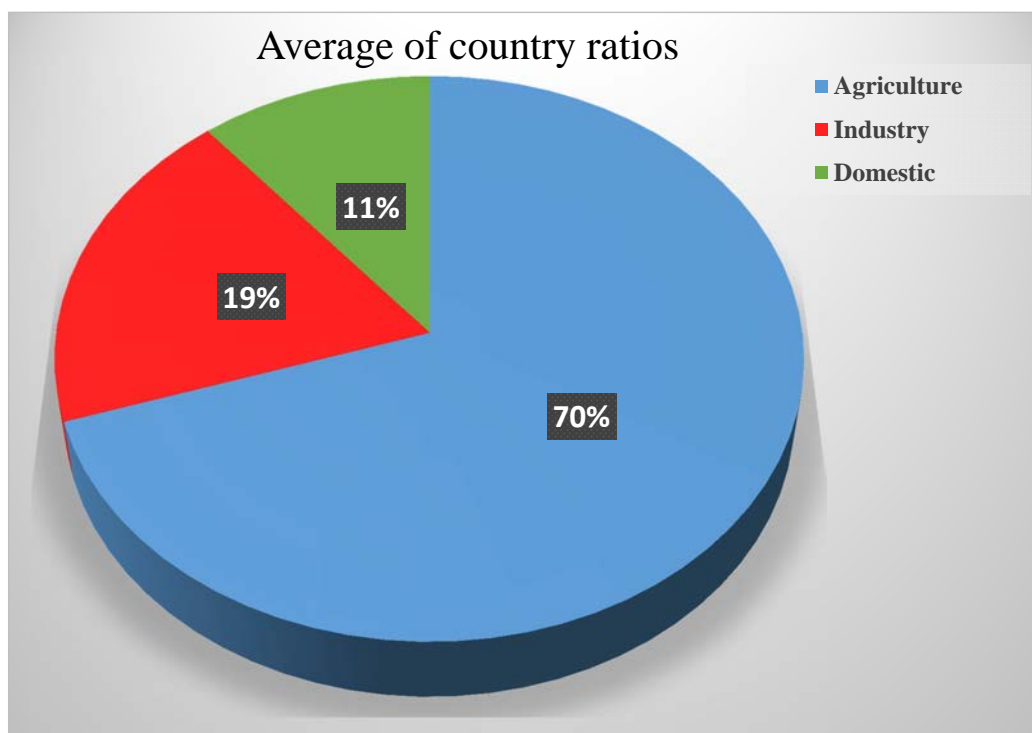
- ❑ There are different kinds of water cycles on the Earth.
 - Small scale water cycle
 - Large scale water cycle

- ❑ Water resource on the Earth is very limited, we need to use water efficiently.

- ❑ We have to use water appropriately towards a healthy water cycle.

Water Use

Water use patterns in the world



Fresh water

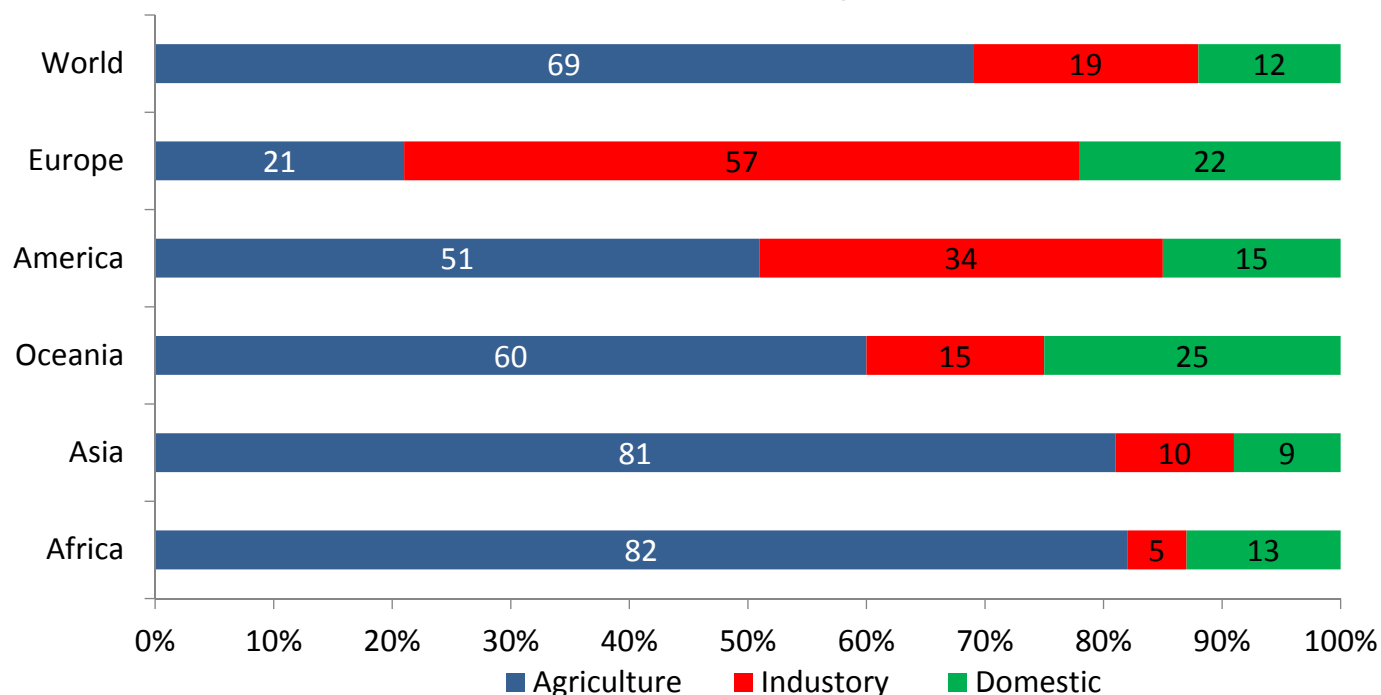
Global use of freshwater, 2016 FAO data

Includes: *surface water* (rivers and lakes), and *ground water*

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Ratio of water consumption by region

Water withdrawal ratios by continent



Date of preparation: September 2015

http://www.fao.org/nr/water/aquastat/water_use/index.stm

Agricultural water use

The water which is mainly used for irrigation to the fields or for animal breeding.

● Irrigation to the fields



Crops(rice, wheat, corn and etc.)



Vegetables



Fruits

● For animal breeding



Livestock: cows, horse, pigs, chicken and etc.



For growing grass



Washing barns

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Water consumption for food production

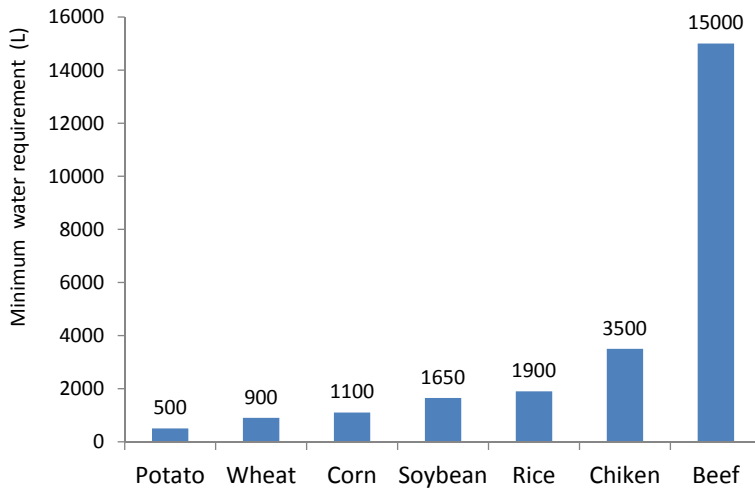
● High water consumption in food production

1. Water of 1900ℓ is necessary for growing 1kg rice. We can say rice is made by using of 1900 times water in weight.
2. Meat production also needs much water, especially for producing beef and lamb. Since animals not only drink water but also they need to eat grass which need much water to grow up.

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Water consumption for food production

Minimum water requirement for producing for 1kg food



Rice for 1 dishes 400 L
Rice production: Japan 1 person per day for 700 L

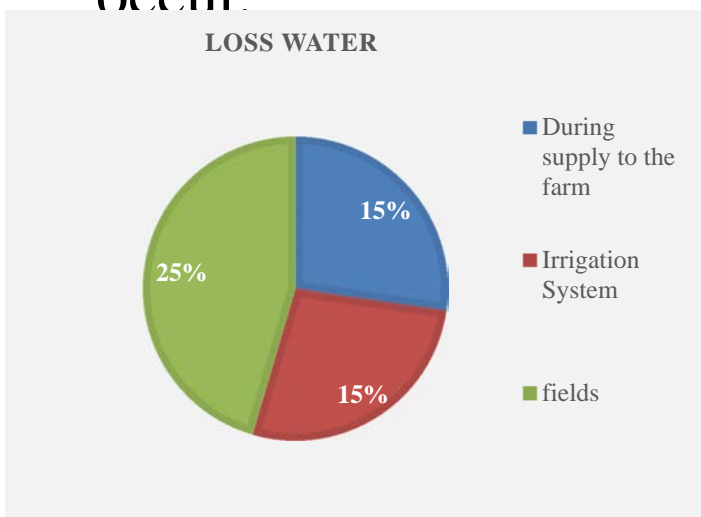
Cheese barker around 2,700 L

Japan: one person 300~350 L per day
USA: one person around 600~700 L per day

k-tai.impress.co.jp/~today_goods/19296.html

Problems of agriculture water use

- In the irrigation process, water loss will occur.



石井 優,「世界の水資源と農業管理について」

There is a little part (around 40%) of water is consumed by crops, and most of them return in water cycle.

However, the quantity of return water which is polluted by overuse of mature is increasing year by year in developing country and developed country(1960~1980).

Industrial water use

Water is essential to most industries. It is used for a variety of purposes:

- As raw materials water
 - Boiler water
 - Cooling water
 - Process water
 - Temperature control water
- and etc.

The amount of water a country needs for industrial purposes varies widely and is low in mainly rural economies.

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Industrial water use

- **Raw materials:** as a raw material in the food industry or pharmaceutical manufacturing.

Ex)

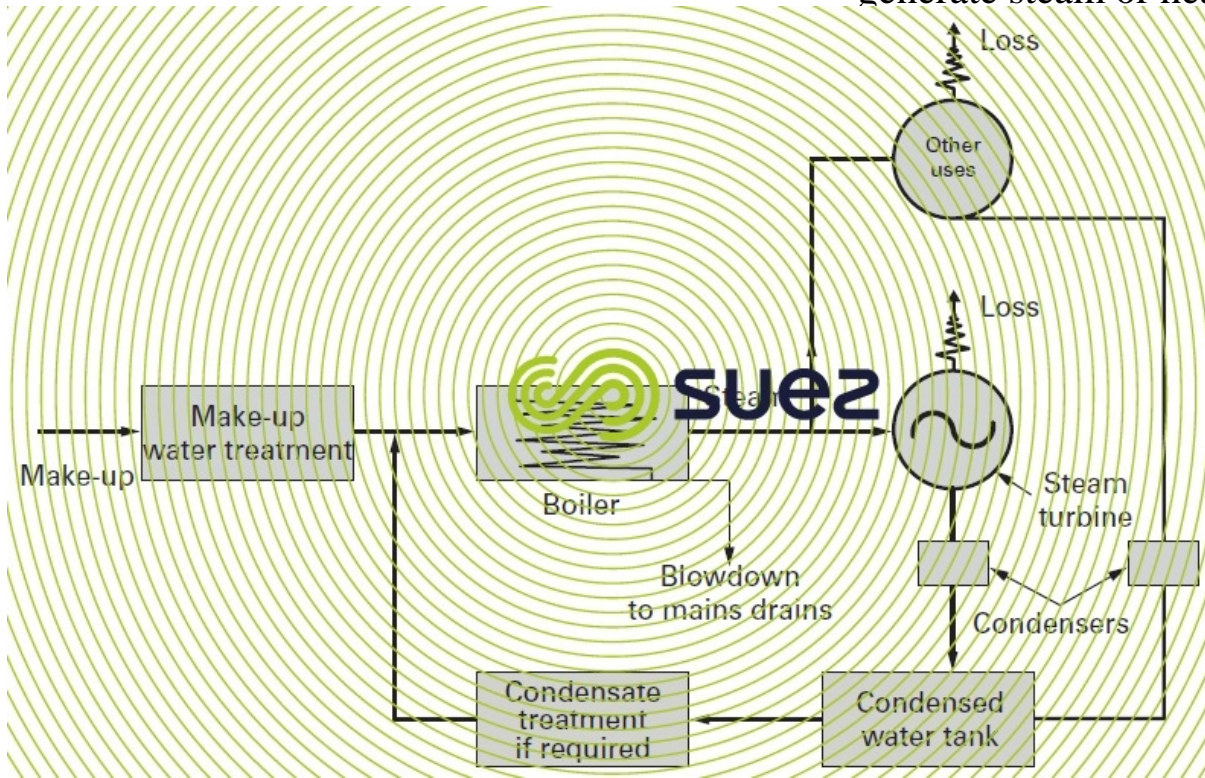
- ✓ Ice cream
- ✓ Lactic acid bacterium drink
- ✓ Soft drink
- ✓ Tofu and so on



Industrial water use

- **Boiler water**

- burning fuels
- energy transmitting to the water
- generate steam or heat



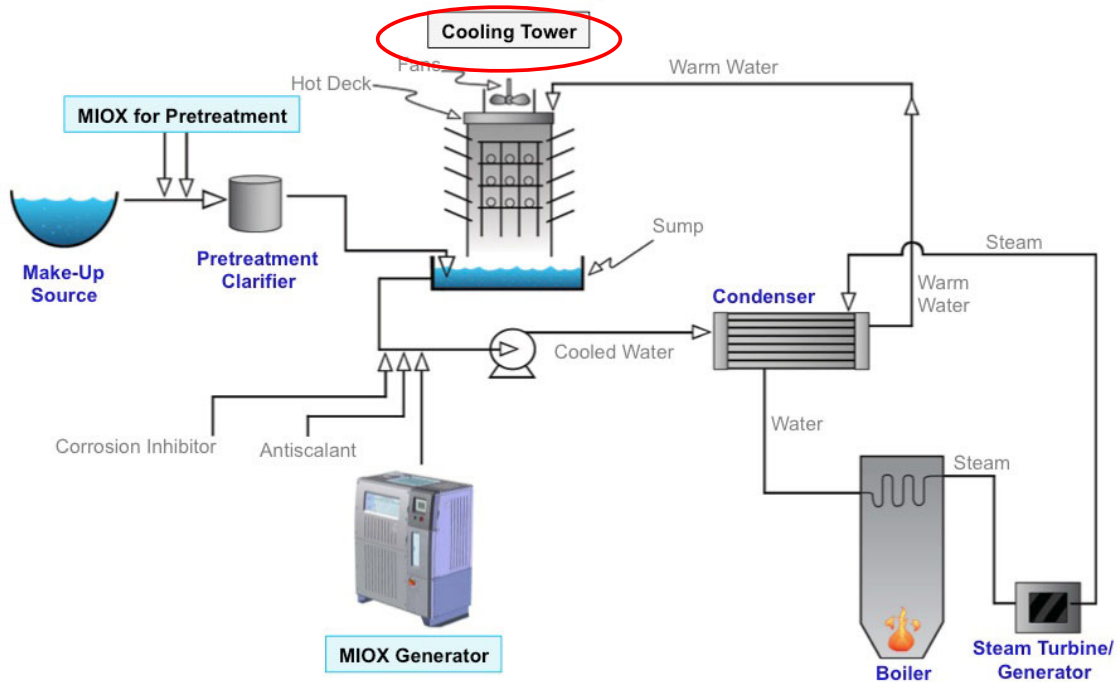
<https://www.suezwaterhandbook.com/water-and-generalities/what-water-should-we-treat-and-why/industrial-water/boiler-water>

Industrial water use

- **Cooling water:** to cool engines and other machinery and nuclear reactors

<https://kotobank.jp/word/冷却水-687801>

Process Train for Cooling Water Treatment

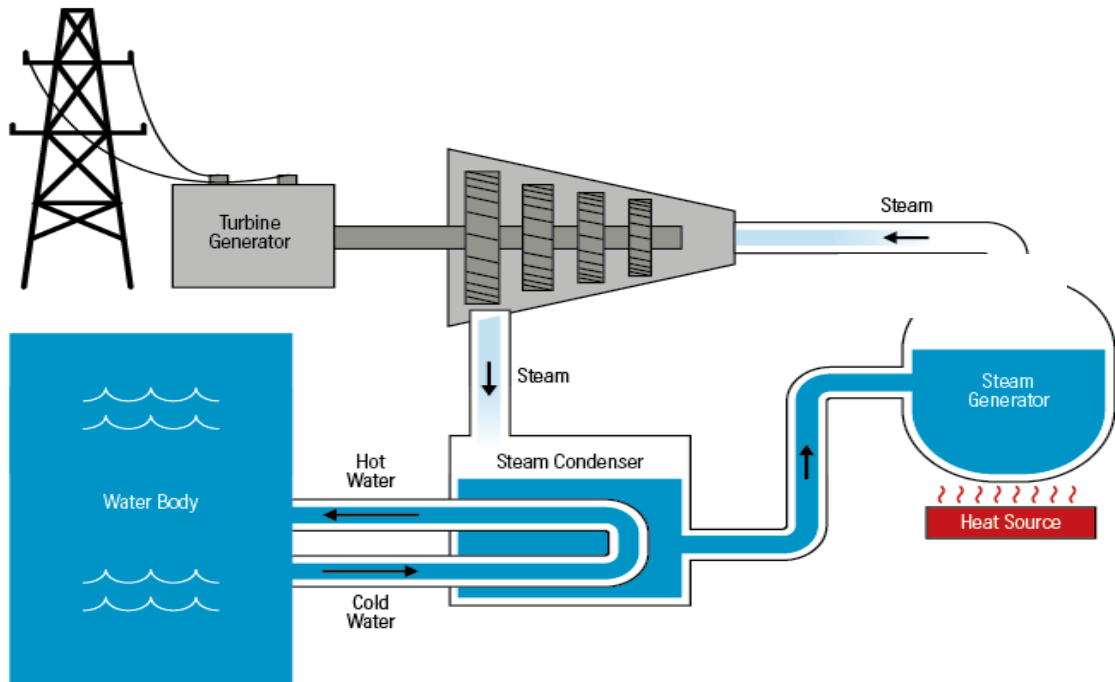


<https://search.yahoo.co.jp/image/search?rkf=2&ei=UTF-8&gdr=1&p=cooling+water+in+industry+for+generation#mode%3Ddetail%26index%3D0%26st%3D0>

Industrial water use

- **Cooling water**

Thermal Power Plant: Once-Through Cooling



Source: Williams E. D. and Simmons J. E., BP (2013):
Water in the energy industry. An introduction.
www.bp.com/energysustainabilitychallenge

 WORLD RESOURCES INSTITUTE

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http://wriorg.s3.amazonaws.com/s3fs-public/uploads/2017_Blog-Water-Generation-01.png

Industrial water use

- **Process water** : water used in different process such as coating and plating; rinsing and spraying; washing and etc.

https://en.wikipedia.org/wiki/Industrial_water_treatment



<http://www.chemtronicsindia.com/images/ozone-flume-wash.jpg>

https://search.yahoo.co.jp/image/search;_ylt=A2RimVsHrU9bL2gATBmU3uV7?p=washing+water+in+industry&aq=-1&oq=&ei=UTF-8#mode%3Ddetail%26index%3D18%26st%3D586.6666870117188

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Industrial water use

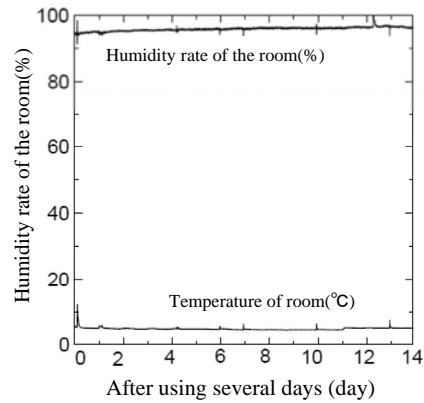
- **Control temperature water:**

- Among industrial water, water used for adjusting the temperature or humidity the factory inside.

Low temperature
humidity



<https://www.webshiro.com/syuhinsetumei2/M812TC-Z02A-SK.html>



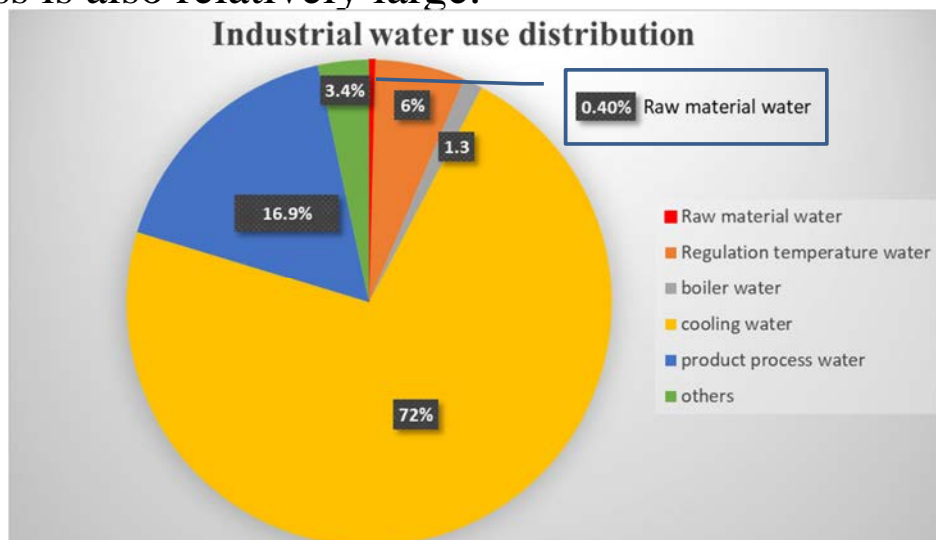
<https://astamuse.com/ja/published/IP/No/2015175553>

This is the machine which is used for regulating of temperature and humidity of the storage room in which food products will be stored. In recent years, from the viewpoint of providing safe and fresh foods, there is a demand for sophistication of techniques for maintaining the freshness of food products.

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Industrial water use

Approximately 20% of fresh water is used for industry. **Half or more of this** are used for hydraulic power generation and cooling at thermal power stations. Then water use for product process is also relatively large.



Ministry of Economy, Trade and Industry in Japan , 1997

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Industrial water use

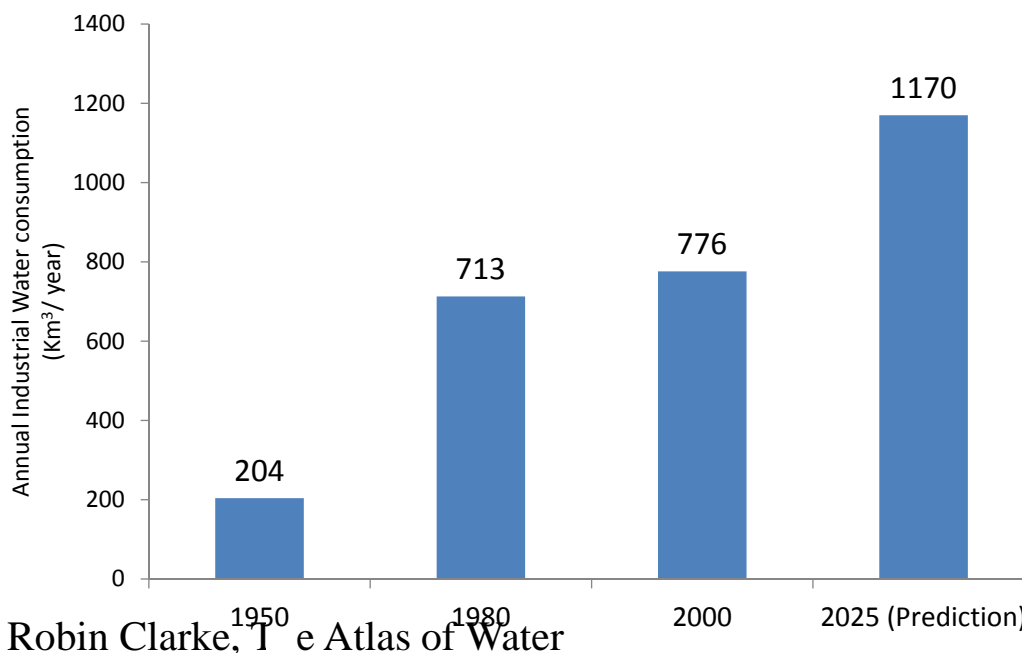
Water type industries: such as

- chemistry and oil plants
- metal industry
- wood, pulp, paper manufacture industry
- the food industry
- the machine manufacturing and etc.

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Industrial water consumption in the world

Annual Industrial Water consumption in the World



Industrial water consumption have been increasing it because emergence of industrialized countries.

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Problems of water use in industry

- Water leakage occurs because of aging facilities.

In many industrial waterways that were developed during the period of high economic growth, water leakage increased due to the deterioration of facilities (in Japan).



http://www.meti.go.jp/committee/sankoushin/chiikikeizai/kougyou_suidou/pdf/007_02_00.pdf#search=%27%E5%B7%A5%E6%A5%AD%E7%94%A8%E6%B0%B4%E5%95%8F%E9%A1%8C%E7%82%B9%27

- Problems of water treatment in developing countries.

Water pollution caused by factories and industries can be the most serious problem the lack of technology in water treatment is apparent in manufacturing in developing countries. Long term pollution and health hazards are common in industrial areas in developing countries.

Domestic water use

Domestic water classified as:

Home water:

Cooking ;Washing ;Bathing; Cleaning ;Flushing lavatory

City activity water:

- Hotel
- Restaurant
- department store
- Supermarket
- the public bath
- air-conditioning
- fire extinguishing water
- the maintenance water of the park
- road sprinkling water
- the cleaning of the sewage pipe.

Current situation of domestic water use

- In general 1 person basically need **61.5L** water a day (11.5L for drinking and sanitation+50L for bathing, cooking and sanitary purpose).
- However, in developed countries (although there are differences depending on region and climate), water for daily use of more than **200 liters** per day is used, about 30% of which is water for flushing in the toilet .
- In the past 50 years, the amount of water use increased by about 2.6 times, but if only focused on water for daily life, it increased by about **6.7** times.
- Water consumption in people's daily life increased with the increasing of life quality.

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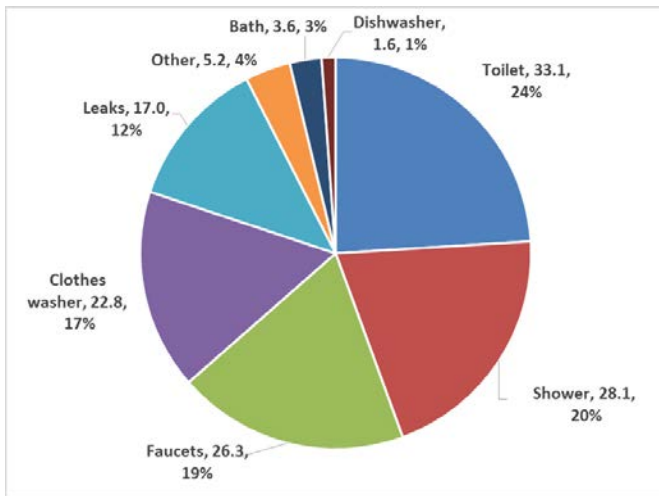
Current situation of domestic water use

- Water consumption in daily life in developed countries is much higher than that in developing countries.
- Water consumption per capita varies around the world. For example,
in American: needs in average 400 liters per day,
in western European: 150 liters
in Africa: only 50 liters per day
- In rural areas people uses less water than in urban areas.

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Current situation of domestic water use

Domestic water use in USA

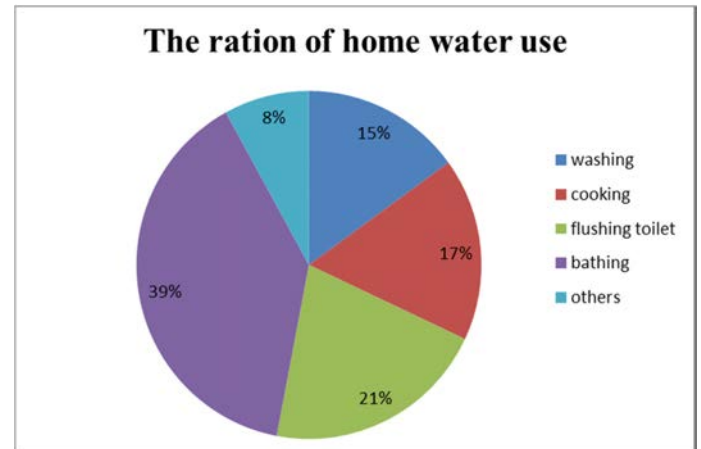


End uses of water for households in the U.S. in gallons per household per day and percent of indoor use.

About 89 gallons (337 liters) per person per day in 2010 and 83 gallons (314 liters) in 2015 were consumed in USA.

https://en.wikipedia.org/wiki/Residential_water_use_in_the_U.S._and_Canada

Domestic water use in Japan



The Tokyo Waterworks Bureau, 2012, Japan

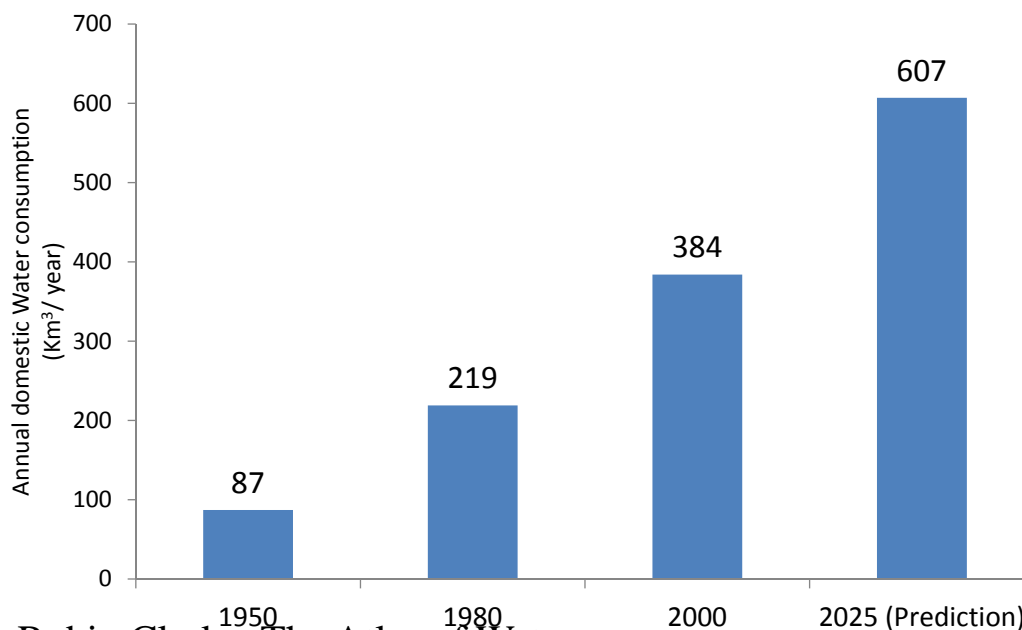
In Japan, average 307L water in 2005 and 297L water in 2010 of daily water were consumed by per day for per person.

http://www.mlit.go.jp/mizukokudo/mizsei/mizukokudo_mizsei_tk2_000014.html

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Domestic water consumption in the world

Annual domestic water consumption in the world



Robin Clarke, The Atlas of Water

Domestic water consumption is increasing year by year. It because an increase in the amount of water used for living by improving living standards in developing countries.

Domestic water use related problems

- **Water quality** of domestic water is a big problem in developing countries.
- **Disease occurs:** many people especially children bear diseases of poor water supply and sanitation, for example diarrheal disease occurs due to unsafe water, it reaches 1.73 million deaths each year.
- **Other diseases** are related to poor water, sanitation and hygiene such as trachoma, schistosomiasis, ascariasis, trichuriasis, hookworm disease, malaria and Japanese encephalitis.
- **Lack of technology** (sewerage systems or purification systems)

more than 1 billion people can not easily use reliable water (pollution and pathogen free water, clean water) until 2000, and 2.3 billion people are suffering from diseases related to water (unreliable water). Many of them are living in developing countries that do not have sufficient water supply and sewerage systems, water purification plants, etc. and no money to buy clean water.

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Summary

- Water is used by three main patterns: for agriculture, for industry and for domestic.
- Agricultural water consumption is largest, and food production consume large water quantity, loss water also occur during the irrigation process
- How the industry water to be used in industry and its problems.
- Consumption of domestic water quantity is difference between developing countries and developed country, and its problems.

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References

https://search.yahoo.co.jp/image/search;_ylt=A2RCA90cy0JbVV8A7w.U3uV7?p=irrigation+for+rice+field&aq=-1&oq=&ei=UTF-8#mode%3Ddetail%26index%3D19%26st%3D480

https://search.yahoo.co.jp/image/search;_ylt=A2RCL5P2y0JbP1gAKQ.U3uV7?p=irrigation+for+fruits+and+flowers+picture&aq=-1&oq=&ei=UTF-8#mode%3Ddetail%26index%3D3%26st%3D192

<https://search.yahoo.co.jp/image/search?rkf=2&ei=UTF-8&gdr=1&p=irrigation+for+vegetables+picture#mode%3Ddetail%26index%3D0%26st%3D0>

https://search.yahoo.co.jp/image/search;_ylt=A2RCL6LDzkJbTgkAlAiU3uV7?p=agricultural+water+for+cows&aq=-1&oq=&ei=UTF-8#mode%3Ddetail%26index%3D18%26st%3D576

https://search.yahoo.co.jp/image/search;_ylt=A2RCL6K00EJbzBwAOxmU3uV7?p=washing+cattle+shed&aq=-1&oq=&ei=UTF-8#mode%3Ddetail%26index%3D5%26st%3D384

https://search.yahoo.co.jp/image/search;_ylt=A2RCL7BYz0Jb0AcAAzGU3uV7?p=irrigation++for+grass+of+breeding+animals&aq=-1&oq=&ei=UTF-8#mode%3Ddetail%26index%3D55%26st%3D2112

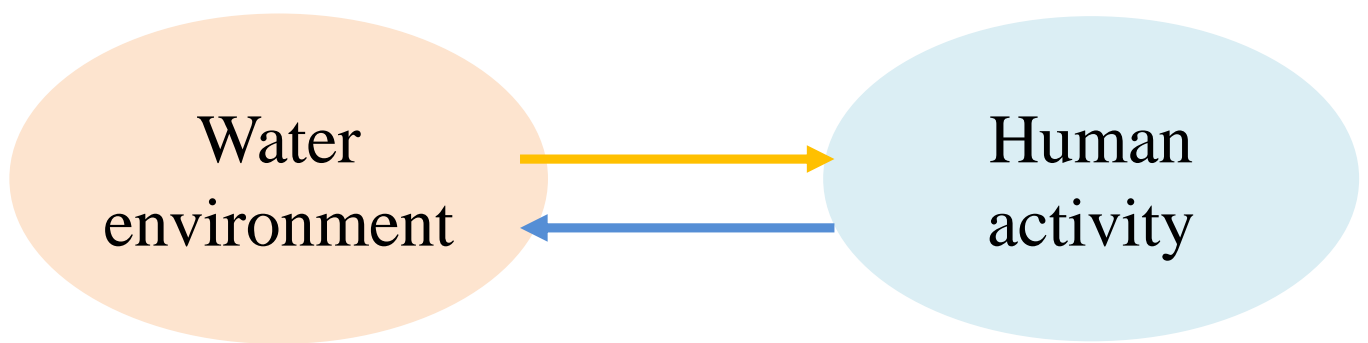


Water environment

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Lecture contents

- Water cycle
- Water use
- Water management
- Relationship between human activities and water environment

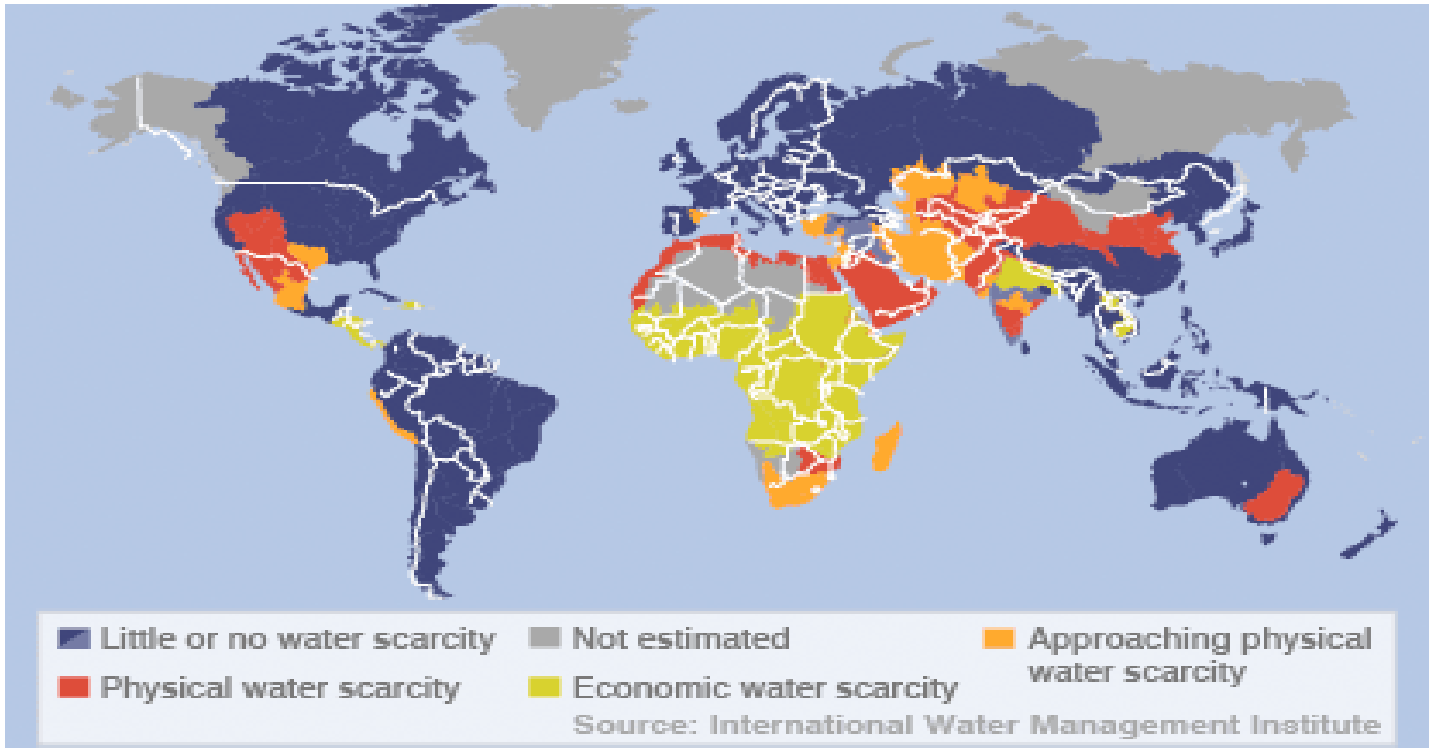


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Water management

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Water scarcity



https://en.wikipedia.org/wiki/Water_scarcity

Over exploitation of groundwater

- Land subsidence
- Sandstorm
- Saltwater



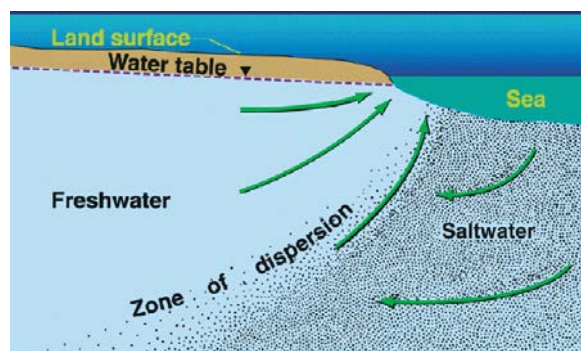
https://www.google.co.jp/search?q=sandstorm&tbm=isch&source=lnms&sa=X&ved=0ahUKEwjzicT24tncAhULgrwKHZXBDSgQ_AUIDygA&biw=1920&bih=934&dpr=1#imgrc=IDbgJr5r-wQwfM:&spf=1533604762605

sandstorm



https://www.google.co.jp/search?q=land+subsidence&tbm=isch&source=lnms&sa=X&ved=0ahUKEwjhwOfH49ncAHVGVbwKHUZYA9sQ_AUICigB&biw=1920&bih=934&dpr=1#imgrc=8jfnVM5YndRt7M:&spf=1533604934990

Land subsidence



https://www.google.co.jp/search?q=saltwater&tbm=isch&source=lnms&sa=X&ved=0ahUKEwj58bOV5NncAhUFE7wKHx12BxMQ_AUICigB&biw=1920&bih=934&dpr=1#imgrc=cUcamnm6HKcNIM:&spf=1533605095774

Saltwater

Water pollution



https://www.bing.com/images/search?view=detailV2&ccid=MRWzSHor&id=CE803F992A3D855430B2922AD68D67D8FC149136&thid=OIP.MRWzSHorNL5rd6QZsA1XwHaDb&mediarurl=http%3a%2f%2fearthuntouched.com%2fwfp-content%2fuploads%2f2014%2f08%2fwater-pollution-is-a-worldwide-problem-1728x800_c.jpg&exph=800&expw=1728&q=water+pollution&simid=608054976571836593&selectedIndex=20&ajaxhist=0

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Water management

- Water management is the activity of planning, developing, distributing and optimum use of water resources under defined water polices and regulations.
- It is the control and movement of water resources to minimize damage to life and property and to maximize efficient beneficial use.

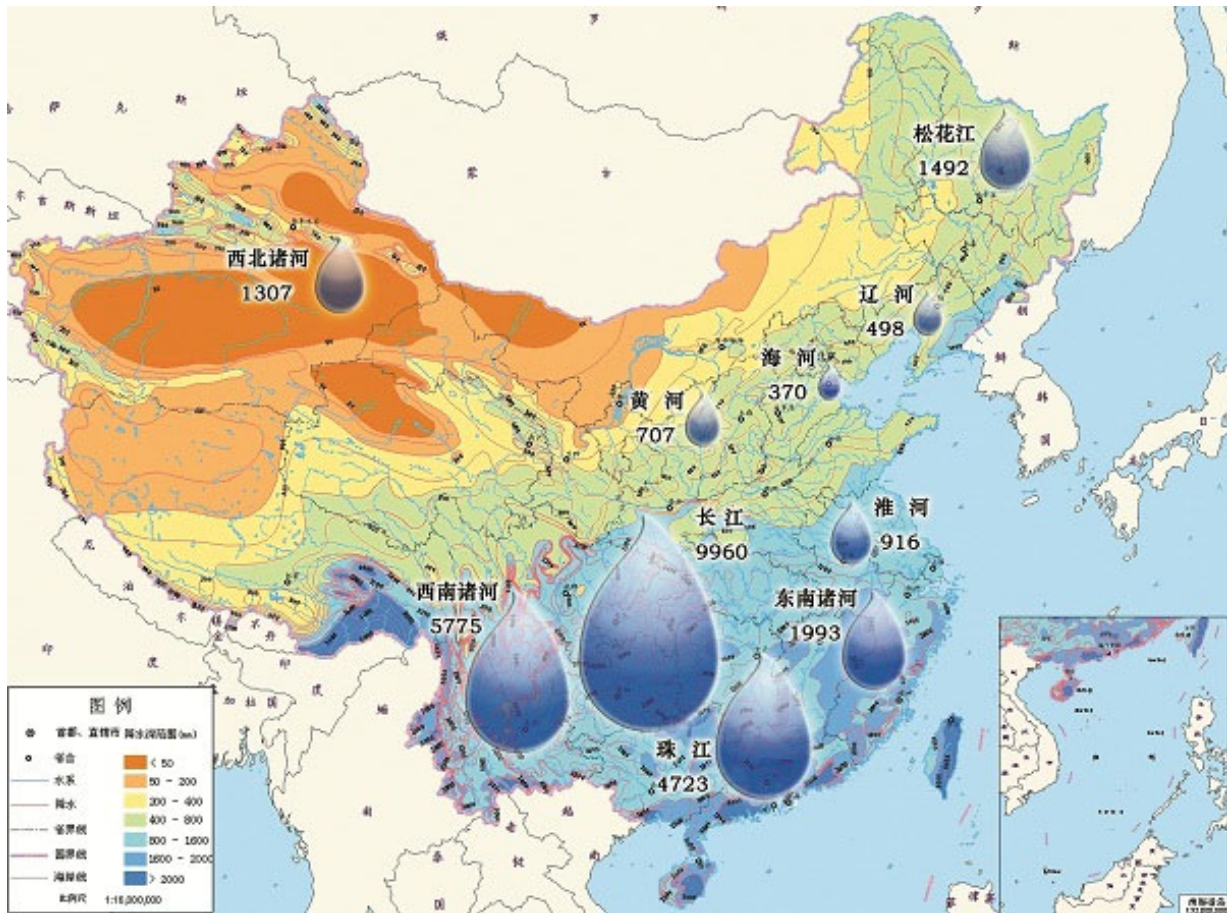
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Types of water management

- Management of water treatment
(drinking water, industrial water, sewage or wastewater)
- Management of water resources
- Management of flood protection
- Management of the water table
- Management of irrigation

South-to-north Water Diversion Project in China

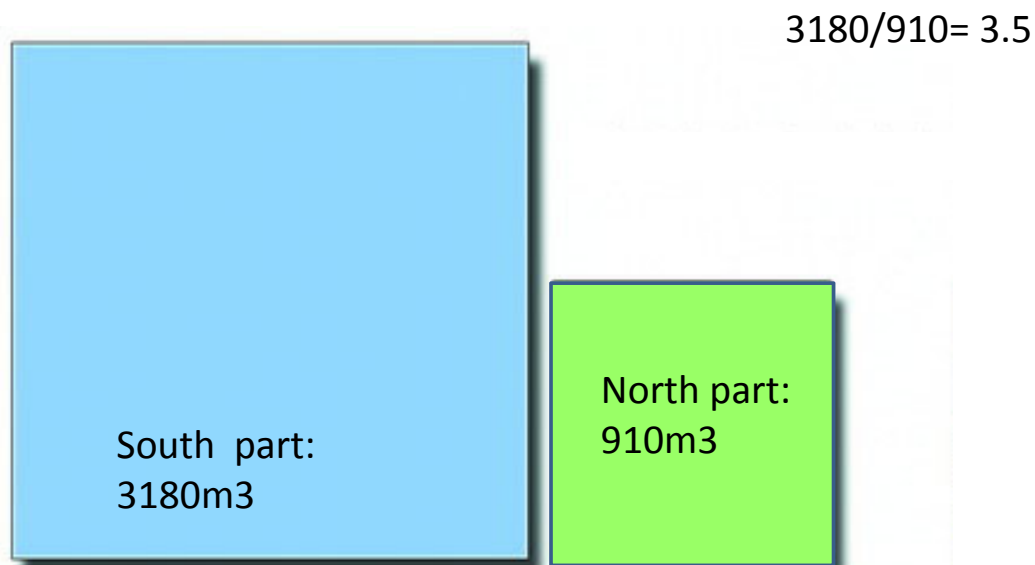
Water distribution in China



<http://www.iwhr.com/zgskyww/ztbd/nsbd/dybf/webinfo/2013/03/1360423714906319.htm>

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Per capita water use in China



<http://www.iwhr.com/zgskyww/ztbd/nsbd/dybf/webinfo/2013/03/1360423714906319.htm>

- 60% of the water used by people in the North China Plain comes from ground water.
- Scientists estimate the aquifers beneath the North China Plain will dry up in 30 years.

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**DECREE OF THE PRESIDENT OF THE
PEOPLE'S REPUBLIC OF CHINA
ORDER NO. 61**

**“Water Law of the People’s Republic of China”
was adopted at the Twenty Fourth Meeting of the Stand-
ing Committee of the Sixth National People’s Congress
on January 21, 1988, and is hereby made public and
effective as of July 1, 1988.**

Li Xiannian

**President of the People’s Republic of China
January, 21, 1988**

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**Chapter I
General Provisions**

Article 1: This law is formulated for the purposes of rational development, utilization and protection of water resources, control of water disasters, fully deriving the comprehensive benefits of water resources and meeting the needs of national economic development and the livelihood of the people.

Article 2: For the purpose of this law, “water resources” means surface water and groundwater. This law must be observed in developing, utilizing, protecting and managing water resources and in controlling water disasters within the territory of the People’s Republic of China.

Provisions for developing, utilizing, protecting and managing sea water shall be stipulated separately.

Article 3: Water resources are owned by the State, that is, owned by the whole people.

The waters in ponds and reservoirs possessed by agricultural collective economic organizations are collec-

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South-to-north Water Diversion Project



m.sdmy168.com/index/6ZW%2F5rGf5L2N572u.html

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Yangtze River: main water resource



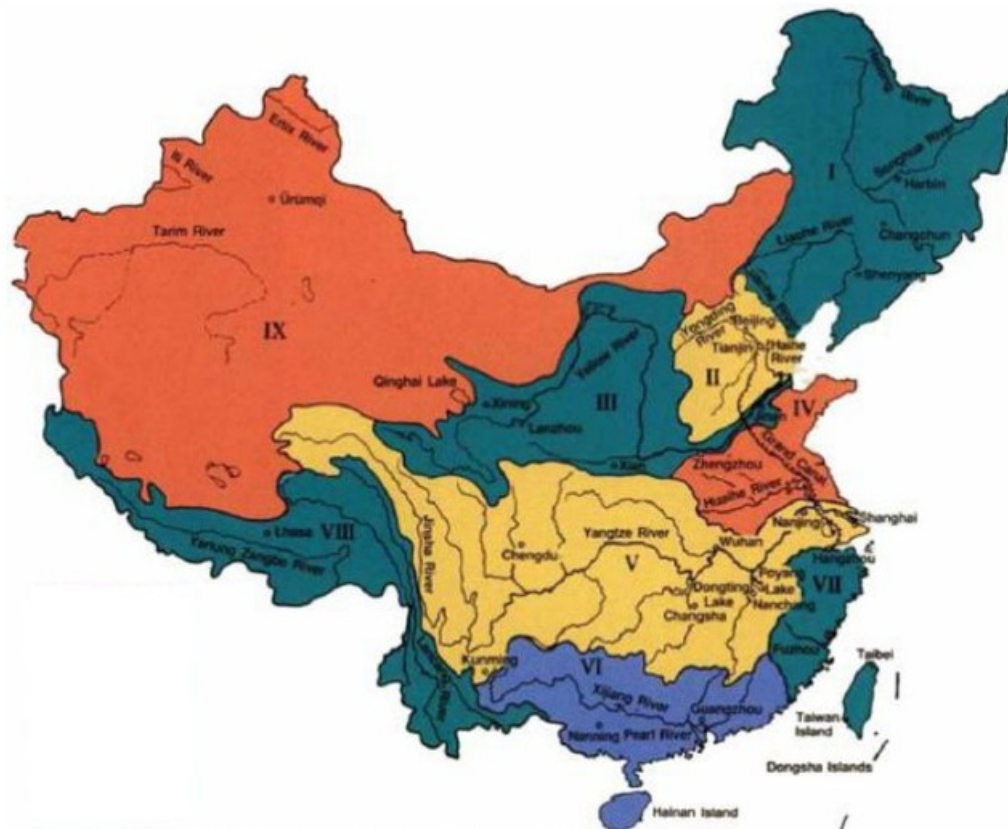
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Yangtze River: main water resource



- 3rd longest river in the world, the longest in Asia.
- It flows from the glaciers on the Qinghai-Tibet Plateau in Qinghai eastward across southwest, central and eastern China before emptying into the East China Sea at Shanghai.
- Average discharge is 30,166m³/s. (max discharge 110,000m³/s, mini discharge is 2,000m³/s)

59

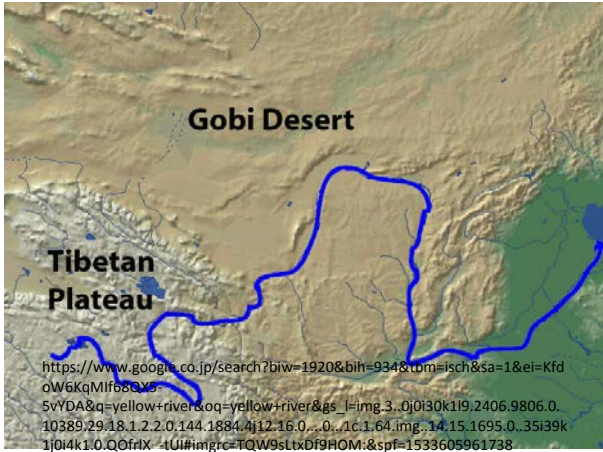


I	Songhua-Liao River Basin	VI	Pearl River Basin
II	Hai-Luan River Basin	VII	Southeast River Basin
III	Yellow River Basin	VIII	Southwest River Basin
IV	Huai River Basin	IX	Northwest River Basin
V	Yangtze River Basin		

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60

The Yellow River



- 6th Longest River in the world and the 2nd longest river in Asia.
- It is the largest source of surface water for northern China. It is called the Huang He by the Chinese.
- Average discharge is 2,571m³/s (max discharge is 58,000 m³/s, mini discharge is 1030 m³/s)



The Yellow River

Stream cease:
frequently occurred

https://search.yahoo.co.jp/image/search?p=%E9%BB%84%E6%B2%B3+%E6%96%AD%E6%B5%81&aq=3&oeq=%E9%BB%84%E6%B2%B3+&at=s&ai=DvtUSD3vQ9iQMGY_mQhH8A&ts=6813&ei=UTF-8&fr=top_ga1_sa



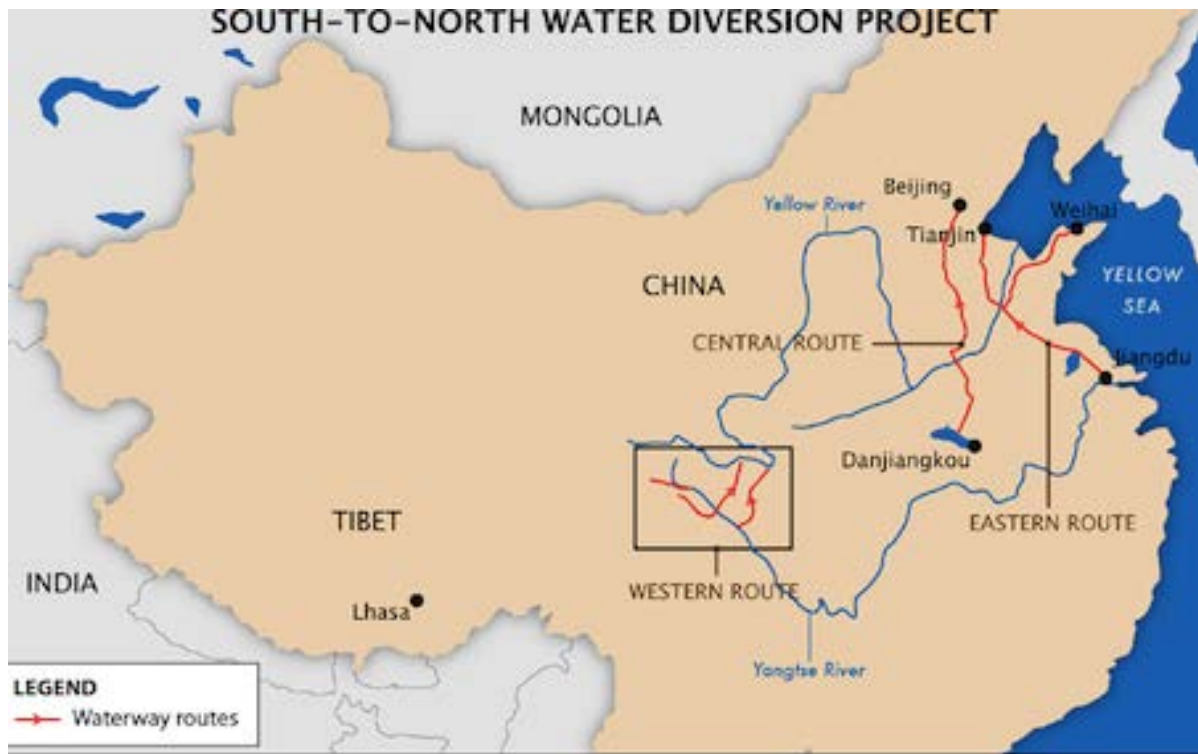
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44.8 billion cubic meters of water per year from the Yangtze River and its tributaries in southern China to the northern China is planned to be diverted .

https://www.google.co.jp/search?q=south+to+north+water+diversion+project&source=inms&tbm=isch&a=X&ved=0ahUKEwIFmJHQ6tncAhUX7LwKHb35D0wQ_AUICyG&biw=1920&bih=934#imgrc=wyJoaz3sRhTRsM:&spf=1533606832257



sketchmap only--exact data unknown
Current status:
Eastern route: extensive work has been done
Central route: work commenced in 2004
Western route: in planning and site preparation stages

63

Several reasons behind 1. Ecological effects

- **Saltwater intrusion:** due to the vast amount of water movement in this project through several bodies of water the Yangtze Delta is at risk for increased levels of saline.
- **Habitat Destruction:** construction for the project has relocated over 300,000 people and has destroyed the landscape of areas causing an animals to be displaced.
- **Increase in concern over seismic activity:** earthquakes are common in China and their destructive power runs of running the project.

64

2. Financial regulation

- The projected cost of 37 billion US\$ does not incorporate the 80 million US dollars that must be spent on new water treatment facilities

65

Mao Zedong first authorized the Project in 1952.

There is a lot of water in the south, less water in the north. And a big project has been carried out to transfer some of "South Water" to the north. But for transferring water, important points are "how to transfer?", "transfer water to where?", "how much water is transferred?", "what route to be taken?", "where to supply?". In order to complete these steps, for the South-to-North Water diversion Project, long-term (last 50 years) and thorough examination has been carried out.



https://www.google.co.jp/search?q=maozedong&source=lnms&tbm=isch&sa=X&ved=0ahUKEwja9a6D69ncAhVDurwKHVMAVsQ_AUICigB&biw=1920&bih=934#imgrc=h8RgrhKX_BYizM:&spf=1533606933883

- 1952~1961: Exploration stage
- 1972~1979: Mainly Eastern Route planning stage
- 1980~1994: Simultaneously carry out the research phase of the eastern, central and western route.
- 1995~1998: Demonstration stage

https://www.google.co.jp/search?q=zhuorongji&source=lnms&tbm=isch&sa=X&ved=0ahUKEwigvZ_W69ncAhXHfwwKRRHqBTkQ_AUICgD&biw=1920&bih=934#imgrc=bx9Sw2ZVTi0WBM:&spf=1533607111042

- In 2002, The construction has been started by declaration of the then Prime minister, Zhu Rongji.



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Benefits

- **More sustainable groundwater supply**
 - The project limits the strain on groundwater, causing the resource to remain controlled.
- **Increase Per-Capita Water Supply**
 - All families can receive water, not just the wealthy family.
- **Decrease Water Shortages Throughout China**
 - The large population of northern China demands more water than the aquifers can give them. This project will help in this shortage.
- **GDP growth is expected to increase**

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Water receiving areas



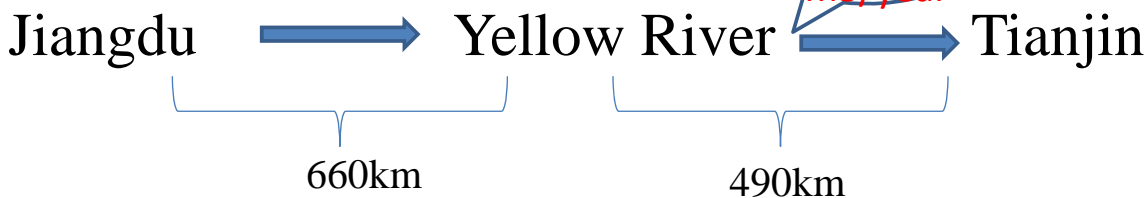
Eastern Route



- Began in Dec. 27th 2002.
- Finished in Dec. 8th 2013.
- Total 1150km in length.
- From Yangzhou City, Jiangsu.
- Through Shandong, Hebei to Tianjin.

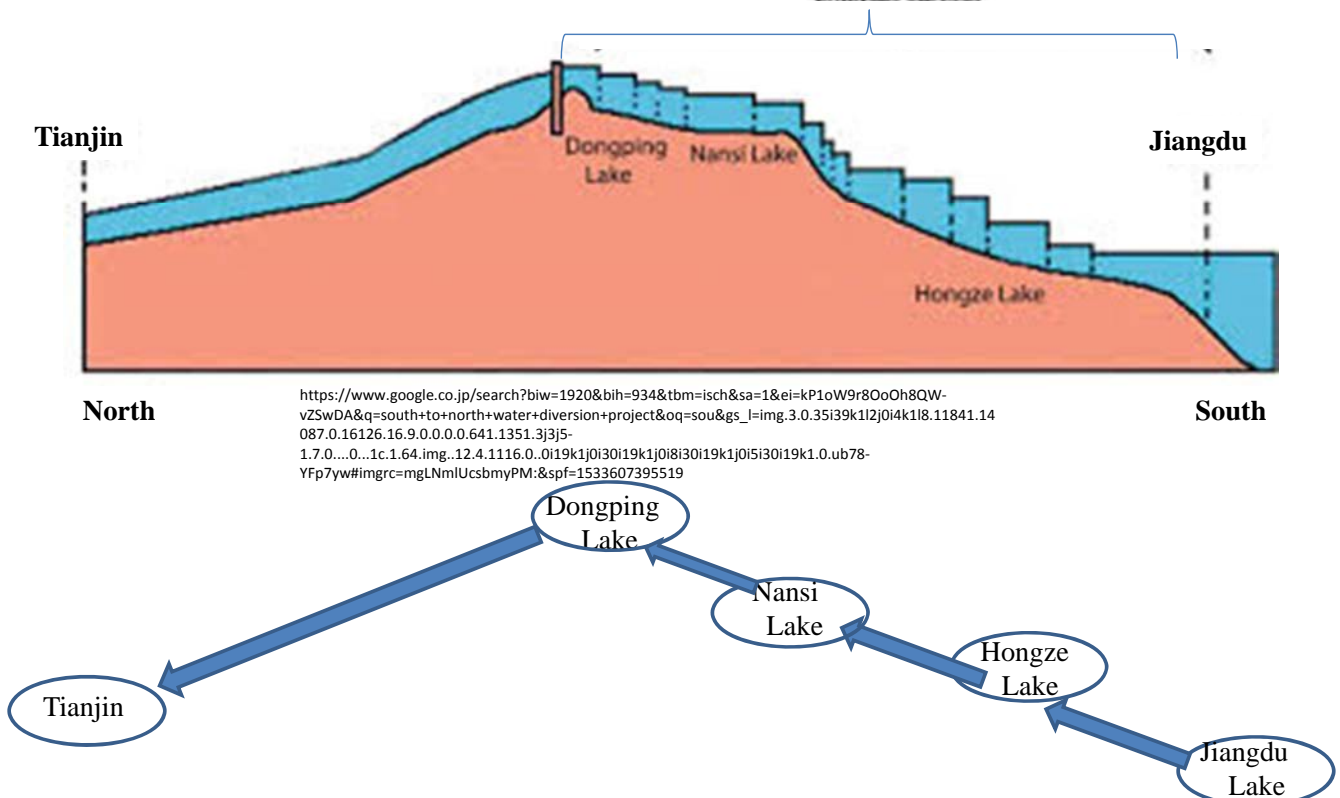
https://www.google.co.jp/search?biw=1920&bih=934&tbn=isch&sa=1&ei=kP1oW9r8OoOh8QW-vZSwDA&q=south+to+north+water+diversion+project&oq=sou&gs_l=img.3.0.35i39k112j0i4k1l8.11841.14087.0.16126.16.9.0.0.0.641.1351.3j3j5-1.7.0...0...1c.1.64.img..12.4.1116.0..0i19k1j0i30i19k1j0i8i30i19k1j0i5i30i19k1.0.ub78-YFp7yw#imgsrc=ZYJ43MX_HQfEpM:&spf=1533607332462

Overall length: 1150 km



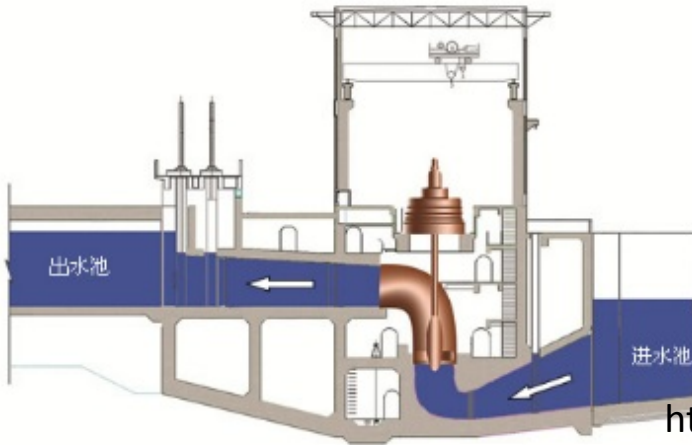
Eastern Route

Pumped Sections: 23



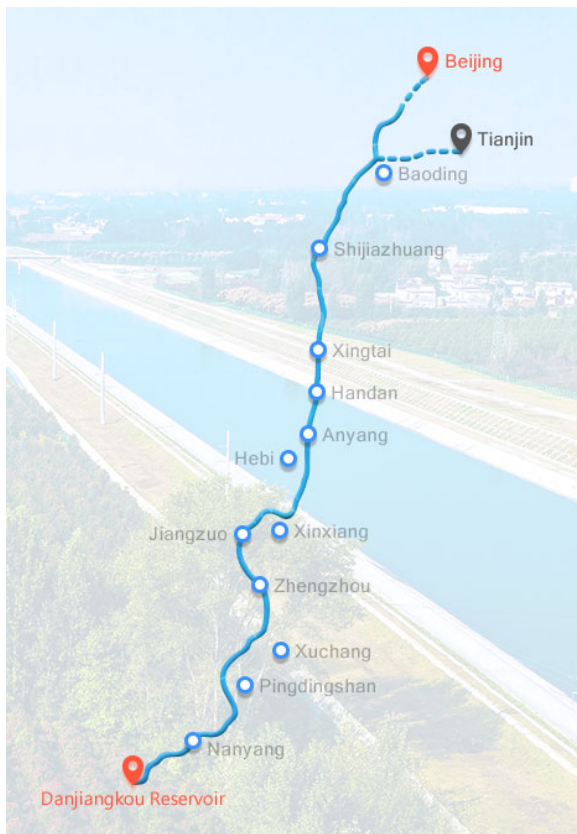


To lift water 40m



<http://www.iwhr.com/zgskyww/ztbd/njsbd/dsbf/webinfo/2013/03/136042371777>

Central Route



- Began in Dec. 31st 2003.
- Finished in Dec. 12th 2014.
- Total 1432km in length.
- From Danjiangkou Reservoir on the Han River.
- Through Henan, Hebei to Beijing and Tianjin.

Danjiangkou Reservoir

<http://www.iwhr.com/zgskyww/ztbd/nsbd/dsbf/webinfo/2013/03/1360423717925381.htm>

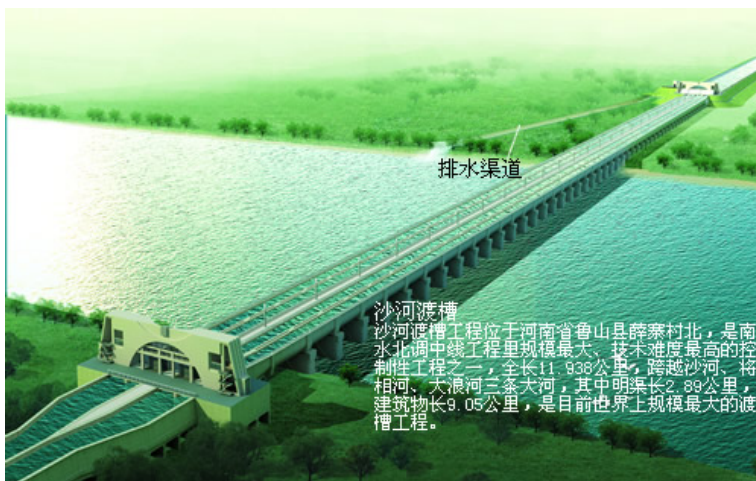


The dam of the Danjiangkou Reservoir has been heightened and thickened, and the normal water level has been raised from 157 meters to 170 meters.

73



Aqueduct or tunnel



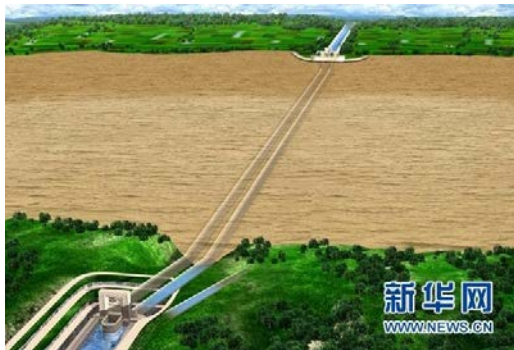
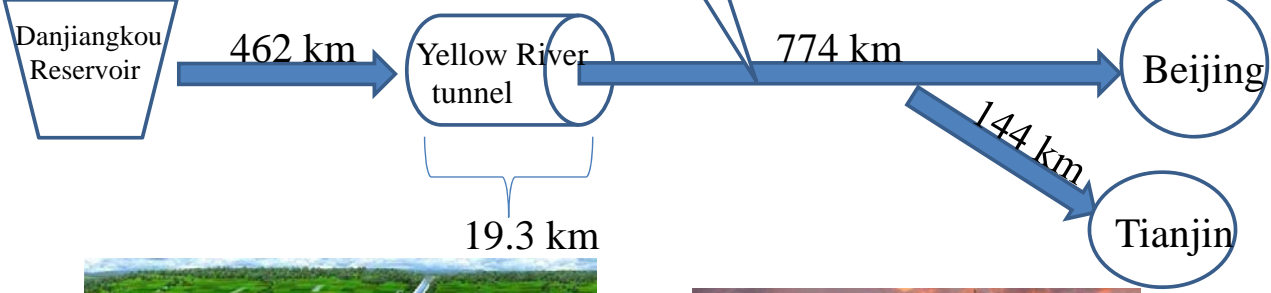
Central Route

<https://www.bing.com/images/search?view=detailV2&ccid=K9jnEIAO&id=7A423E0F045B69E3BAFFB4E5BEBBC067F55A59&thid=OIP.K9jnEIAOVMMzZX3HIdkraAHaEG&mediaurl=http%3a%2f%2fimg.zcool.cn%2fcommunity%2f033dcda554c784b0000158fcc662f9.jpg&expw=1912&expw=3456&q=%e5%a4%a9%e5%ae%89%e9%97%a8&simid=607990595046411241&selectedIndex=1&ajaxhist=0>



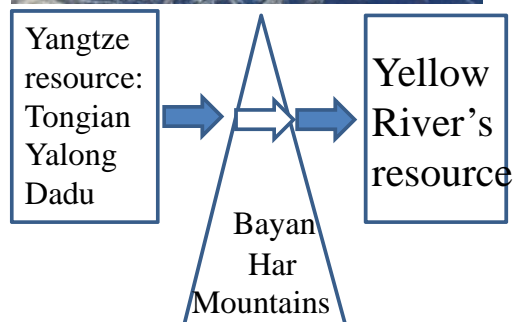
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14.6 billion m³/year



https://www.google.co.jp/search?biw=1920&bih=934&tbm=isch&sa=1&ei=pf1oW8-nlYGa8QWYj7roBA&q=tianjin+&og=tianjin+&gs_l=img.3..0j3j0i30k1i7.240096.243936.0.244593.46.20.0.0.0.356.2489.8j3j1j3.15.0...0.1c.1.64.img..40.6.1713.0..35i39k1j0i30i19k1j0i8i30i19k1j0i19k1j0i5i30i19k1j0i4k1.0.JnpV9u4knr4#imgrc=nR3oU26BROBeLM:&spf=1533607641383

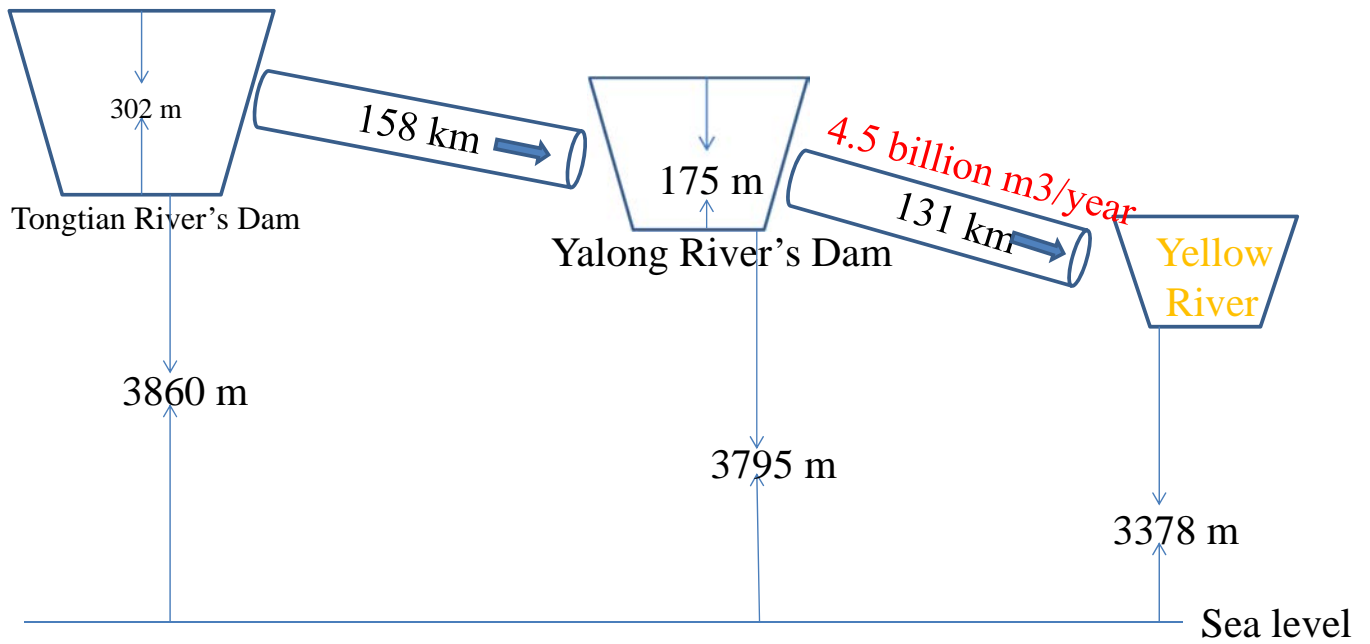
Western Route (in preparation)



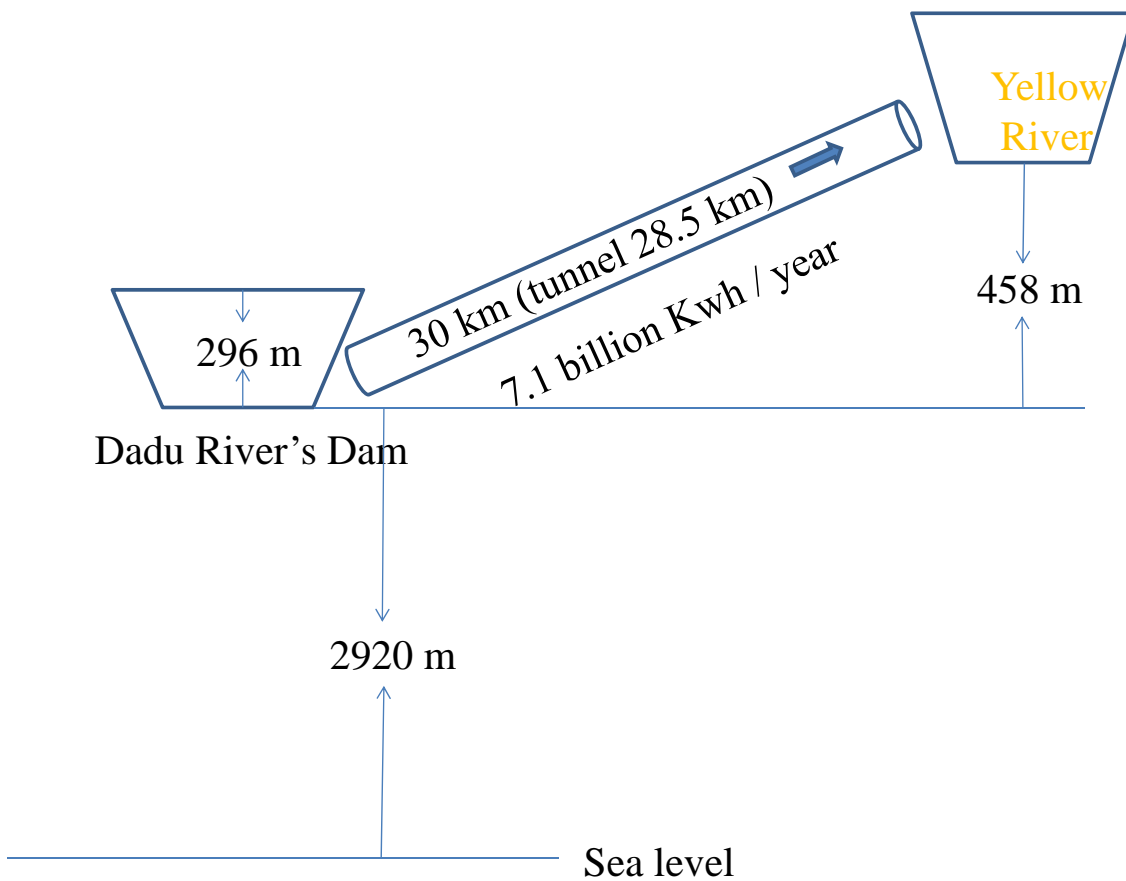
<https://www.bing.com/images/search?view=detailV2&ccid=cEgLY6Y&id=F5A8B7&thid=OIP.cEgLY6YRHKyN3HPM22CldgHaEv&mediaurl=http%3a%2f%2fwww.chinesetimeschool.com%2fPortals%2f2fcms%2fimages%2f201401%2fBayan-Har-Mountains-travel-to-china-qinghai-0.jpeg&expw=382&expw=597&q=byankara&simid=607996187116178019&selectedIndex=1&ajaxhist=0>

The project will bring 4 billion cubic meters of water from three tributaries of the Yangtze – the Tongtian, Yalong and Dadu rivers – nearly 300km across the Bayan Har Mountains and then on to northwest China.

Western Route



Western Route



Current situation

- **The project began as an idea in 1952 and has yet to be 100% completed.**
- **Water is diverted along three routes:**
 - ✓ Eastern Route- Takes water from the lower reaches of the Yangtze River to Jiangsu, Anhui, Shandong, Hebei and Tianjin.
 - ✓ Central Route- Carries water from the Danjiangkou reservoir to many cities including Beijing.
 - ✓ Western Route- Carries water from three Yangtze tributaries. Water is moved through the Bayankala Mountain Range.

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Summary

- Towards efficient and sustainable water use, water management (activity of planning, developing, distributing and optimum use of water resources) is indispensable.
- The South-to-North Water Diversion Project in China is an example of water management planned by Chinese government and has been carried out partly, focusing on the how and where to transfer, how much water is transfer and what route would be the best for water supply and optimum use at a reasonable cost.

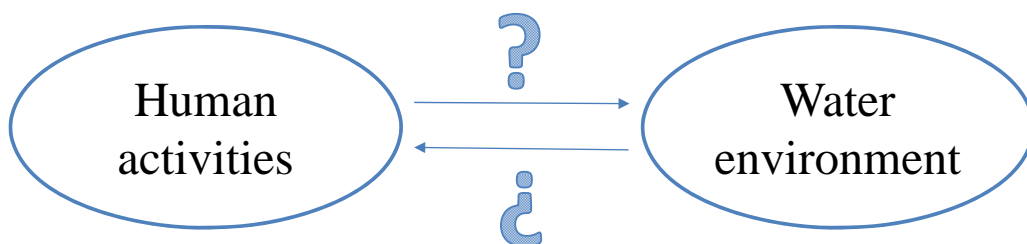
80

Relationship between human activities and water environment

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Lecture points

- The impact of human activities on water environment: water cycle, water quality and water quantity;
- The impact of water environment on human activities: food culture and living culture;



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The impact of human activities on water environment

- Our water resources face many serious threats, all of which are caused primarily by human activities. They include, pollution, deforestation, landscape changes, and urban growth.



<https://food.ndtv.com/health/about-1-7-million-children-die-each-year-due-to-pollution-who-1666551>



<https://spineofindia.com/deforestation-in-india/>

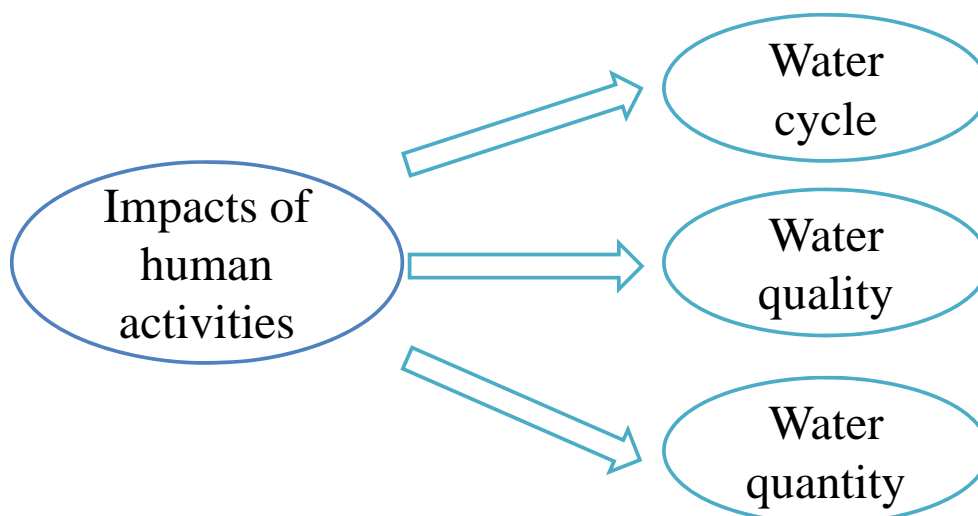


<http://cur.org.au/blog/ideas-australia-city-v4-0-new-model-urban-growth-governance-australia/>

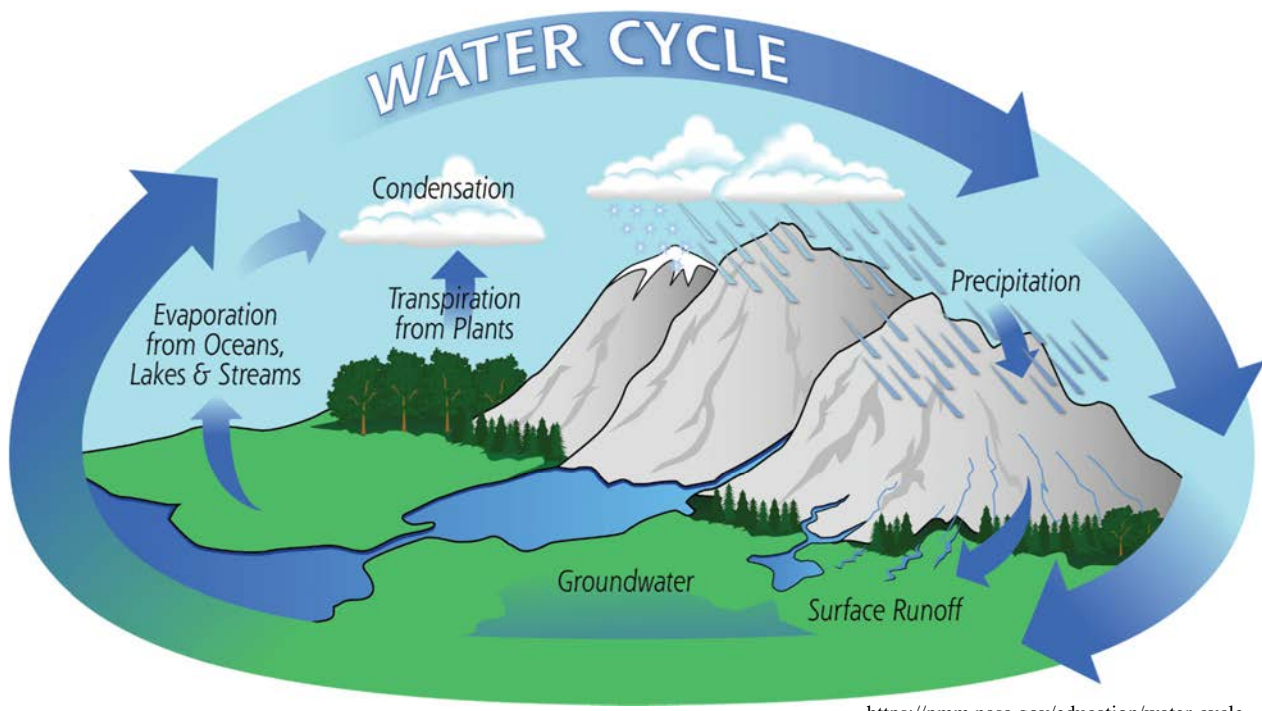
83

The impact of human activities on water environment

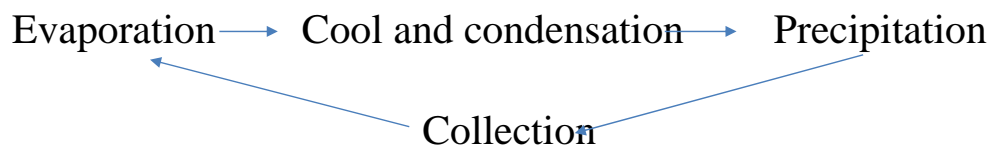
- First part



84



<https://pmm.nasa.gov/education/water-cycle>



85

Impact of human activities on the water cycle

- Human activities directly change the quantity or quality of water cycle elements and their spatial distribution, such as the construction of reservoirs, crop irrigation, cross-basin diversion works, urbanization and industrialization, etc.

Construction of reservoirs



The Nation

Crop irrigation



Cross-basin diversion works



<http://wenku.baidu.com/view/ae9b2451227916888486d78e.html>

Impact of Reservoir Construction on Water Cycle

- The reservoir intercepts surface runoff and reduces the flow into the sea, thus it will change the water balance factors in the basin.
- With the elevation of the water level in the upstream of the reservoir dam raising, the groundwater level in the upper reaches of the reservoir will increase.



<https://nation.com.pk/01-Apr-2018/icci-for-construction-of-water-reservoirs-to-overcome-water-crisis>



<https://constructionreviewonline.com/2017/09/300m-set-aside-kondo-dam/>

87

Impact of irrigation on water cycle

- Large-scale irrigation causes significant changes in river runoff and its distribution during the year, watershed evaporation, groundwater levels in the irrigation area.
- Irrigation causes soil salinity to be drained into rivers, changing the chemical composition of the river.



<http://12.000.scripts.mit.edu/mission2017/irrigation/>



<https://www.dreamstime.com/stock-photo-crop-irrigation-center-pivot-sprinkler-system-sprinklers-work-under-sunrays-badajoz-spain-image70254682>

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Impact of cross-basin diversion works on water cycle

- Large-scale water transfer projects will have a profound impact on the water cycle and water balance. The first is to change the path of the water, and in addition it will destroy the already formed ecological balance.

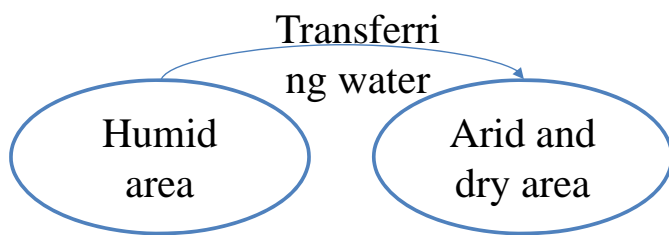
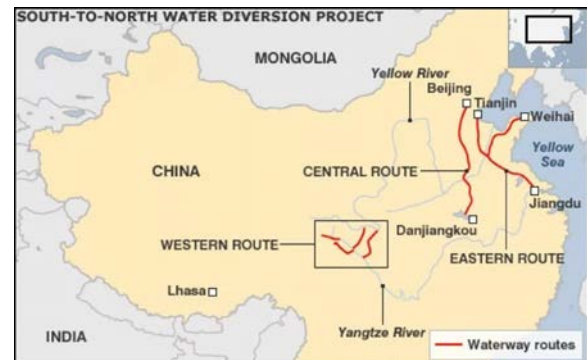


Diagram of cross-basin diversion work



<http://www.globalwaterforum.org/2014/03/04/diverted-opportunity-inequality-and-what-the-south-north-water-transfer-project-really-means-for-china/>

89

Impact of urbanization and industrialization on water cycle

- Landscape is changed with the development of urbanization and industrialization. Therefore, it will have a evident impact on the surface runoff and groundwater use. According to one report, the runoff coefficient is changed to about 80% from 60% with the development of our society.



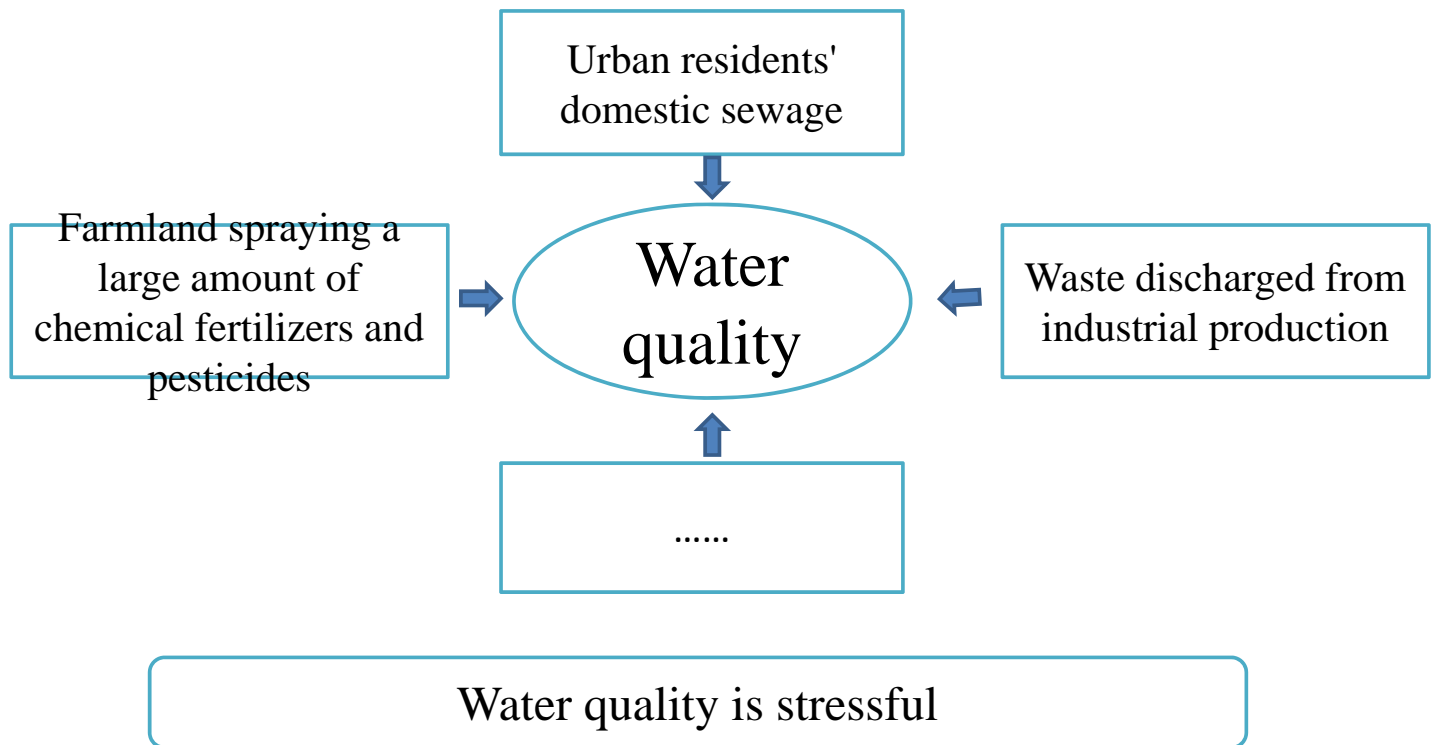
<http://thecontextofthings.com/2014/04/10/urban-sprawl-and-politics-republicans-tend-to-live-in-sprawling-metros-and-democrats-tend-to-live-in-compact-ones/>



<https://wsimag.com/architecture-and-design/32403-planetary-urbanization>

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Impact of human activities on Water quality



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Impact of human activities on water quality

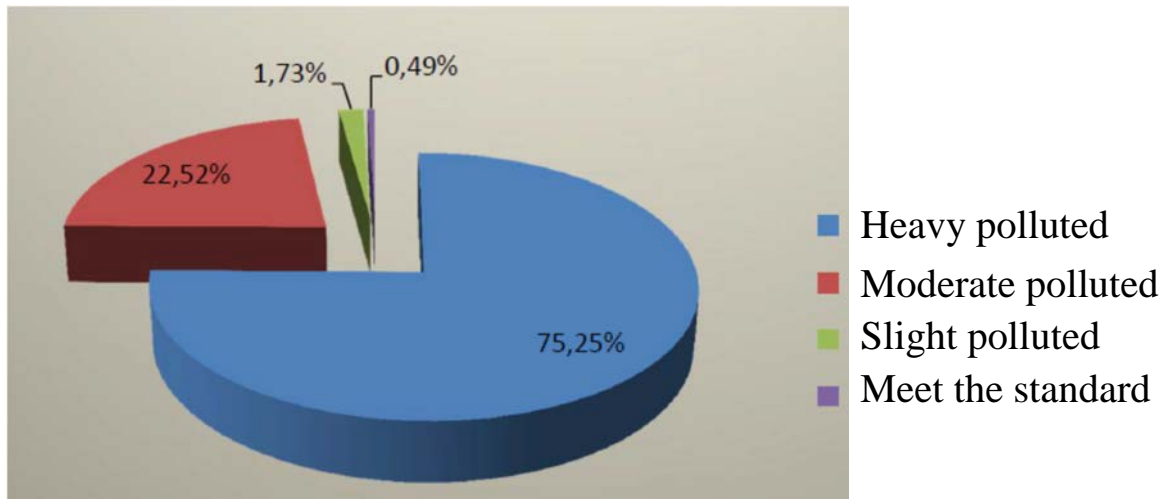
- For example, China's total wastewater volume in 2012 is 68.48 billion tons, 67.8% of China's rivers are reported to be contaminated.



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Impact of human activities on water quality

Water quality monitoring result in Indonesia
(411 sample points, 2013)

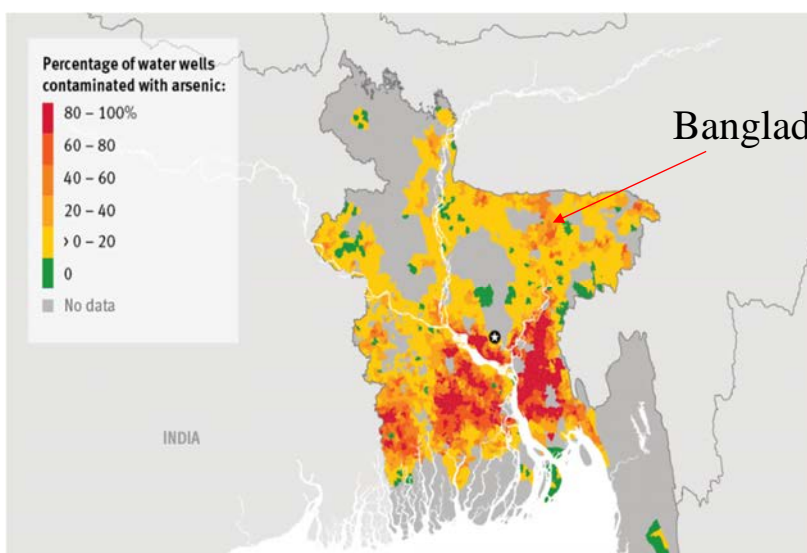


In Indonesia, diarrhea (下痢) is among the top five causes of mortality.

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Impact of human activities on water quality

Percentage of water wells contaminated with arsenic



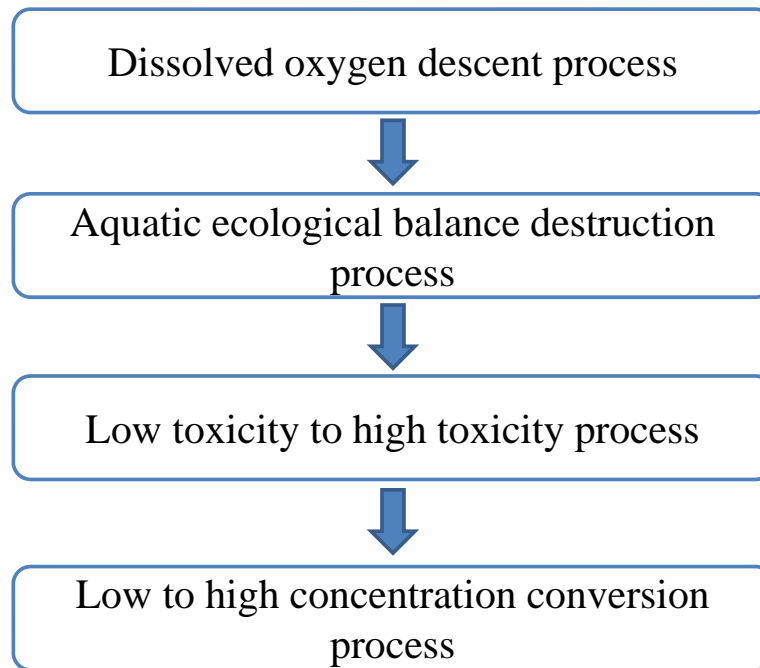
1. Of 160 million people in Bangladesh, 4 million lack safe water and 85 million lack improved sanitation.

2. Long-term exposure to arsenic in drinking water can cause cancer in the skin, lungs and kidney.

<https://www.hrw.org/report/2016/04/06/nepotism-and-neglect/failing-response-arsenic-drinking-water-bangladeshs-rural>

94

The deterioration of the water environment



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Impact of human activities on water quantity

- Impact on lake area

In the past half century, the area of Xinjiang Ebinur Lake has decreased by 286.8 km² (the area of Gifu city is 203.6 km²), mainly due to water use for human activities (water demand for agricultural irrigation is the main factor) (Ma et al., 2014).

- Impact on water level

Guo et al. (2015) discovered that the water level of Bosten Lake and area of the lake decreased because of human activities (direct water consumption upstream and indirect runoff response to land use change).

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Impact of human activities on water quantity

- Impact on runoff

1. He et al. (2012) showed that human activities contributed 40.29%, to the increased runoff in the upper reaches of the Heihe River, and that human activities contributed 74.77%, to the decrease in runoff in the middle reaches.

2. Dong et al. (2014) discovered that in the hydrological processes of the Jinghe River, human activities (mainly cultivated land) contributed to a reduction in runoff of about 85.7% from 1981 to 2008.

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Benefits of human activities on water environment

- The quality of any surface or ground water body is a function of either or both natural influences and human activities.
- Without human activities, water could contain substances that are harmful to life. These include metals such as mercury, organic toxins and radioactive contaminants.
- Therefore, necessary treatment for natural water should be done by human.

Technology is necessary
and important !!!

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Impact of water environment on human activities

- Second part

1. Food culture



<https://kuaibao.qq.com/s/20180322A19ZK900?refer=spider>



<http://www.tianqi.com/news/212746.html>

In China, land in the north is a dry land, which is suitable for wheat and sorghum and other pasta plants; while the land in the south is a paddy field, which is suitable for rice cultivation. Therefore, northerners like to eat pasta while southerners like to eat rice.

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Impact of water environment on human activities

2. Living culture

Kummu, M. et al (2011) tells the results like these:

1. Over 50% of the world's population lives closer than 3 km to a surface freshwater body, and only 10% of the population lives further than 10 km away;

2. Population distributions in arid zones show statistically significant relationships with a combination of climatic factors and distance to water.



<https://borgenproject.org/water-pollution-in-china/>



http://newhouse.fs.fang.com/2017-03-27/24779582_all.htm

100

Summary of my part

- The relationship between human activities and water environment is mutual impact, however, because of human independent creativity, it seems like that impact of human activities on water environment is stronger than the other side.
- For the water quality and water quantity, we should keep a clear brain, so as to protect our living water environment.



101

References

- Kummu, M., De Moel, H., Ward, P. J., and Varis, O. (2011): How Close Do We Live to Water? A Global Analysis of Population Distance to Freshwater Bodies, PLoS ONE, 6, e20578.
- X.Q. He, B. Zhang, L.W. Sun, *et al.* (2012), Contribution rates of climate change and human activities on the runoff in upper and middle reaches of Heihe River basin, Chin. J. Ecol., 31 (11), pp. 2884-2890.
- W. Dong, B. Cui, Z. Liu, *et al.* (2014), Relative impacts of human activities and climate change on the river runoff in an arid basin in Northwest China, Hydrol. Process., 28 (18), pp. 4854-4864.
- L. Ma, J. Wu, W. Liu, *et al.* (2014), Distinguishing between anthropogenic and climatic impacts on lake size: a modeling approach using data from Ebinur Lake in arid Northwest China, J. Limnol., 73 (2), pp. 350-357.
- M. Guo, W. Wu, X. Zhou, *et al.* (2015), Investigation of the dramatic changes in lake level of the Bosten Lake in Northwestern China, Theor. Appl. Climatol., 119 (1-2), pp. 341-351.

102

Summary of this lecture

- Water cycle: Types of water cycle on Earth and our life are connected with water environment (20th/7).
- Water use: Present use condition and problems in industry, agriculture and daily life (20th/7).
- Water management: Importance of water management and water management strategies (27th/7).
- Relationship between human activities and water environment: The relationship between them is mutual impact, we should try our best to maintain the balance between them (27th/7).