

Characteristics and Values of Irrigation Historical Sustainability in China

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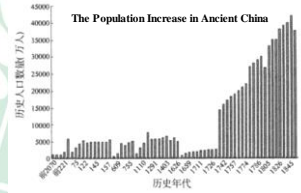


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I. BACKGROUND

□ Typical Agricultural Country

- > Population: with large population and wide distribution, the demand for food makes irrigation irreplaceable
- > History: the irrigation projects had been constructed throughout history with 5000year
- > Government: Agricultural taxation is the main source of finance



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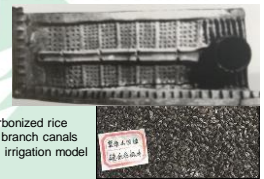


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II. BRIEF IRRIGATION HISTORY OF CHINA

2.1 origins:3000B.C.-476B.C.

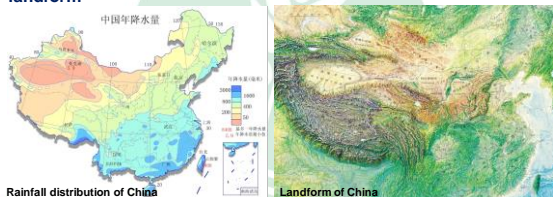
- >Legend
 - King Yu tamed the flood: Start a new era of water conservancy and irrigation
- >Archaeological discovery
 - Liangzhu (around 3000BC): rice field site, 10,000kg carbonized rice
 - Shang Capital(around 1600BC): irrigation for trunk and branch canals
 - Yuzhuang Tombs in Han dynasty (around 200BC): well irrigation model
- >Written Records:
 - Oracle bone script (around 200BC): **■**, means irrigation system of ditch and canal in farmland
 - The Western Zhou Dynasty (1100-476BC): appointed officials in charge of irrigations (With records in the *Rites of Zhou*)
 - King You of Zhou Dynasty (?-771BC): ruined the rice field due to his tyranny (With records in *The Book of Songs*)



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I. BACKGROUND

□ Typical East Asian Monsoon Climate on complex and various landform



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II. BRIEF IRRIGATION HISTORY OF CHINA

2.2 The first boom of irrigation construction: 475B.C.-100A.D.

- >Quebei Lake designed by Sun Shu'ao (613BC-591BC)
 - Irrigation area: >5000ha
 - Agricultural area in middle reaches of Huai River.
- >Dujiangyan Irrigation System designed by Li Bing (256BC-251BC)
 - Agricultural area in Yangtze River: Shan He Weir, Bai Qi Canal
- >Zhengguo Canal (246BC)
 - Irrigation area: around 2300ha
 - Agricultural area in the central Shaanxi Plain: Chengguo Canal, Cao Canal, Longshou Canal
- >Exploration in Northwest and North China
 - Karez in South Xinjiang, water diversion irrigation in the Hexi Corridor
 - Canals of Zhanghe River, Zhibo Irrigation Canal



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II. BRIEF IRRIGATION HISTORY OF CHINA

2.3 Eastern Han Dynasty-Northern & Southern Dynasties: 25A.D.-589A.D.

> Huaihe River Basin

- Middle reaches: Hongxi Po as the center
- Lower reaches: Bai Shui Tang, Caowei garrison troops and open-up land

> Jiangnan area

- Jiangnan: Chishan Lake in Jurong, Lian Lake in Danyang
- Eastern Zhejiang: Jian Lake in Shaoxing, Dongqian Lake in Ningbo
- Southern Zhejiang: Tongji Lake in Lishui

> Nanyang Irrigation System-Tangbai River region

- Zhao Xinchen: Liu Men Ye, Qian Lu Po (489C-33BC)
- Du Shi: improved Nanyang Irrigation System (25AD-55AD)
- Du Yu (222-285) improved Nanyang Irrigation System the second time



Besides the irrigation area, there are several kinds of water storage: weirs like ponds, lake, etc., with broad areas for water conservancy. Once used for irrigation, water flowed into rice fields, with ditches connected with each other.— NanduFu By Zhangheng

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II. BRIEF IRRIGATION HISTORY OF CHINA

2.6 Introduction of Western Science & Technology and Modernization 1840-

> China's irrigation develops from traditional model to modern since the introduction of western science and technology

- **New science and technology:** topographic mapping, hydrographic survey, geologic prospecting, model test, modern engineering planning and design theory and technology, new engineering types, materials, equipment and technique

- **Pumping drainage and irrigation:** combustion engine, 1906, Wujin Jiangsu, electronic irrigation, electronic irrigation 1927, Changde, Fujian

- **Institutionalization** of irrigation system greatly improved, **Modern education and researches**

> Rapid development of irrigation in China

- In 2019, China's irrigation area of 74 million ha ranked first in the world and water-saving irrigation area of 34.3 million ha.

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II. BRIEF IRRIGATION HISTORY OF CHINA

2.4 Prosperous Development Period: The Sui and Tang dynasties and Song Dynasty 581A.D.-1279A.D.

> Rapid development of irrigation projects in Southern China

- Polders in the Taihu Lake region: Tangu and Lougang Polders
- Bai Juyi: Jiangnan contributes most of the agricultural tax of the nation
- Coastal regions of Zhejiang and Fujian: Tuoshan Weir, Mulanbei with storing fresh water and refusing sea water.

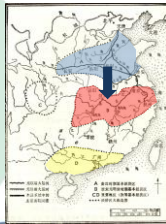
> Improvement of Northern China's irrigation Projects

- Song Dynasty: warping irrigation in the sediment-laden stream area
- Northern China: Pond and pool irrigation in Baiyangdian Lake

> Development of water laws and techniques

- Masonry projects: block, dam and canal
- Promotion of waterwheel and scoop waterwheel
- Wide application of irrigation rule for crop and quantitative management of irrigation and drainage

- Regulations: *Shui Bu Shi, The laws of irrigation and water conservancy in Northern Song Dynasty and Western Xia, irrigation system in Dun-Huang*



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III. SUSTAINABLE CHARACTERISTICS AND VALUES OF HISTORICAL IRRIGATION

No.	WWS	Inf.Area(m ²)
1	Dongfengyan Weir	9153
2	Mulanbei Weir	10867
3	Tongyan Dam	2000
4	Ziqiqie Terraces	6416
5	Quebei Pond	44900
6	Tuoshan Weir	13829
7	Zhuji Shadoff-Weirs Irrigation	27
8	Charanbei Weir	3300
9	Taihu Lougang & Polder Lands	28000
10	Zhengguoqu Canal	97000
11	Ningxia Irrigation Area	552000
12	Hanzhong Weirs	14500
13	Huanggu Irrigation System	1333
14	Dujiangyan	710000
15	Lingqu Canal	4333
16	Jiangnyan Weir	2333
17	Changqu Canal	20000
	总计	1515992

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II. BRIEF IRRIGATION HISTORY OF CHINA

2.5 stable and fast development: Yuan, Ming and Qing Dynasties 1271A.D.-1911A.D.

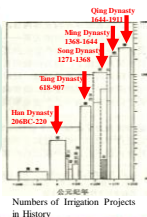
> New irrigation areas

- Yangtze valley: the rapid development of polders in Dongting Lake
- The Delta of the Pearl River: the development of dike pond irrigation
- Coastal regions of Jiangsu & Zhejiang: seawall construction
- Irrigation in capital regions of Qing Dynasty (Jifu): expansion and improvement

- Inland and frontier: Xinjiang, Yunnan, Guangxi

> Systematic planning of valleys and regions: integration and coordination

- Central management of flood control, irrigation, drainage, salt alkali control
- Lower regions of Taihu Lake: drainage, shipping, flood control and polder
- Yellow River valley: flood control, water diversion and warping irrigation



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III. SUSTAINABLE CHARACTERISTICS AND VALUES OF HISTORICAL IRRIGATION

3.1 Relationship Between Engineering and Environment

> Low-impact development mode

- mild ways to collect / divert water
- environment-friendly traditional materials

> Adaptation to local condition

- Natural diversity in different regions
- Various layouts, types, structures and materials of irrigation schemes in ancient time
- No strong limits on thinking and technology in traditional society

> Beautiful irrigation agriculture landscape



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III. SUSTAINABLE CHARACTERISTICS AND VALUES OF HISTORICAL IRRIGATION

3.2 Project system and structure characteristics

➤ Systematic planning

- with great vision and systematicness
- components of the system work as an organic whole

➤ Architectural structure design

- the traditional materials such as stones and wood are more environment-friendly and have no negative impact on soil and rivers in the long term



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III. SUSTAINABLE CHARACTERISTICS AND VALUES OF HISTORICAL IRRIGATION

3.3 Fair and effective irrigation management

- Two aspects: project management and water management
- Government-led and private-sector participation
- Reconstruction of annual repairing system

3.4 Advancing with the times

- irrigation structures are "living" heritages
- environment and society is always changing



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IV. CONCLUSIONS

- The origin and development of irrigation engineering sometimes are of historical significance, which represent the evolution and spread of civilization of the regions.
- The continuation of projects is the continuation of management and culture accumulation, which reflect the wisdom of ancient people to deal with the relationships between human and water
- The empirical knowledge and engineering philosophy reflected in these heritages can serve as a valuable reference for contemporary irrigation construction and development.
- To learn history wisdom and maintain irrigation civilization, it is necessary to protect the ancient irrigation heritage as the start, which may be the best example of sustainable development



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