

# Study on Management System of Inter-Basin Water Diversion Project –A Case Study of the Project of Drawing Water from Datong River into Huangshui River

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**Abstract:** Inter-basin water diversion projects are a major way to redress demand-supply imbalance of water resources among regions and realize rational allocation and effective utilization of regional water resources. A scientific management system of inter-basin water diversion projects is the basis to ensure the project's smooth progress and maximize its integrated efficiency. Basic principles for building of the management system for inter-basin water diversion projects are clearly defined herein, and an advisable plan for building of the management system for the project of diverting water from Datong River to Huangshui River (hereinafter referred to as Datong-Huangshui Water Diversion Project) is proposed to provide reference for the government in decision-making of the management system for this water diversion project.

## 1. Introduction

Inter-basin water diversion projects are a major way to redress the demand-supply imbalance of water resources among regions and to realize rational allocation and effective utilization of water resources [1][2]. Inter-basin water diversion is large-scale project, usually entailing long water-diversion passages and covering large areas. Management of such projects attends to not only water-resource allocation of both the water-export area and the water-import area, but also such issues as volume control of the diverted water, scheduling of diversion projects, water quality protection and management of relevant assets [3]. Besides, the interests of multiple parties involved also add to the difficulty of management. Scientific construction of management systems for inter-basin water diversion projects underpins the project's smooth progress and maximization of integrated efficiency [4]. By defining the basic principles of management systems for inter-basin water diversion projects, this paper puts forward three types of project management modes, compares the three types and recommends a favourable plan for the government to build the management system for the Datong-Huangshui Water Diversion Project.



## 2. Basic Principles for Building of Inter-basin Water Diversion Project Management System

### 2.1. Strengthen Integrated Management and Coordination of Water Resources and Maximize Integrated Efficiency

Water-diversion projects are, in essence, re-allocation of water resources. Such projects are related to interests of multiple parties in the water-export area and the import area, so the water-resource demands of different parties shall be attended to in a coordinated way, and these projects shall conform to the integrated management of water resources by management organizations of the basins involved, and meanwhile ensure coordination of different functions of water resources including flood prevention, water supply and power generation. Rational allocation of different types of water resources, transferred water and local water as well as surface water and underground water, shall be emphasized, and the engineering efficiency of water diversion projects shall be maximized to realize optimal allocation of regional water resources. Water diversion projects in America and Australia are coordinated by management organizations in an integrated way, which plays a crucial role to full and rational utilization of water resources in different regions <sup>[5]</sup>.

### 2.2 Give Full Play to Government-Coordinated Public Management in Non-Profit Water Diversion Projects

In the whole process of non-profit water diversion projects from planning, construction to management, the leading role and the government's public management function shall be strengthened, and the government's coordination capacity and authority in related issues shall be highlighted. For instance, in financing, construction and management of water diversion projects in California in America, the government's function in organization and monitoring is fully realized, which meets the needs of water resources for national economy, social development, ecological and environmental protection <sup>[5]</sup>. The Snowy Mountains Scheme in Australia is managed by the Snowy Mountains Engineering Bureau founded by the Australian federal government <sup>[5]</sup>. By taking a guiding role in water diversion projects, the government can administer to and coordinate interests of the country, different regions and departments, avoid short-term behaviours, ensure optimal allocation and effective utilization of water resources, realize integrated water-resource allocation and guarantee realization of the public-beneficial goal of projects.

### 2.3. Introduce Market Mechanism and Implement Enterprise-style Management

In light of the experience drawn from management of existing water diversion projects, it is advisable to give full play to the role of the market in management of inter-basin water diversion projects. Enterprise-style management which clearly defines the rights and obligations of different investors separates ownership from management rights, improves the operation efficiency of enterprises and the capital, and ensures the interests of the owners. Take the water diversion project in California in America as an example: the project management framework was established in the form of law by the state council, which decreed that the government shall not interfere with the projects directly and that the project shall be managed by the construction and management organizations in compliance with the law <sup>[5]</sup>. Snowy Mountains Engineering Bureau in Australia, when the project was completed, was restructured into Snowy Mountains Engineering Corporation which adopted a stockholding system and the enterprise management mechanism.

## 3. Introduction to Datong-Huangshui Water Diversion Project

The main purpose of this Datong-Huangshui Water Diversion Project is to provide domestic water for 3 million residents in eastern cities of Qinghai province, production water for industrial parks along the main stream of Huangshui River and water for irrigation and river ecological balance in the modern agricultural and husbandry corridor that extends hundreds of miles in eastern Qinghai. This project is going to benefit Xining City, Huangzhong County, Datong County, Haidong City, Huzhu County,

Pingan County, Ledu County and Minhe County along the Huangshui basin. The planned annual average volume of diverted water is 1.02 billion m<sup>3</sup>, 270 million m<sup>3</sup> from the main stream of Huangshui River and 750 million m<sup>3</sup> from Datong River. The project will increase the irrigation area by 1 million mu (about 67,000 hectares).

This project composes of “One Overall Plan, Two Reservoirs and Three Channels”. To be specific, the Stone Valley Reservoir is built on Datong River to block the water; the main channel is to divert water from the downstream of the dam of Stone Valley Reservoir through Daban Mountain to Heiquanshui Reservoir which is located on Baoku River, the upper stream of Beichuan River which is a branch of Huangshui River; the 1<sup>st</sup>-phase project and 2<sup>nd</sup>-phase project of the north channel of Huangshui River are initiated to divert water to some areas of Datong County, Huzhu County and Ledu County along the northern bank of Huangshui River; the western channel project is to divert water to some areas of Datong County and Huangzhong County along the southern bank of Huangshui River (Fig.1). Apart from the above projects, the project on the main stream of Huangshui River will divert 438 million m<sup>3</sup> water to water-stressed areas including Datong County, Xining City, Pingan County of Haidong City, Ledu District of Haidong City to provide domestic water for residents and industrial parks as well as drinking water for surrounding villages. This project also provides irrigation water for the water-import areas to ease the water shortage of crops in winter.

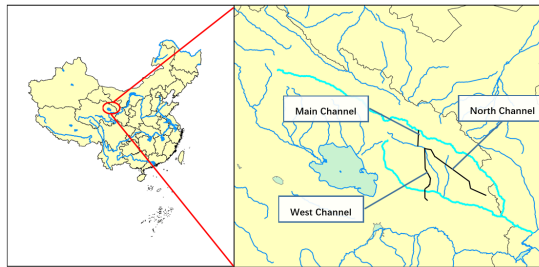


Fig.1 Datong-Huangshui Water Diversion Project

#### 4. Design of Management System

To give the market's decisive role in resource allocation to full play and enhance the function the government, three management system modes for Datong-Huangshui Water Diversion Project are proposed: the first is the government-dominated administrative management mode which features government guidance, authorized operation, centralized coordination and participation of water users; the second is the market-guided management mode in which market techniques play a decisive role and its main features are government macro control, market-guided operation and enterprise-style management; the third is the integrated management mode in which the government and the market both play a part, and its main features are government guidance, enterprise-style management and participation of water users.

##### 4.1. Mode One: Administrative Management Mode

In this mode, a management organization of Datong-Huangshui Water Diversion Project is set up specifically for project management; or a Huangshui River Basin Management Bureau is built for centralized control of the basin (Fig.2)

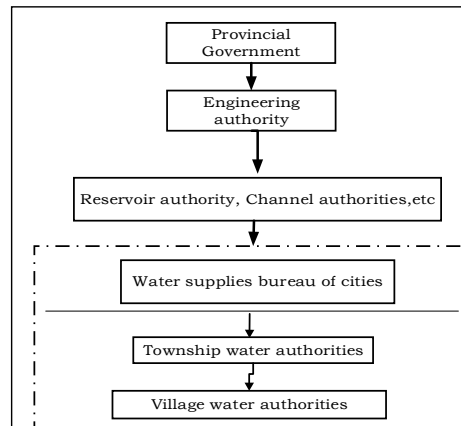


Fig.2 Management System of Project Management Bureau

*4.1.1. Setting of management offices specifically for project management.* The Project Management Bureau of Datong-Huangshui Water Diversion Project can be set up to take charge of operation, coordination and management of the project, including maintenance of the project, payment of debts, value preservation and appreciation of assets, statistics and collection of water rates, volume control of diverted water, water quality monitoring, water source protection, flood and drought prevention, building of management system and etc. In addition, independent project management offices are built under the Datong-Huangshui Water Diversion Project Bureau or in the regions of sub-projects, including the reservoir management office (including the original Heiquan Reservoir Management Office and whether to establish the Stone Valley Reservoir Entrance Management Office depends on the overall management conditions), the Main Channel Management Office, North Channel Management Office, West Channel Management Office and others. As for management of water users, group management organizations and water usage associations are organized to manage projects above the lateral-canal water diversion points (including the lateral canal) and projects below the branch canal (excluding the branch canal), i.e. management of the lateral canal and branch canal.

*4.1.2. Setting of a basin management bureau for integrated watershed management.* The Huangshui Basin Management Bureau is set up to manage Datong-Huangshui Water Diversion Project and meanwhile fulfil other functions including centralized management of water resources, integrated treatment and surveillance in Huangshui River Basin. To be specific, the bureau is to establish and implement rules and regulations for projects in the basin, carry out centralized management and allocation of water resources in the basin, and take charge of management of Datong-Huangshui Water Diversion Project as well as subsequent projects. It is also to make preparations for controlled hydraulic engineering projects within the basin and key inter-city projects, determine investment plans, guide integrated treatment and development of the basin, formulate the annual water distribution and diversion schemes in the basin, and monitor implementation of these schemes.

#### *4.2. Mode Two: Market-Guided Management Mode*

If the market-guided management mode is adopted, the Datong-Huangshui Project Corporation will be set up (Fig.3). According to Corporate Law and relevant regulations, the corporation will be operated as a stockholding enterprise with stockholder meetings, a board of directors and a board of supervisors. Its subordinate companies (filiales) including the Reservoir Development Company (Filiale of Reservoir), North Channel Development Company (Filiale of North Channel), West Channel Development Company (the filiale of west channel) and Main Canal Development Company (Head Office) are responsible for hydropower development and management their respective management areas as well

as supply of water for life, industry production, agricultural irrigation, aquaculture and tourism in Huangshui River Basin.

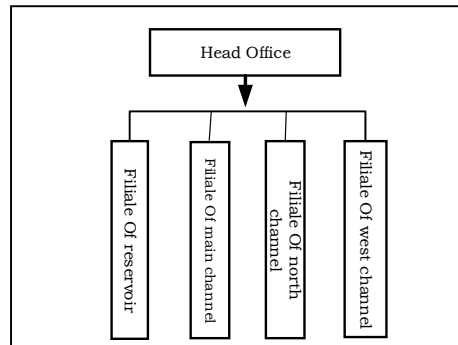


Fig.3 Market-Guided Management Mode

#### 4.3. Mode Three: Integrated Management Mode

In this mode, the Datong-Huangshui Project Management Bureau (Head Office) is founded, which is managed in the way of a public institution and operated as an enterprise (Fig.4). Subordinate management organizations under the Bureau (Head Office) include Reservoir Management Office (filiale), Main Channel Management Office (filiale), North Channel Management Office (filiale) and West Channel Management Office (filiale).

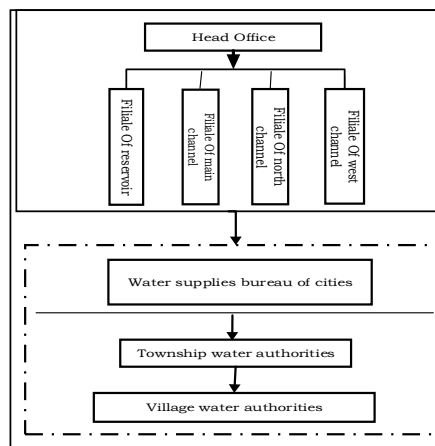


Fig.4 Framework of Integrated Management Mode

## 5. Merits and Demerits of Different Modes

### 5.1. Administrative Management Mode

Merits:

1. This mode can summon joint efforts in management and efficiently resolve the conflicts in the Datong-Huangshui Water Diversion Project. It handles well the relationship of interests between the water-export area and the water-import area, volume control the water transfer, water diversion and attend to flood and drought prevention; it can also coordinate the relationship among water quality protection, water diversion and hydropower generation, and meanwhile deal with resettlement of residents displaced by the project and facilitate subsequent water administration.

2. It can meet the needs of ecological protection. It can protect the water resources and water environment during the construction of the project, avoid partiality towards water users of great economic efficiency and thus ensure water supply for ecological, life and agricultural purposes.

3. It can effectively adjust the water price. It helps avoid disorderly price fluctuation due to market forces and by taking into consideration of cost, profit and tax as well as the affordability of agriculture, urban citizens, the low-income population and industrial needs, it can ensure that the project meets its goal of benefiting the public and eliminating poverty.

Demerits:

1. It may increase fiscal expenditure. Construction and management of the project rely on government grants, and it will certainly exacerbate the government's financial burden when the society undergoes economic downturn and the government suffers financial difficulties.

2. The incentive and restraint mechanism are still in want of improvement. If the internal reform is not in place and the appraisal system is defective, the internal driving force to improve operation efficiency may be insufficient.

### 5.2. Market-Guided Management Mode

Merits:

1. This mode expands financing channels. The market-guided management mode has diversified financing channels and engages social capital in construction and management of the operation, hence to some extent easing the government's financial burden.

2. This mode features high management efficiency. It follows the law of market economy, introduces the market competition mechanism and seeks profit maximization, which helps integrate advanced management resources and flexible management techniques of modern enterprises.

3. It increases efficiency of water utilization. Through market regulation, it diverts water resources from low-efficiency users to high-efficiency users, and thus improves water utilization efficiency and fully taps the project's economic potential.

Demerits:

1. The water-supply market is still immature. Datong-Huangshui Water Diversion Project is a fundamental and strategic project with the purpose of eliminating poverty and benefiting the public. Currently, the basis for market-guided management is still weak, so the pure market-guided management mode is not advisable for management of the project.

2. There are risks of market failure. When the public-beneficial function conflicts with the economic function of the project, it is not sure whether the enterprise can continue fulfil the goal of benefiting the public.

3. The market only plays a limited supporting role. Management of Datong-Huangshui Water Diversion Project entails coordination of various relations, and enterprises usually perform poorly in this regard; if the management enterprise fails to connect with government support and surveillance, the project may not be able to continue smoothly.

### 5.3. Integrated Management Mode

Merits:

1. This mode reflects the development direction for reform of current hydraulic engineering projects. While giving full play to the market's decisive role in resource allocation, it also promotes economic system reforms in which the government plays a more important part.

2. This mode ensures realization of both the public-beneficial goal and economic goal of Datong-Huangshui Water Diversion Project. It not only guarantees sound operation of the project but also maximizes the project's economic, social and economic efficiency.

3. This mode integrates the project's operation, management, debt payment and value preservation and appreciation of assets into a whole, which reduces the cost of administrative coordination.

4. By combining the administrative mechanism of public institutions and operation system of enterprises, this mode integrates different kinds of resources, alleviates the government's financial burden, increases management efficiency and helps realize flexible management.

Demerits:

To adopt this mode, the whole project or some parts of the projects can achieve balance between income and expenditure, which means there must be fixed water users and fixed profit from water usage in this project.

## 6. Conclusion

To meet the requirements of reform of contemporary hydraulic engineering projects, based on experience drawn from management of inter-basin water diversion projects that have been built or are being built at home and abroad, and in light of the status quo of Datong-Huangshui Water Diversion Project, this research recommends adopting the administrative management mode to build management offices in the early stage of the project based on comparison of different modes in terms of management difficulty, operation cost, management efficiency, financing channels and management techniques, as this mode enables coordinated management and scientific allocation of water resources in the basin and the water-import area, facilitates stable transition from construction management to operation management, improves the project's comprehensive efficiency and conforms to relevant policies and regulations. Under the administrative management mode, two alternative institution-setting plans are proposed: one is to build the Datong-Huangshui Project Management Bureau, and the other is to set up Qinghai Huangshui River Basin Administration Bureau. The advantages of the first plan are that it has clear and targeted management goals, integrates construction with management and facilitates smooth transition from the construction stage to the operation stage. Yet, this plan shows limited strength in coordination of different departments and different local governments as well as integrated management of water resources. In comparison, the second plan which sets up Qinghai Huangshui River Basin Administration Bureau works better in terms of coordination of development, utilization and protection of water resources; it also helps redress water shortage and solve ecological problems from the perspective of the whole basin, but in practice, the accountability is hard to define between the government and the management enterprise.

As proved by experience at home and abroad, decision-making, coordination and support of the government plays a crucial role in early-stage preparations, construction and management of large water-diversion projects. The administrative management mode reflects the direction of reform of contemporary hydraulic engineering projects, gives full play to the market's decisive role in resource allocation and the government's central role in promotion of economic system reforms. This mode can fulfil the public-beneficial goal and the economic goal of Datong-Huangshui Water Diversion Project, ensure the project's sound operation and maximize its economic, social and ecological efficiency. Meanwhile, by integrating operation and management, debt payment with value preservation and appreciation of assets, this mode can considerably reduce the cost of coordination; Moreover, through public-institution management and enterprise-style operation, this mode integrates different kinds of resources, alleviates the government's financial burden, increases management efficiency and realizes flexible management. The recommended management mode herein is to provide reference for the government in deciding the management system of Datong-Huangshui Water Diversion Project. Subsequent studies will refer to the direction of reforms in the current economic system and hydraulic engineering initiatives, and introduce the market mechanism to the management of Datong-Huangshui Water Diversion Project to figure out a feasible integrated watershed management system.

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## References

- [1] Xu M. Y. 1997 Yangtze River 28 11-13

- [2] Zheng L. D. 2003 South-to-North Water Transfers and Water Science & Technology 1 8-9
- [3] Wang H. C., Jiang Y. Z., Lu F and Dong Y. J. 2008 Advances in Science and Technology of Water Resources 28 79-83
- [4] Shen P. J., Shao D. G. and Guo Y. Y. 1995 Engineering Journal of Wuhan University 28 463-469
- [5] Huntley E. F. 2015 Hydraulics/Hydrology of Arid Lands (ASCE) pp 206-211



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