

Article

# Construction of Chinese Smart Water Conservancy Platform Based on the Blockchain: Technology Integration and Innovation Application

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**Abstract:** Blockchain technology has triggered a new round of technological innovation and industrial change. Promoting the deep integration of blockchain technology and smart water conservancy has become an essential part of the digital transformation of the Chinese smart water conservancy industry. On the basis of the analysis of the framework of the smart water conservancy system and the technology infrastructure model of the blockchain, a conceptual model of a smart water conservancy information sharing platform is established. The platform has four-in-one and mult centralized participants including government departments, water conservancy enterprises, the public, and third-party maintenance, and the design of “alliance chain + private chain” dual chain smart contract. Moreover, the multidimensional scenarios of smart water conservancy innovation applications incorporating blockchain platform technology are addressed. Then, the water rights trading market is taken as an example to propose an innovative development path with consensus mechanisms, smart contracts, asymmetric encryption, and information source tracing. Although there may be some questions and challenges related to smart water conservancy and blockchain technology, this paper can provide a reference for the sustainable development of the smart water conservancy industry due to its fundamental societal contributions.

**Keywords:** Chinese smart water conservancy; platform construction; blockchain technology; innovative application

## 1. Introduction

With the advent of the Internet era and the digital society, a new generation of information technology represented by big data, cloud computing, and artificial intelligence has gradually matured and penetrated into all aspects of human life. In recent years, the application of blockchain technology in various fields of society has attracted renewed attention. As the underlying technology and infrastructure of Bitcoin, its outstanding advantages such as decentralization, openness, transparency, and nontampering have led to new business development models and broken the barriers and restrictions of traditional industries. Thus, the developing prospects of blockchain technology cannot be easily underestimated.

Although China is a large country with water resources, it is facing increasingly complex problems, such as a lack of per capita water resources, uneven spatial and temporal distribution, and pollution of the water environment. At the same time, there are still many deficiencies, such as those related to drought and flood prevention and mitigation and the incompleteness of traditional water engineering facilities. Smart water conservancy construction based on modern science and technology is the only way to transform traditional water conservancy and modernize water conservancy. Blockchain + smart

water conservancy is becoming a potential force to promote the high-quality development of water conservancy construction and water conservancy project management.

## 2. Overview of Smart Water Conservancy

### 2.1. Concept of Smart Water Conservancy

The word “smart” originated from the concepts of “smart country, global city” and “smart city” proposed by Singapore in 2006. More than 200 cities in China have clearly presented smart city construction and development plans, and in 2017, “new smart city” construction rose to a national level, and over 50 cities launched smart city pilots. Smart water conservancy is an essential part of the physical foundation of the smart city system and is a highly extended development of water conservancy informatization [1]. According to the relevant definition of “smart water conservancy” made by the Chinese Information Center of the Ministry of Water Resources, it can be defined as the application of advanced information technology methods for water resources. The operational activities of resources and water conservancy systems are real-time sensing, comprehensive interconnection, dynamic monitoring, and intelligent services to achieve efficient use of water resources and promote the harmonious coexistence of humans and water. The academic research of smart water conservancy is mainly divided into two levels, focusing on the theoretical framework level [2–4] and the applied technology level [5–7].

At the practical level, smart water conservancy construction in different parts of the world has gone through a development stage from theoretical research to practical application. According to the relevant literature from the Information Center of the Ministry of Water Resources, a list of successful smart water conservancy construction projects around the world are shown in Table 1.

**Table 1.** Successful smart water conservancy construction projects around the world.

	Projects	Technical Characteristics
<b>Foreign countries</b>	National Smart Water Grid <sup>TM</sup> (USA) Texas Evaporation and Transpiration Net (USA)	Automation, interaction, intelligence Information gathering, public-facing, and automatic irrigation
	National Water Supply (ISR)	Unified deployment, national control, open system, and reasonable economy
<b>China</b>	Pilot Project on Smart Water Conservancy in Tai Lake in Wuxi, Jiangsu (CN)	Intelligent perception, scheduling and management
	Pilot Project on Smart Water Conservancy in Taizhou, Zhejiang (CN)	One center, two platforms, and four support systems

### 2.2. Framework of the Smart Water Conservancy System

The basic framework of the smart water conservancy system is shown in Figure 1. The framework takes government, enterprises, and the public as service objects, and takes rivers and lakes, water conservancy infrastructure, and water conservancy project management as the perceived objects. It is divided into five levels: a comprehensive decision-making layer, an intelligent application layer, a data center layer, a communication transmission layer, and an all-round layer. Besides, the framework is composed of three major support and guarantee systems: the information security guarantee system, the technical specification standard system, and the operation management service system.

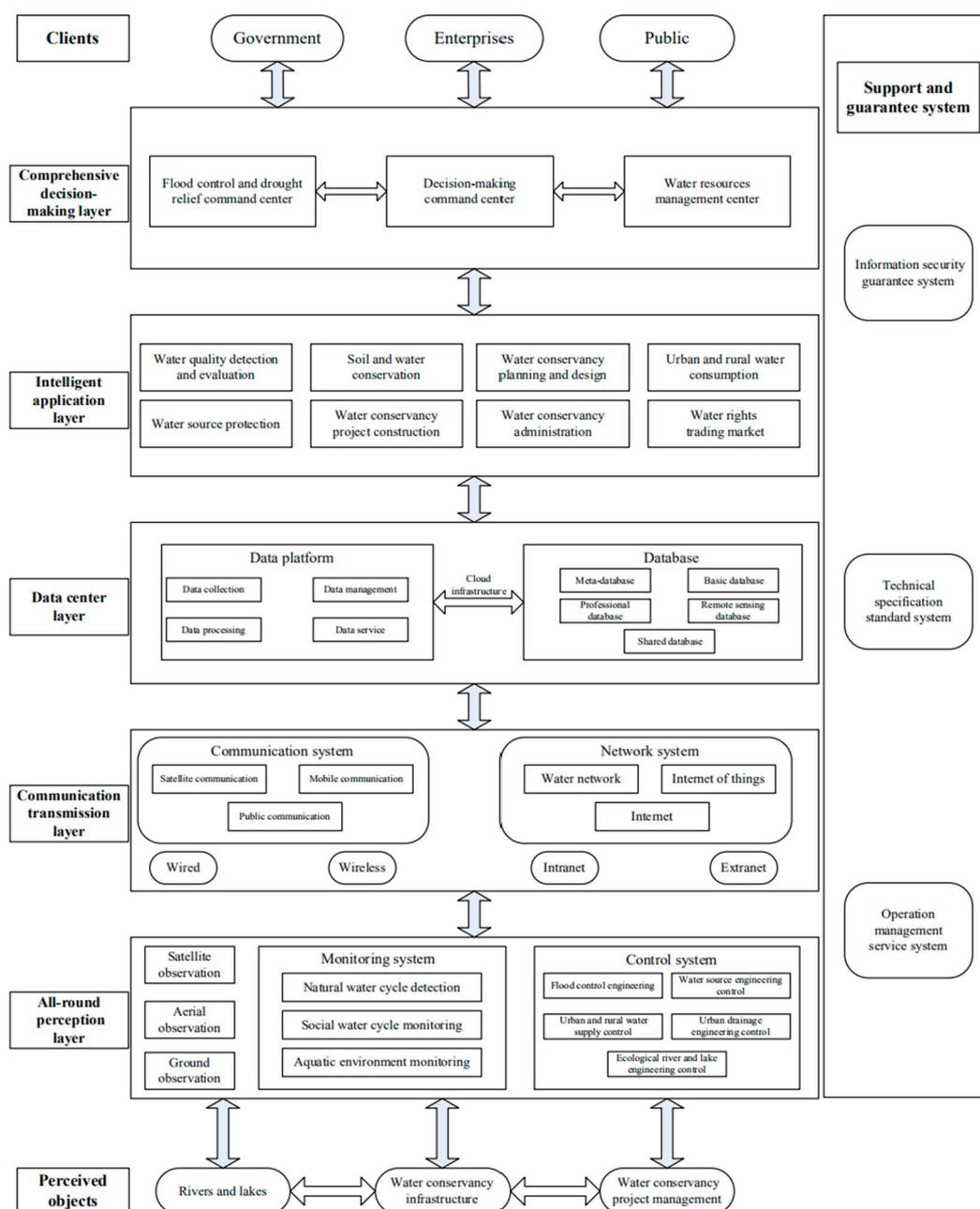


Figure 1. The basic framework of the smart water conservancy system.

### 3. Outlook of Blockchain Technology

#### 3.1. Literature on Blockchain Technology

Blockchain technology originated from the architecture concept of the Bitcoin system described by Satoshi Nakamoto in 2008 [8]. According to the “China Blockchain Technology and Application Development White Paper” released by the Ministry of Industry and Information Technology in 2016, the blockchain is defined as a new application model of computer technologies such as distributed data storage, point-to-point transmission, consensus mechanisms, and encryption algorithms. In short, during the formation of Bitcoin, each block storage unit records all the transaction information of each block node within a certain time, and each block is successively connected by a hash algorithm. The chain data structure formed is called a blockchain.

Blockchain technology is not a single information technology, but is similar to other new-generation information technologies such as big data, artificial intelligence, and Internet of things (IoT). It is based on existing technology, which is recombined and developed to generate new application functions. Thus far, the development of the blockchain has generated three phases: Blockchain 1.0 is the primary phase of blockchain technology, and it focuses on the decentralized digital currency system represented by Bitcoin; Blockchain 2.0 is currently applied in all stages. There are application development platforms, such as Ethereum and Asch, based on smart contracts, but they are limited to the financial field; Blockchain 3.0 is the core of the Internet value. It can confirm, measure, and store valuable information and bytes, so that assets can be tracked, controlled, and traded on the blockchain. In addition, the scope of applications is likely to extend to the broader fields of social governance.

Currently, the literature on blockchain technology in academic circles at home and abroad can be roughly divided into three levels. The first level is related to the basic research on the origin, technical principles, types and features, and architecture models of the blockchain. Biktimirov et al. [9] proposed the project elaboration of the configuration and mathematical model of distributed blockchain data storage. Yan et al. [10] expounded theoretical research on the development status, application prospects, challenges, and countermeasures of the blockchain. On the basis of the current survey, Ferrag et al. [11] highlighted open research challenges and discussed possible future research directions of blockchain technology for IoT. Second, there is the related research of blockchain technology in the financial field [12–16]. This also involves industries such as banking, equity trading market, supply chain, and energy trading [17–20]. Third, we have the application of blockchain technology in other industrial fields, such as medical, government, e-commerce, tourism, and so on [21–28].

### 3.2. Model of Blockchain

Generally speaking, the technology infrastructure model of the blockchain (Figure 2) can be divided into three modules, which are, from the bottom to top, the basic module, the core module, and the interaction module. Among them, the basic module contains two levels: the data layer, which includes Merkle trees, timestamps, Hash algorithms, asymmetric encryption, and other technologies, as well as transaction data and data infrastructure services; and the block layer, which includes block headers, block bodies, and chain structures. Principally, these form the blockchain structure system. The core module includes three levels: the network layer, which includes the P2P network, the network interface, and the propagation mechanism and authentication; the consensus layer, which includes the consensus mechanism and incentive mechanism; and the contract layer, which contains the script code, algorithm mechanism, and smart contracts. The application layer of the interaction module corresponds to the three stages of Bitcoin development (*1.0 programmable currency, 2.0 programmable finance, and 3.0 programmable society*).

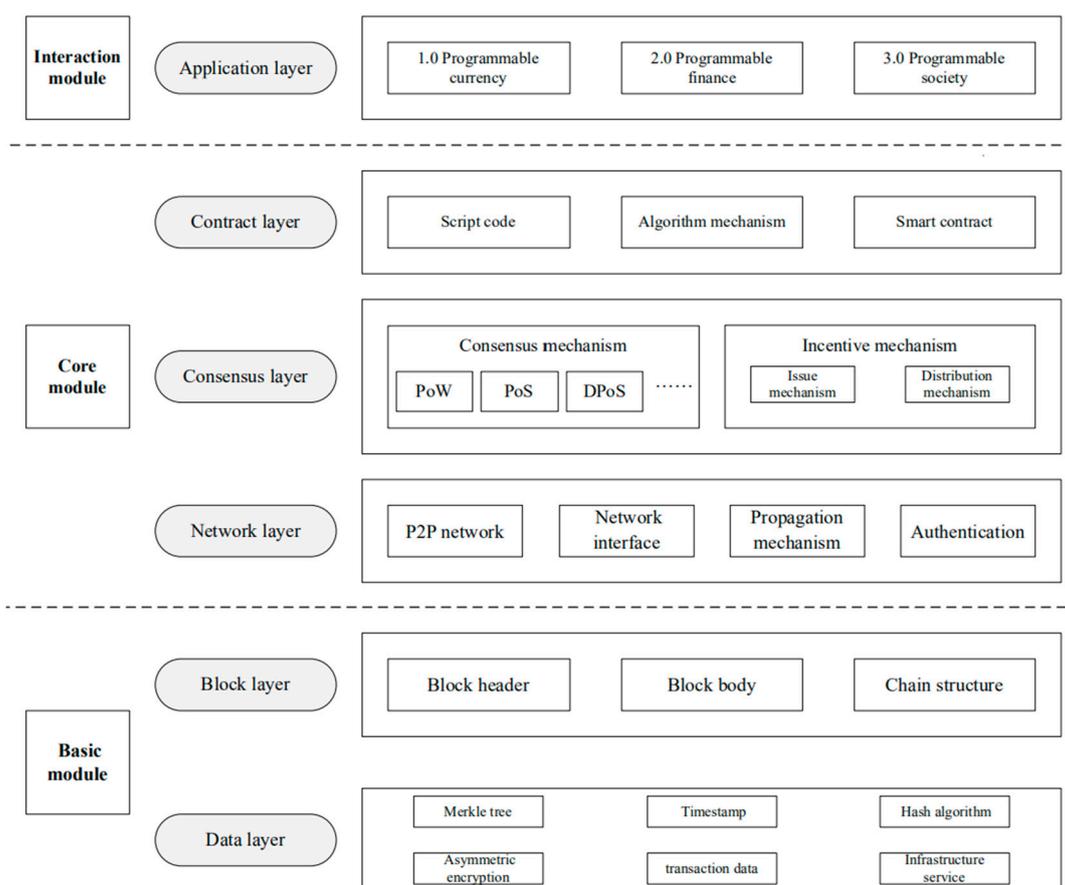


Figure 2. The technology infrastructure model of the blockchain.

Blockchain is a decentralized accounting system based on the Internet. In the absence of a robust centralized role control, all nodes participating in the blockchain need to reach a common cognitive mechanism and establish a relationship of mutual trust. As the core technology of blockchain, there are currently several mainstream consensus mechanisms: *Proof of Work* (PoW), *Proof of Stake* (PoS), and *Delegated Proof of Stake* (DPoS). PoW, also known as the mining mechanism of Bitcoin, is a very simple and primitive election algorithm that can effectively prevent malicious attacks. The PoS consensus mechanism is an alternative to PoW. It was proposed to solve the waste of resources of the PoW consensus mechanism and to meet higher requirements for security. In order to effectively solve the shortcomings of the PoS consensus mechanism, Daniel Larimer [29] proposed the DPoS consensus algorithm on the basis of PoS to improve the enthusiasm and initiative of coin holders to participate in mining. Which consensus mechanism is the best? As a matter of fact, the existing mainstream consensus mechanisms on the market have their own advantages and disadvantages, and there is no difference between the best and the worst [30–37]. The advantages and disadvantages of the three consensus mechanisms are shown in Table 2.

**Table 2.** Comparison of three mainstream consensus mechanisms.

Consensus Mechanism	Advantages	Disadvantages
PoW	Simple implementation, safe and reliable, less network resource consumption.	More computing resource consumption, high probability of fork, long consensus time.
PoS	Less resource consumption.	Complicated implementation, intermediate steps, more security breaches, high network traffic pressure.
DPoS	High throughput, short consensus time, less network resource consumption.	Complicated implementation, intermediate steps, more security breaches.

#### 4. Construction of the Smart Water Conservancy Information Sharing Platform Based on Blockchain Technology

##### 4.1. Types of Blockchain

As is shown in Table 3, the blockchain can be divided into the public chain and the private chain according to the degree of openness, application scenarios, and design ideas. The public chain refers to a blockchain in which anyone in the world can read, send transactions, and the transactions can be effectively confirmed. They can also participate in the consensus process. Moreover, the private chain can be subdivided into the fully closed private chain (the pure private chain) and the semi-public private chain (the alliance chain). The public chain is the earliest and most widely used blockchain, which is the most open and completely decentralized. Any individual or group can participate in it. The read and write permissions are available to everyone, which means that all participants are bookkeepers and they can participate in the consensus process and receive economic rewards. Meanwhile, they have the advantages of high stability, openness, and transparency, and they cannot be tampered with so that they are mainly used in the field of virtual currencies such as Bitcoin and Ethereum smart contracts. The pure private chain only targets a certain blockchain opened by the enterprise or individual, so only a certain authorized node has the right to participate and view the data. Individuals cannot keep accounts, but adopt the general ledger technology, which is determined by the blockchain organizations. Overall, it has the advantages of high transaction speed, low cost, and privacy protection.

**Table 3.** Comparison of three types of blockchain features.

Types of Blockchain	Public Chain	Alliance Chain	Pure Private Chain
Participant	Any person or group	Within a specific group	Enterprise or individual
Bookkeeper	All participants	Negotiation decision-making	Self-determination
Read and write permissions	Everyone	Nodes joining the alliance	A node
Degree of centralization	Decentralized	Polycentric	Highly centralized
Trust mechanism	Proof of work	Consensus mechanism	Endorsement
Incentives	Need	Optional	No need
Openness	Highest	Higher	Low
Transaction speed	Slow	Faster	Fastest
Representative application	Bitcoin, Ethereum	Hyperledger	Ant Financial

With the development of blockchain technology, the boundary between public and private chains is becoming more and more blurred. It is no longer purely public or private, because the read and write permissions of some nodes are gradually complicated, and the permissions of some specific nodes are open to everyone. Some core node permissions are only available to authorized nodes.

The alliance chain is a hybrid compromise between the two, which makes up for the shortcomings of slow public chain transactions, low thresholds, and high centralization of the pure private chain. Partial decentralization is achieved under the premise that transaction speed is ensured and data cannot be tampered with. Read and write permissions of data can be directed to all participants or authorized transaction parties. Each node represents a participant, and each block must be valid for more than half of the participants' confirmation. Therefore, on the basis of the basic framework characteristics of the smart water conservancy system, the alliance blockchain technology is chosen to build the smart water conservancy information sharing platform.

4.2. Conceptual Model of the Smart Water Conservancy Information Sharing Platform

The conceptual model of the smart water conservancy information sharing platform (Figure 3) is a technical architecture based on four-in-one and multicentralized participants and a dual-chain smart contract platform design based on blockchain technology. For the convenience of research, this model is simplified and the complexity of subdivision inside it is eliminated.

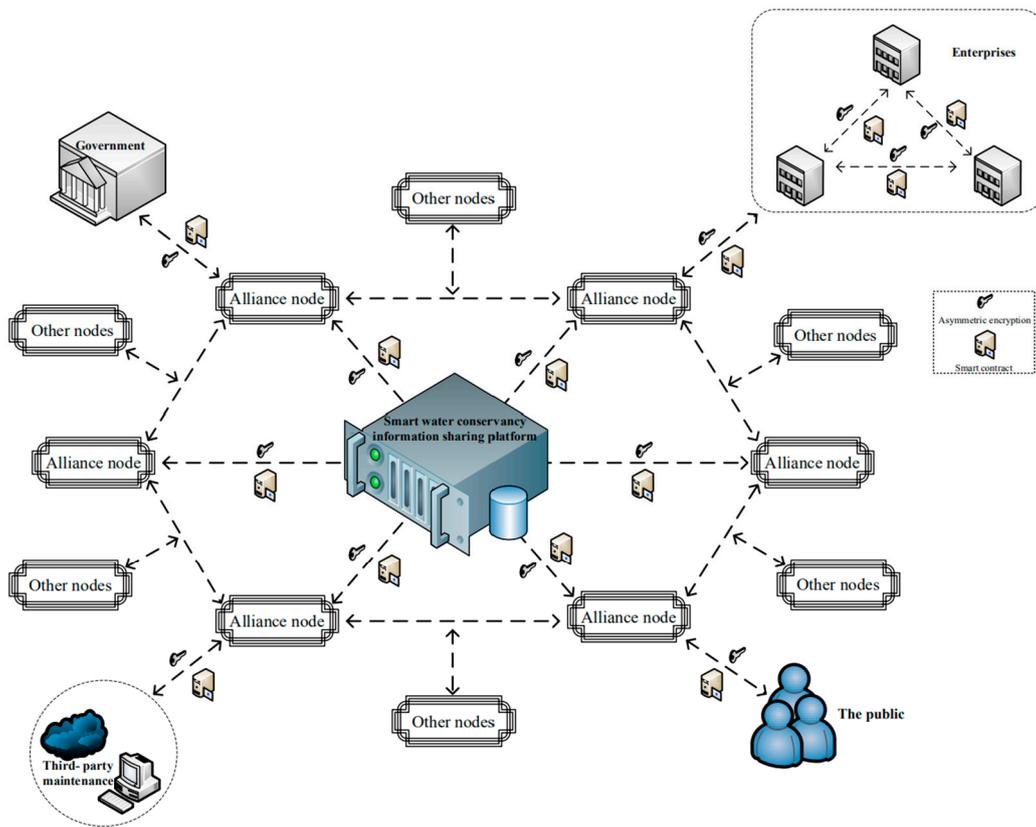


Figure 3. The conceptual model of the smart water conservancy information sharing platform.

4.2.1. Four-in-One and Multicentralized Participants

(1) Government departments

In the construction of smart water conservancy, government departments play multiple roles, such as managers, decision-makers, and supervisors. At present, Chinese water conservancy departments, river basin agencies, and water administration departments are independent of each other. However, mutual trust between them is not high. On the basis of the collective endorsement and trust mechanism of the blockchain system, government departments can transform the traditional single management model into a multiagent common governance model, and establish a flexible horizontal linkage

working mechanism. Thus, enterprises, the public, institutions, and others can adopt a distributed authorization and open approach, and write blockchain codes on their own to access information sharing platforms, thereby eliminating the problem of information islands across regions, levels, and departments, and achieving intelligent water conservancy and collaborative information sharing.

#### (2) Water conservancy enterprises

Water conservancy enterprises include state-owned enterprises, administrative institutions, and private enterprises engaged in water resource development and utilization, water conservancy engineering construction, integrated management of rivers and lakes, water rights market transactions, and other related water conservancy industries. They are the leading service targets of smart water conservancy information sharing platforms. Each one is a robust reflection of the public data of government departments and the market information of the public. The enterprises can directly conduct peer-to-peer transactions through information sharing platforms, and use encryption algorithms and smart contracts to make the transaction information at each link immutable and traceable, which can guarantee the authenticity and reliability of data and the privacy and security of personal information. Furthermore, water conservancy enterprises can improve the transparency and auditability of transaction data under the dual-platform supervision of government departments and the public, eliminate the risks of information asymmetry, and reduce the cost of space–time transactions.

#### (3) The public

Unlike government departments and water conservancy enterprises, the public has limited access to water conservancy industry information. They are usually limited to the publicly available parts of government departments and water conservancy enterprises, and cannot share or even record the latest data they have at any time. Nevertheless, blockchain technology gives the public information viewing and reading and writing permission. In addition, identity anonymity also provides another guarantee for the privacy and security of general account information, and any organization and individual in society can participate in the blockchain anonymously. Besides, the public not only plays the role of market supervision for the entire intelligent water conservancy information system and social public management system, but also may become the collector, processor, and even manager of information resources, not just users. According to the needs of each user and the differences of application scenarios, the smart water conservancy information sharing platform needs to differentiate and customize services based on the construction of standard models.

#### (4) Third-party maintenance

The trust foundation of the mult centralized alliance chain is a consensus mechanism. There are some risks due to the fact that the data recording and maintenance of each block node is reliant solely on participants while being completely disengaged from third parties. For example, when the system faces upgrades or the vulnerabilities cannot be repaired, government departments, enterprises, and the public are obviously helpless. The relationship between block nodes is equal, and problems with smart contracts deployed by any node may affect other nodes, even if the possibility is not high. Moreover, the tamperability of blockchain data increases the difficulty of system repair. The construction of a smart water conservancy information sharing platform can be carried out within the alliance. However, to carry out system development, operation testing, and daily maintenance, professional third-party institutions are required. More importantly, these third-party institutions do not have information read and write permissions, and they can only perform functional testing and data maintenance.

### 4.2.2. Dual-Chain Smart Contract Platform Design

The public chain and the pure private chain are usually single-chain designs, and all participants on the blockchain correspond to a node. When joining, the internal account information must be shared with others to ensure the consistency of the distributed ledger. However, some organizations

or individuals do not share all information in practical applications, such as confidential documents between government departments, contract details between enterprises, customer information, etc. Water conservancy projects are related to the national economy, people's livelihood and economic development, and their essential status is self-evident. Planning and construction must be carried out under the premise of controllable risks and clear rights and responsibilities. Therefore, a smart water conservancy information sharing platform based on the "alliance chain + private chain" dual-chain design is proposed, which not only satisfies the information sharing and flexible expansion requirements, but also ensures privacy and security within the organization.

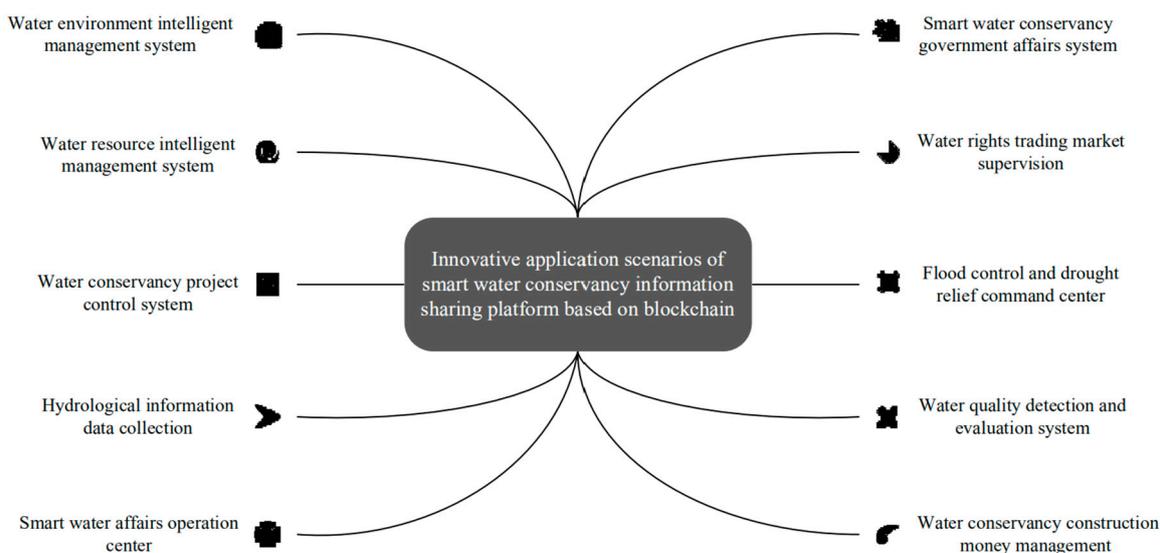
The smart water conservancy information sharing platform is a multicentralized fusion platform composed of two types of blockchains. It allows multiple fixed blockchain platforms, and the nodes of the platform can be linked, integrated, and interconnected, but it is not entirely indifferent. The crucial nodes of the block are controlled by important organizations and have open permissions that other nodes do not have. All nodes are operated and maintained by independent third parties and are supervised by statutory bodies. The entire smart water conservancy information sharing platform is organized with institutional alliances as a unit. After an organization or an individual obtains permission, they can link to the information sharing platform through the alliance node to achieve relevant water conservancy information. The information on the alliance chain can only be authorized by endorsement using the consensus mechanism without affecting the data of other block nodes. For an institutional alliance, it is generally composed of different departments or branches, or even relatively independent individuals. Consequently, the government water conservancy departments, water conservancy enterprises, and the public are highly centralized private chains, both horizontally and vertically. Furthermore, they are used for self-determined accounting, account information storage, and selective transaction information sharing.

Smart contracts and asymmetric encryption algorithms are two core technologies used by the blockchain in the field of smart water conservancy. On one hand, smart contracts are formed by trusted and immutable data on the blockchain. Pre-set rules and terms are negotiated by both parties of the transaction through programming languages as trigger conditions. Once the trigger conditions are met, the contract will automatically run, and the system will not be easily changed. This step can eliminate the risks caused by human operations, optimize the transaction business process, and improve the transaction efficiency. On the other hand, the paired public and private keys are generally used to decrypt each other by asymmetric encryption algorithms. The public key is available, and the private key that matches it cannot be directly derived. The private key is only owned by the individual. If you use one of these keys to encrypt the data, only the corresponding key can be decrypted. If one of the keys can be used to decrypt the data, the data must be encrypted by the corresponding key. The algorithms can also be used for digital signatures and identity authentication.

## **5. Prospects for the Application of Blockchain Technology in the Field of Smart Water Conservancy**

### *5.1. Application Scenarios of the Smart Water Conservancy Information Sharing Platform*

Since the birth of blockchain technology, it has attracted great attention around the world, and its innovative applications can be extended to more and more social fields. The construction of the smart water conservancy industry is currently booming, and the convergent and innovative application of the blockchain can help the digital transformation of the water conservancy industry and further improve the level of intelligent management and services. Some of the main scenarios in which the conceptual model of a smart water conservancy information sharing platform might be utilized are shown in Figure 4.



**Figure 4.** Innovative application scenarios of the smart water conservancy information sharing platform based on blockchain technology.

### 5.2. Convergent and Innovative Applications of the “Blockchain + Water Rights Trading Market”

Currently, water rights play a key role in water resources management and utilization. Moreover, water rights and water markets are also an essential part of the reformation and development of water conservancy. According to market forms, water rights trading markets can be divided into primary markets, for the initial allocation of water resources, and secondary markets, for redistribution. The initial allocation of water rights in the Chinese primary market is completed by the government through administrative means [38,39]. Strictly speaking, there is no formal primary water rights trading market in China, so the water rights trading market here refers to the secondary market. Because of national conditions and the particularity of the economic system, the Chinese water rights trading market formed a preliminary “quasi-market” framework and is gradually improving after undergoing a series of practical explorations and transformation pilots. However, in the process of the construction of the water rights trading market, there are still some shortcomings: First, the roles of the government and the market are not clear, and the boundaries of functions are ambiguous; second, the operating mechanism and system are not standardized, and it is difficult to control the cost of capital and time efficiency; third, there is uncertainty risk in water rights transactions, and the information of the transaction process is asymmetric; fourth, the market supervision system is not complete, and social supervision and public participation are insufficient.

Therefore, we take the water rights trading market as an example, and integrate the application of the smart water conservancy information sharing platform based on blockchain technology, and propose the following innovative development paths to solve the above problems:

#### (1) Consensus mechanisms—participation of multiple subjects

The Chinese water rights trading market is a complex ecosystem involving multiple parties. The main transaction bodies include the government and water users. The former refers to governments at all levels and their authorized departments, enterprises, and institutions. In addition, the latter refers to corporate organizations, nonadministrative organizations, or individuals, such as societies, legal entities, self-employed parties, or water organizations (peasant water user associations). Besides, there are transaction intermediaries (such as the China Water Rights Exchange, various water rights trading centers) that guarantee and verify both parties in the transaction. If these fragmented water rights trading market participants are connected in the form of blockchain nodes, forming an alliance

chain with a consensus mechanism as the guarantee of trust, then each participant can act as a node by accessing the blockchain system to participate in and witness the entire process of water rights transactions. In the alliance chain system, the update and maintenance of the water rights transaction database must be completed by the collaboration of the participants, the authorities. The functions are clearly divided between the subjects and the information exchange, and data sharing is carried out equally. Therefore, a water rights trading operating mechanism for macrocontrol, market allocation, public service, and social supervision by the government can be formed.

### (2) Smart contracts—design of water rights trading

Under different scenario conditions, affected by policy requirements and market requirements, the determination of rights and the transaction process in water rights transactions are dynamically changed. Traditional water rights trading contracts are determined through negotiation between the two parties in the transaction, and a verbal negotiation and condition adjustment make the contract lack of certain standardization and adaptability. Thus, the smart contract that can serve the water rights trading market designed herein is shown in Figure 5. The specific process is as follows: the water rights transferor submits the transfer application; the trading platform reviews and announces the transaction order externally; multiple transferees generate contracts through negotiation or bidding; the preliminary generation of the smart contract (the basic contract and additional contract); both parties evaluate the contract, and if it meets the standard, it is determined. Otherwise, it needs to return for dynamic adjustment and re-evaluation until the standard is reached; after the contract is digitized, both parties sign the contract; after the contract is executed, the platform needs to perform file management and information disclosure on the transaction. The advantage of the process is that the signing, execution, and supervision of the contract can have different methods, regulations, and procedures according to the specific needs. After writing a contract that meets the requirements of the scenario and putting it in the blockchain, the contract contents are disclosed to the relevant nodes. When encountering duplicate or similar contract scenarios, the system is automatically triggered and an action is executed. It can not only exclude information security risks that may be caused by human participation, such as paperless approval and so on, but can also minimize water rights transaction costs and improve work efficiency of the water rights trading market.

### (3) Asymmetric encryption—information sharing and interactive platform

Information asymmetry and privacy security protection are always potential risks faced in daily water rights transactions, hindering the operation and development of the water conservancy market. However, the emergence of blockchain technology can effectively solve this problem. On the one hand, the blockchain itself is an open and transparent distributed ledger co-built by multiple parties. It can realize the real-time synchronization of data of numerous nodes through encryption algorithms, and give participants certain access rights to share these transaction data. Apart from the private account information of both parties in the transaction, other contract information, such as the terms of the parties, the subject matter of the transaction, and the information on the water right certificate, is available, which can solve the problem of information asymmetry in the water right transaction process. On the other hand, asymmetric encryption technology can effectively protect the privacy and security of transaction users. During the transaction, the user information and the blockchain address are completely separated, and the information of the associated user cannot be obtained from the node records. At the same time, user information storage has multiple protection mechanisms such as permission control, access authentication, and encrypted storage. The modification of transaction data must be authenticated by digital signatures. There is also a data comparison mechanism between nodes. In short, the water rights trading market based on blockchain technology is a secure and stable information sharing and interactive platform.

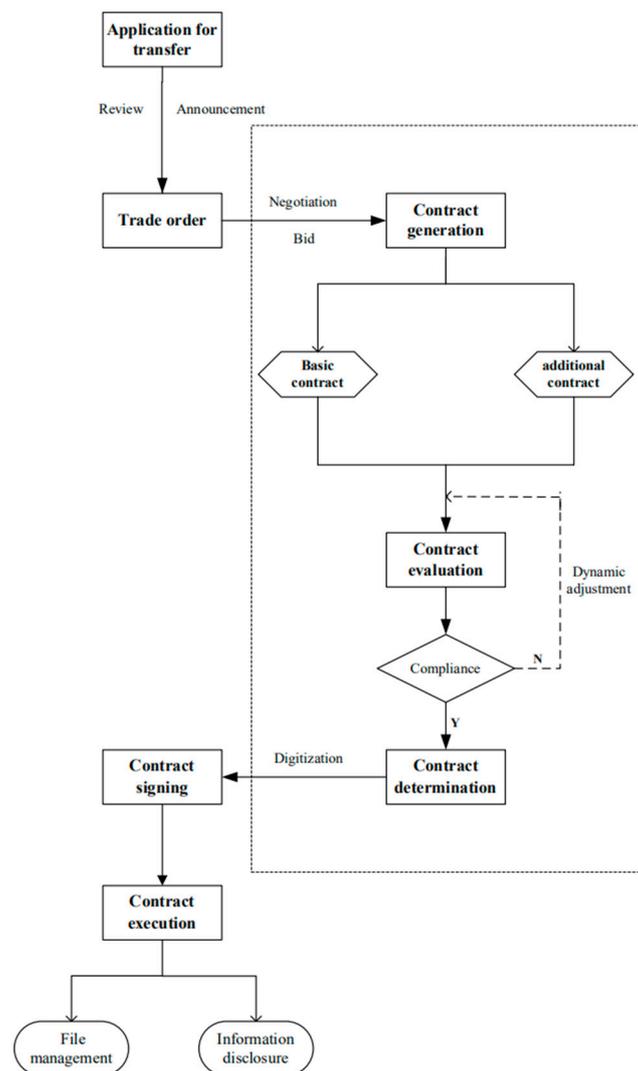


Figure 5. The flow chart of smart contracts for water rights transactions.

#### (4) Information traceability—establishment of social supervision feedback mechanism

The Chinese water rights trading market has long relied on the government-led management and control system. As a result, market mechanisms such as supply and demand, prices, and competition cannot play their due roles. Moreover, the supervision system is simplistic, and the public, especially grassroots users, know little about water rights transactions. The construction of independent third parties and service intermediaries is lagging somewhat behind, and the development of the water rights trading market is extremely uneven. The blockchain can retain the original data and store real-time information, and users leave a timestamp in the use process, so all data recording, querying, and modifications are traceable. Government departments, the public, relevant stakeholders, and independent third parties (verification agencies, news media, etc.) can use the blockchain platform to launch, apply, review, evaluate, register contracts, and disclose information on water rights transactions so as to perform visual supervision. For this reason, a traceable database of water rights transaction processes is formed, timely communication and feedback channels are established, and simultaneously, the dual role of administrative supervision and social supervision is played.

## 6. Questions and Challenges of Research

At present, the development of the smart water conservancy industry is still its preliminary stages, the applications of blockchain technology research are still immature, especially in the field of social management. After investigation and evaluation, the following questions and challenges related to the research are determined:

### 6.1. Questions and Challenges of Smart Water Conservancy

First, a theoretical framework of smart water conservancy based on general conditions is proposed. The situation of China's water resources is complex, and the problems existing in the water conservancy industry cannot be generalized. Specific application scenarios need to be further studied according to specific conditions.

Second, the construction of the system and the platform lack unified planning. There are also a lot of severe phenomena related to low-level repeated development and repeated construction. The investment in project construction is huge, and many companies have insufficient funds. Therefore, it is necessary to flexibly apply national policy support and strive to attract diversified capital forces to enter the game, providing substantial support and solid guarantees for the development of smart water conservancy.

Third, the auxiliary decision-making and statistical analysis systems are insufficiently equipped, and the popularization of professional training cannot keep up, which cannot effectively meet the application needs of the smart water conservancy information sharing platform. Therefore, it is necessary to cultivate new types of talent with relevant knowledge in order for there to be sufficient human resources for the long-term development of the industry.

### 6.2. Questions and Challenges of the Blockchain

From the aspect of the market, the standards among stakeholders have not yet been unified, and there is no effective coordination mechanism. In order to apply blockchain technology, government departments, water conservancy enterprises, the public, and third parties need to adjust internal processes and receive professional training related to the information sharing platform.

From the aspect of the technology, there are many blockchain platforms, and a number of enterprises do not understand how to apply blockchain technology. The introduction of this technology requires lots of capital investment, and in this regard, government departments may have an advantage. Besides, a larger scale blockchain means weaker computing power, which may limit the development of the smart water conservancy information sharing platform.

From the aspect of the supervision, the international community has different attitudes towards the blockchain industry, leading to inconsistent formulation of blockchain regulatory standards. Although China has issued a list of blockchain regulatory policies to conduct blockchain supervision from multiple dimensions and multiple links, data protection laws probably create several problems, and blockchain nodes are likely to span jurisdictions.

## 7. Conclusions

In the era of the rapid development of information and intelligence, countries and industries around the world are actively digitizing. As an emerging Internet information technology, the popularity of the blockchain in various applications is exploding around the world, bringing new development opportunities for digital transformation, technology integration, and innovative applications in the smart water conservancy industry. Consequently, this research on the construction of the Chinese smart water conservancy platform based on blockchain technology has fundamental societal contributions.

First, at the theoretical level, the concept and development history of smart water conservancy are explained, and then the basic definition of smart water conservancy is given. At the practical

level, successful smart water conservancy construction projects at home and abroad and their technical characteristics are summarized. According to the concept and characteristics of smart water conservancy, a basic framework for the smart water conservancy system, including three service objects, three perceived objects, five application levels, and three support and guarantee systems, is designed.

Second, after reviewing a great deal of literature, we found that the development of the blockchain has roughly gone through three stages with a wide range of applications. The academic research on blockchain is also divided into three levels, and this research mainly focuses on the third level. The technical principles of the blockchain and the infrastructure model are analyzed. The three mainstream consensus mechanisms in the core module are emphasized, and their advantages and disadvantages are compared.

Third, the three types of blockchain are compared, and it is found that the alliance chain is more suitable for our research. A conceptual model of a smart water conservancy information sharing platform is established. The platform has four-in-one and mult centralized participants including government departments, water conservancy enterprises, the public, and third-party maintenance, and the design is one of a “alliance chain + private chain” dual chain smart contract. Fourth, innovative application scenarios for the smart water conservancy information sharing platform based on blockchain technology are discussed. Taking the water rights trading market as an example, an innovative development path with a consensus mechanism, smart contracts, asymmetric encryption, information source tracing is proposed.

Finally, after investigation and evaluation, the questions and challenges of smart water conservancy and blockchain technology are addressed. Among them, smart water conservancy may have issues related to universal applicability, redundant construction, insufficient funds, and a lack of professional talent. Blockchain technology may have issues regarding the unification of the market coordination mechanism, the selection of technology platforms, and the formulation of supervision standards. The above questions and challenges need further research and exploration in the future.

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