LUND UNIVERSITY • CENTRE FOR EAST AND SOUTH-EAST ASIAN STUDIES

Development of Water Markets in the Yellow River Basin:

A Case-Study of the Ningxia Hui Autonomous Region

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ABSTRACT

The Yellow River Basin Commission (YRCC) is struggling with demand and supply water imbalances due to inter-jurisdictional rivalries, and has consequently promoted the development of water rights trading to incentivize provinces from not exceeding their allocated withdrawals in the Yellow River Basin (YRB). This thesis employs the case of Ningxia Hui Autonomous Region to examine factors that facilitate or hinder market-based water rights allocation in the YRB. By reviewing scholarly literature, governmental reports and conducting interviews with governmental officials and water rights experts, it argues that two features of China's water resource management shape water markets in Ningxia: asymmetric information and lack of coordination mechanisms. The flaws in the performance of Ningxia's water rights transfer system – including inconsistency and lack of integration between the Yellow River Water Allocation Plan and abstraction permits; little consideration to groundwater and surface water linkages – stems from asymmetric information on hydrology and abstraction licenses and absence of formal mechanisms for cross-sectoral coordination. As economic development proceeds in the western interior regions along the Yellow River Basin, the pressure to reallocate water between agriculture to industry through inter-sectoral water trading will increase. Consequently, trade-offs between energy *vs* food production, higher-value use *vs* equity & environmental flows as a result of tradable water rights is to some degree inevitable; however, collective action challenges of exclusion and coordination tied to mitigating these tensions will put the existing institutional framework governing water rights under growing pressure.

Keywords: Water markets, institutions, central-local relations, water management, Yellow River Basin, water-energy nexus

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GLOSSARY OF TERMS

Consumption Volume – The net amount of water extracted from a river or aquifer.

Transfer – a change to the holder of a water right, whether by agreement between two parties, or compulsory reallocation done by government.

Water Abstraction – The total water diverted from the river, lake or underground body.

Water Abstraction Permit – Permission to take water. The Water abstraction License is the official certificate for water abstraction.

Water Abstractor – The unit or individual who takes water from the river, lake or groundwater body, either for their own use or to deliver it to other water users.

Water Resouces Allocation Plan – A plan prepared by a water administrative department or river basin authority to define the water available to administrations and users below that agency for a period of years into the future.

Water Right – Any entitlement of a region, unit or indidual to water. Includes: rights to allocate water and to take water; long-term rights to water as well as the water available during a year or season; includes rights under a permit as well as statutory rights such as those of agricultural collectives.

WUA – Water User Assocation

YRB – Yellow River Basin

YRCC – Yellow River Basin Commission

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To all those who have been in motion with me over the years:

The sated day is never first.
The best day is a day of thirst.

Yes, there is goal and meaning in our path -
but it's the way that is the labour's worth.

The best goal is a night-long rest,
fire lit, and bread broken in haste.

In places where one sleeps but once,
sleep is secure, dreams full of songs.

Move on, move on! The new day shows its light.
Our great adventure has no end in sight.

1. INTRODUCTION

This thesis will start with introducting the research problem that the thesis investigates. Following, it moves on to present the aim and purpose of the thesis as well as the social and scientific relevance of the study.

1.1 Problem Statement

Empirical study reveals that market-based instruments are often not sufficiently effective to induce changes in water use behavior at the local level in China. Instruments, such as licensing of water rights and levying charges for possessing these rights, are modified and filtered by institutionalized practices leading to weak policy implementation on the ground (Wei et al., 2011). At the heart of central-local relations lies the enforcement-gap between centrally determined policy targets and effective local policy implementation (Schröder 2011:27). In a vast country like China, where concrete measures for financing and meeting central targets are left to local administrations, raises the question of how can the central government create market-based solutions to its water shortages to induce local compliance and avoid excessive water withdrawals?

The Yellow River Basin (YRB) exemplifies the challenge of incentivize local governments to adhere to national water quotas. Several provinces in the Yellow River Basin, including Inner Mongolia and Ningxia, have exceeded the water quota allocated when the Yellow River Water Allocation Plan was issued (Wang 2012). Compounding the water challenge is the fact that energy is vital to extract, treat, distribute & supply water and water is essential for energy extraction, processing and production (Olsson 2012:3-4). Along the YRB, the three provinces in China with biggest coal reserves, namely Shanxi, Shaanxi and Inner Mongolia account for more than half of the total national coal output and 16 % of thermal power generation, but only have 3 % of national water resources (Anadon & Zhang 2013:3). Therefore, possibilities for water use efficiency through inter-sectoral and up- and downstream water allocations have been seen as ways of coping with the new industrial demands for water (Jia et al., 2008). One option to hold off the confrontation between scarce water resources and growing coal-based industrial sector in Ningxia and Inner Mongolia is “an investment for water saving and water rights transfer measure” sanctioned by the Ministry of

Water Resources and the Yellow River Basin Commission (YRCC). It is regarded as a win-win game, not only solving the water demand of new industries, but also promoting the water efficiency of agricultural water use. Since 2003 more than two dozen cases of water rights transfer[1] occurred where water is being reallocated from agriculture to industry through irrigation efficiency, generally by reparing canal lining. While on paper the framework for water right allocation is comprehensive, research in Inner Mongolia has shown that in practice, ecological impacts and limited stakeholder involvement, undermine its strenght and effectiveness (H. Zheng et al., 2009:376). This study, by looking at water rights transfer projects in Ningxia, seeks to fill a void in the literature: there are studies of water rights trading with transaction costs in the YRB (Wang 2012) and case-studies of water rights trading in Hangjin district, Inner Mongolia (Hang et al., 2009), but none – in the english academic literature – specifically focus on Ningxia.

1.2. Aim and Purpose

China's rapidly rising need for energy is restrained not only by the threats of climate change but also scarce water resources. Market mechanisms are regarded as a crucial component to enhance efficient water use. The purpose of this study is to examine factors that facilitate or hinder market-based water rights allocation in the YRB.

1.3. Research Questions

Following the problem statement and the aim of the thesis I analyze the application of market-based instruments in Ningxia by looking at water rights transfer. My main research questions are:

(1) How does a normative solution to water rights transfer look like?

(2) How do formal institutions in China and Ningxia regulate water right transfers?

[1] The role of government has played an important role in the previous reallocation of water rights in China compared to a pure market-based approach. Thus, in this thesis the phrase "water transfer" is used rather than "water trading".

(3) What are the current problems and potential solutions to water rights transfer in Ningxia?

1.4 Thesis Structure

Following the introduction of the thesis research problem, chapter 2 justifies the thesis by identifying a empirical gap and how the thesis contributes to current research. Subsequently, chapter 3 presents the chosen methodology and the reasons for it. Chapter 4 gives a in-depth understanding of water markets and the institutional dimension of water markets in China drawing from New Institutional Economics (NIE), which serves to form my theoretical framework. Chapter 5 presents the empirical findings from Ningxia province. Finally, chapter 6 analyses the collected data and answers the three research questions before highlighting the implications the finding have on the future of water rights trading in the Yellow River Basin. The thesis concludes in chapter 7.

2. LITERATURE REVIEW

This chapter gives a overview of water markets research in China concerning water rights trading in order to identify a research gap.

2.1. Research on Water Markets in China

Market-based water transfers have since 1980s been gradually developed and the number (and volume) of water transfers within and between sectors are expected to increase manifold in the future (Varghese 2013:3). While water rights market in theory has a lot of potential, in practice there exist various factors which constrain the applicability of market-based water-trading as a response to water scarcity. In China, the YRB has been the site of several water rights transfer initiatives since 2003 with the common characteristic of ”investing in channel lining and transferring water rights”, creating water savings which were allocated on an administrative basis to industries. The grant of water rights at the farmer level for undertaking water rights trading has also been practiced but occured to a limited extent to date because it is still unclear how water trade should be established and implemented. Research emphasis that factors such as incremental licensing, poorly specified entitlements, limited recognition of environmental flows, and a lack of security of entitlement and restrictions on transferring water rights undermine the certainty, security and sustainability of the water rights system (Speed 2009:396). One important factor that has been emphasized in many studies to constrain water rights trading is transaction costs (Wang 2012; Zhang 2007; Zhang et al., 2009).

Wang’s (2012) results from simultation of water markets with transaction costs in the YRB show that the potential benefits from the trans-jurisdictional water markets are considerable in the condition of zero transaction costs, and the benefits increase with the decrease of transaction costs. Moreover, the results imply that the inter-sectoral market between agricultural and industrial actors has a larger potential and tolerance capacity for transaction costs than the development of trans-jurisdictional water trading within the agricultural sector. Since the industrial actors are less sensitive to the transaction costs because of higher economic returns from the water use and greater capacity to pay various costs, the water trading between the industrial and

agricultural sectors is more feasible and more likely market form in the future, which explains why transfers have been conducted in Inner Mongolia and Ningxia.

In this context, research from the channel lining and water rights trading programme in Hangjin, Inner Mongolia has shown that the irrigation water that has been traded to downstream factories has helped alleviate the water shortages experienced by industry, and has also helped reduce the burden of farmers by saving water and reducing farm costs. Farmer's costs have reduced because they dont have to pay for water losses in the channels that deliver water to the point where water user associations (WUAs) make bulk purchases on behalf of the farmers they represent. However, H. Zheng et al. (2009) also highlight problems:

- *Decline in agency income:* as less water needs to be delivered to farmers following canal lining, water ticket sales and revenue has declined for the Hangjin Irrigation Management Bureau.

- *Possible third party impacts:* the transfer may affect users outside the district by reducing leakage and hence groundwater recharge.

- *Irrigation remains inefficient:* although the water efficiency between sectors has improved, the water rights transfer has not led to more "crop per drop" within the district by farmers.

- *Water rights within the district remain ambiguous:* the YRCC has clearly defined water abstraction permits to Hangjin irrigation district but water rights to WUAs and farmers within them are not.

- *Monitoring is rudimentary:* water monitoring is based on equipment and method used in the 1950s and recording is carried out by hand.

Speed's (2009) findings on transferring and trading water rights in China suggest that many problems are rooted to the importance of clearly defined rights and the systems that govern them. Speed's research summarizes these barriers to the applicability of

water rights trading in the YRB: ”*Despite efforts since the introduction of the 2002 Water Law, water rights in most cases in China are not well established at the regional, abstractor, or farmer level. Rights have often not been granted at all, and where they have, the rules surrounding the rights are often ambiguous”* (Speed 2009:276). Both Speed’s (2009) and H. Zheng et al. (2009) academic reports are the result of the Water Entitlements and Trading (’WET’) Project undertaken under the auspices of the Australian Department of the Environment, Water, Heritage and the Arts and the Chinese Ministry of Water Resources in 2006. The final report ”Development of Water rights and Trading in the People’s Republic of China” for the WET project aimed at reviewing existing arrangements and ongoing developments related to water rights in China to provide recommendations on a framework for water entitlements and trading that could be implemented across China (WET 2006:5).

Based on site investigations in Zhejiang, Fujian, Jiangxi, Gansu, Ningxia, Xinjiang and Inner Mongolia regions and Tianjin Municipality, the report found that the existing legal, institutional and management arrangements are solid for establishing a water rights system but several shortcomings taken in implementing water rights hamper its function. Problems such as unclear roles of different governments, poor connections within water management system, lack of definition & security and certainty of rights, not all water & water users captured, no trading framework, limited recognition of environmental needs, limited rights of farmers, limited system capabilites, limited transparency & public participation, and absence of a framework has led to wide regional variation for how water rights are assigned and managed (Ibid). In the case of Ningxia, the report found that 3 pilot projects had been implemented between irrigation districts and industries at abstractor and not farmer-level. Furthermore, the findings suggest that groundwater is not closely managed and therefore raised concerns over groundwater and surface water linkages during water rights transfers. Conclusions from the site-investigation in Ningxia also emphasized the importance of developing a method to link consumptive water resource allocation plans to water abstraction permitting as a basis for water-rights trading in China (Ibid:164).

2.1. Thesis Contributions

This thesis advances empirical research on water markets in China in three ways. Existing research tend to emphasize property rights and transaction cost of water markets, rather than the role of political relationships and institutions which shape market-based water rights allocation in the YRB. Yet because of China's centralized political system and decentralized market-economy, the role of governments and institutions in establishing and maintaining a framework for effective market-based instruments at the micro-macro level are key to understanding Ningxia's transfer schemes toward meeting the challenge of water scarcity in the YRB. Secondly, though scholars have paid attention to issues related to efficiency, equity and sustainability they don't address their tradeoffs. Furthermore, despite that the water-energy nexus is at the heart of China's future water challenge where the water footprint of energy development and the energy footprint of water are large and growing, the linking of our two most precious resources have been overlooked in previous studies on water markets and water rights transfer schemes. In this light, the energy sector is a major user of water resources: energy production is responsible for 61.4 billion m^3 water withdrawals, 10.8 billion m^3 water consumption and 5.0 billion m^3 wastewater discharges in China, which are equivalent to 12.3 %, 4.1 % and 8.3 % of the national totals, respectvely (Anadon & Zhang 2013:1). According to the 12th five year (2011-2015) development plan, total capacity of coal-based thermal power is expected to reach 0.93 TW in 2015 and 1.17 TW in 2020, compared with 0.71 TW in 2010 (Ibid:15). Stimulated by the impulse of promoting local economic development, local governments in coal production provinces in Inner Mongolia and Ningxia are, however, subject to the constraints of water resources. This raises a key question: how can the national government enjoy the benefits of decentralization by driving provinces in the Yellow River Basin to expand coal-production for satisfying increasing national energy demand while at the same time keeping localities under check for not exceeding water limits set out in the Yellow River Water Allocation Plan?

Against this background, this study seeks to advance understanding of what factors facilitate or constrain the applicability of market-based instruments to enhance

efficient water use in Ningxia province where climate change and energy are major components of YRB's water scarcity challenge. By studying transfer schemes in a transitional country, this thesis will shed light on what can be learned from Ningxia's experience with market-based instruments with the aim to improve water resource management in the YRB.

3. RESEARCH DESIGN

This chapter presents the ontological and epistemological foundation of this study, motivates a qualitative approach and discusses the implications for the chosen research method. Finally, I discuss data collection, generalizability and ethical considerations.

3.1. Ontological and Epistemological Considerations

My research on water markets in the YRB takes its ontological and epistemological point of departure in critical realism, yet it deploys an interpretivist methodology. For critical realists, reality – such as water resources in the YRB – exists independently from researchers ideas and descriptions of it. However, reality does not just consist of material objects but ideas and discourses embedded in the management of the YRB that can explain responses to water scarcity in the YRB. Therefore, as a critical realist I share the interest of positivism in the objective world, patterns, generalization and in finding causalities, but I also diverge from this tradition to reduce the world to observable objects and facts outside the subjective domain (Alvesson & Sköldberg 2009:40). In contrast to establish predictable patterns and the exact relation between cause and effect, critical realism emphasizes the ideal and possibility of causal explanation (Ibid:42). More importantly, this thesis does not seek to find a reality that can be regarded as definite but rather to interpret contingent factors – such as transaction costs, property rights and institutions - that shape transferring and trading water.

3.2. Qualitative Research

Since the purpose of the study is to employ the case of Ningxia to examine factors that facilitate or hinder market-based water allocation in the YRB, I have adopted a

qualitative approch which uses semi-structured interviews. It is theory-driven in nature and seeks to evaluate water transfer practices against the backrop of a normative solution to the problem, namely promoting water-use efficiency for both agriculture and industry under unified management. As such, neoliberal theories rests on the assumptions that individuals have perfect information about the market, and that there are no transaction costs of exchange. Often, these assumptions are not met in reality. This thesis, therefore, expands the analysis beyond a neoliberal economics approach by including transaction costs theory, property rights theory and collective action. Developing an institution-based theoretical framework is a sensible approach to explain the challenges and opportunities of market-based water-allocation in the YRB and specifically in the case of Ningxia.

Semi-structured interviews will be conducted with an open framework, which can provide insights into how participants view the water rights transfers. By using semi-structured interviews I can ask supplementary questions, deepen the discussion and adjust the emphasis in the research as a result of significant issues that emerge in the course of interviews (Bryman 2012:470). *Primary data* was obtained in semi-structured interviews with governmental officials and water experts who I selected based on recommendations coming out of the snowball process. From February 27th to April 2th 2014, I carried out fieldwork in Beijing, Henan and Ningxia provinces where I conducted seven semi-structured interviews. Most of the interviews were done in English, except two interviews with officials from Ningxia Water Resources Department that were conducted in Chinese together with an interpreter from Ningxia University. All the interviewees wished to remain anonymous, except for a water expert from China Academy of Sciences. They are:

Mr. Jia Shaofeng (Chinese Water Resources Management Expert, Professor, Institute Of Geographic Sciences and Natural Resources Research CAS),
Anonymous researcher (Chinese Water Rights Expert, Professor and Vice Dean, Tsinghua University),
Anonymous researcher (Chinese Water Resources Management Expert, Professor, China Institute of Water resources and Hydropower Research),
Anonymous official (International Cooperation, Science and Technology, YRCC),
Anonymous official (Department of Water Resources Management and Regulation, YRCC),

Anonymous official (Ningxia's Department of Water Resources Governance), Anonymous official (Water Saving Office at Ningxia's Water Resources Department)

Information from the interviewees were supplemented with *secondary data* from governmental reports, scholarly literature and news-reports. The rationale for a heterogeneous sample or triangulation is to employ maximum diverse variation in opinions to converge lines of inquiry (Creswell 2007:127-128; Yin 2009:98).

3.3. Selection of Case

Given that the thesis is based on water rights transfers in Ningxia, this thesis employs a qualitative case study research method that "investigates a contemporary phenomenon in depth and within its real-life context" (Yin 2009:18). In this context, a "multiple case study" is preferable where the focus is on one issue (e.g. water rights transfer) but where I select 8 pilot projects within a single province, namely Ningxia, to illustrate the issue (Creswell 2007:74). My selection of eight pilot-projects in Ningxia is based on three factors: a topical concern with illustrating market-based mechanisms to address water-shortages, a methodological concern with advancing social scientific thinking on conducive factors and constraints in establishing water markets, and a practical concern for collecting data, as these cases in Ningxia have not – to the author's knowledge – been previously described in english academic literature. Even if there are quantitative studies showing that market-based instruments – such as water abstraction policies – are not working at the local level due to governance failure, the institutional heterogeneity in China makes it difficult in pinpointing out underlying factors why market-based instruments fail or not. Therefore, this study eliminates institutional differences by looking at eight pilot projects undertaken in a single province, Ningxia.

3.4. Validity and Reliability

Recognizing that complete objectivity is impossibe in social research, critical realism emphasizes the importance of multiple measures and observations to address validity and reliability. In this light, I have collected multiple forms of data, which include triangulating data from several sources to ensure greater confidence in my findings. Furthermore, in order to ensure good linkage between my findings and the

perspectives of participants I revisited interviewees to confirm or correct statements. To ensure credibility and being transparent in my findings I have quoted extensively from the interviews so that the reader can follow that my research has been carried out according to good practice.

3.5. Generalization

Social science, according to Flyvbjerg (2006), ”*has not succeeded in producing general, context-independent theory and, thus, has in the final instance nothing else to offer than concrete, context dependent knowledge”* (Flyvbjerg 2006:223). In this light, this case-study aims to contribute to context-dependent knowledge by producing knowledge that can provide lessons to build on. Conducive factors and constraints in establishing a water rights transfer system in Ningxia can draw out lessons rather than proofs to other provinces in the YRB that seek to rely more on the market to reallocate water from agriculture to industry.

3.6. Ethical Considerations

Ethical dilemmas are embedded in interviews with the concepts of relationships and power between me as a researcher and my respondents (Orb et al., 2001:93). Orb et al., (2001) note that researchers negotiate access to participants to collect information and the quality of the interactions between researchers and the participants may facilitate or inhibit access to information (Ibid:94). Therefore, I attached great importance to encourage disclosure, trust and awareness of ethical issues to my respondents. In order to ensure ethical responsibility in qualitative research, an informed form[2] with questions was presented to interviewees prior to conducting an interview where I declared the purpose of my research and anonymity was guaranteed.

[2] See Appendix.

4. CONCEPTUAL BACKGROUND AND THEORETICAL FRAMEWORK

This chapter provides the reader with concepts essential to understand water markets and their implementation, and goes on to discuss the economic rationale behind market-based water-allocation. Subsequently, I discuss conducive factors and constraints for water markets highlighted in the literature and place it within China's water resources management context. Finally, I develop a analytical framework drawn from New Institutional Economics (NIE) that is beneficial for identifying strengths and limitations in Ningxia's water rights schemes.

4.1. Concept's in Water market literature

Institutions

Institutions are defined as the "humanly devised constraints, formal (rules, laws, constitutions) and informal (norms of behavior, conventions and self imposed codes of conduct), and their enforcement characteristics" (North 1990). Institutions play a major role in determining economic and political development of a society.

Private property rights

Water rights, defined as the rights and restrictions over the use of particular water resources, are pivotal for the establishment of tradable water rights to allocate water within and across sectors. The effectiveness of property rights depends, however, on the extent to which they can be defined, established, transferred and maintained. Strength and security of property rights therefore hinges on relationships between individual rights holders and the institutions that back up those claims (Meinzen-Dick et al., 2013:26). Moreover, rights can be backed by diverse institutions – state, customary, religious laws or other normative principles – and how effective these claims are depend on recognition of rights through internalized legitimacy or external enforcement (Ibid). However, each property rights system – whether it is private, common property or state ownership – have strengths and weaknesses and even if they are defined and enforced properly they cannot resolve all problems related to inefficiency or disputes (Maestu et al., 2013:5). For instance, water resources can be conducive to management via private property rights to facilitate the reallocation of

water to higher-value uses. One the other hand, access to water is also a human right and its allocation cannot be solely basked on market principles if this excludes social groups from accessing water.

Transaction cost's

High transaction costs discourage trades and are an important factor in restraining water rights trading. Whether market or non-market, transaction costs are high for any reallocation process due to the complex effects of one persons water use on others and could be large enough to block market-pricing or tradable water rights in many cases (J.Zhang et al., 2009:96). In this context, Garrick et al (2013) broadly refer transaction costs to the resources required to:

(1) *"define, establish, transfer and maintain property rights"*. This definition focuses on costs of information, bargaining and other costs associated with specifying contracts.

(2) *"address collective action challenges of exclusion and coordination in natural resource management"*. This definition addresses costs of collective action challenges – exclusion and monitoring – tied to public goods and free-riding in the provision and maintenance of water infrastructure and freshwater ecosystem services.

The first definition of transaction costs are broadly the costs of establishing a system, including information costs, bargaining and decision-making costs, contracting costs while the second definition are the costs of implementing a system, including monitoring costs, enforcement costs, etc (Garrick et al., 2013:196).

4.2. Water markets through A New Institutional Economics Approach

Conducive factors and constraints for water markets

The founding principle for water markets is based on the belief that tradable water rights give water a value and provide an incentive to use water more efficiently since water saved can be used to increase production or sold (Bjornlund & McKay

2002:771). However, market-based water trading will only achieve a socially optimal allocation of water if the following conditions hold: the market is highly competitive (individuals cannot control price), buyers and sellers exclusively enjoy and incur all benefits and costs associated with their decisions (no externalities, public goods), an efficient flow of market information (for example price) where the market does not have greater transaction costs than other allocation mechanisms (Maestu et al., 2013:7). In reality, waters mobility and variability makes theoretical assumptions of a self-maintaining allocation-system with little need for government involvement unlikely to be fullfilled given costly exclusion and collective action to manage interdependent private (irrigation transfers) and collective (environmental flows) water-related goods (Garrick et al., 2013:196). Given that the Chinese government has taken an active role in facilitating the emergence of quasi water markets the neo-classical economics assumption of water markets needs to be supplemented with an institutional dimension.

A recent study by Grafton et al., (2010) employs an integrated framework to assess and compare the institutional foundations, economic efficiency and environmental sustainability of water markets in Australia, the western US, Chile, South Africa and China and found that effective institutional arrangements and allocative mechanisms are of importance for a well functioning water market. In this light, the New Institutional Economics (NIE) provides a robust analytical framework for examining conducive factors and constraints for a water rights transfer market in Ningxia (See Table 1). The reasons for choosing the NIE approach are twofold: it draws knowledge from a number of schools of thoughts and is not constrained by the tools of any single analytical framework (Sharma 2012:41) which is beneficial for studying complex issues such as the development of water trading. Secondly, the flaws in the performance of Inner Mongolia's water rights trading schemes, highlighted in the literature review, are attributable to the institutional arrangements under which water is managed. Failure to define and secure water rights to WUAs & farmers, lack of information and monitoring systems, and poor recognition of environmental flows are linked to NIE:s theoretical core derived from interrelated theories of transaction, property rights and collective actions that can help diagnose similar challenges in Ningxia. Based on the new institutional economists such as North (1990) on institutions, Williamson (1998) on transaction cost, Coase (1960) on property right's

and Ostroms (1990) theory on collective actions, three components of the NIE approach are of importance to this study: transaction costs, property rights and collective actions. Contrary to the neo-classical economics tradition, the NIE recognises that rationality is bounded by time and information asymmetry, transactions are not costless and bargaining strengths are not always equal (Maziotis et al., 2013:4). As pointed out by North: ”we have incomplete information and limited mental capacity by which to process information...In such a world ideas and ideologies play a major role in choices and transaction costs result in imperfect markets” (North 1993:1).

Due to incomplete information, institutions are needed to reduce human uncertainty, reduce transaction costs and incentivise agents to act together in which cumulative experiences and collective learning are best utilized (Ibid:5). Thus, instituional arrangements are supposed to facilitate efficiency through low transaction costs and property rights. However, institutions are controlled by the will of those with bargaining strength which in turn is linked to water user’s economic strength and knowledge of and access to formal water organisations within the larger institutional framework (Jenks 2009:21). Institutions – such as WUAs – are made up of agents bounded together to create and implement water markets. Delegate rights and powers over water to WUAs at lower levels in a politico-administrative and territorial hierarchy shape markets. As the case of Inner Mongolia has shown, those with the bargaining strength shape the direction of economic change: farmers and WUAs dont have defined and secure entitlement and have to ’bid’ for water in negotations with IMB while the IMB and industrial enterprises are able to put the scarce water resources to highest-value use.

Since it is important to have adequate information concerning water supplies and demands for water markets, clear legal rights over water to WUAs can play a pivotal role in providing such information and reduce transaction cost by creating a process of acceptable behavior which can improve the likelihood of a socially equitable redistribution of water (Dinar et al., 1999:103). At the same time, unclear and incomplete registry of water rights will not only fail to give the owner an incentive to improve the water resource consumption but also encourage the water rights holder to ignore social and other external costs. Failure to address externalities and potential damage to third parties claiming they have been damaged by a transfer raise

transaction costs and result in the over-utilization of the resource (Donoso 2013:126). As a result, property rights not only need to be well-defined to reduce transaction costs but are dependent on the effectiveness of the institutions that enforce the rights so that a new level of efficient equilibrium of resource-use can be achieved (Maziotis et al., 2013:6). Other problems that raise transaction costs include the lack of sufficient infrastructure to transfer water among potential buyers.

In summary, the NIE perspective sees competition over scarce resources driven by rationality not always as the best option for economic goods like water. Transaction costs stemming from production and information imperfection demands institutions to moderate information asymmetry and align incentives for effective water allocation through markets. On the other hand, the hierarchy of power in the institutional structure determines which and how transaction costs are borne by actors which shape the direction of economic markets (Jenks 2009:20). Difference in bargaining strength implies that enterprises vis-à-vis local governments can pull the teeth of water rights trading initiatives by not providing legal and enforcement support that end-users need to exercise rights efficiently. The next section discusses the theory of transaction costs and collective action in the Yellow River Basin to identify conducive factors and constraints embedded in China's water management system which shape water rights markets.

Transaction costs and collective action in the Yellow River Basin

Ostrom's theory of collective action (1990) highlights the impacts of transaction costs on the likelihood of effective collective action in common-pool resources, including the cost of exclusion, information, and collective action to establish, monitor and enforce boundaires (Garrick 2013:197). Factors include the number of people involved; heterogeneity of interests; rules governing decision-making; norms, trust and social capital; and degree of centralisation (and therefore degree capacity for local users to devise and change rules). Common pool resources in the Yellow River Basin which cross provincial boundaries are subject to externality problems and have been placed under regulation by the YRCC. In order to internalize external effects caused by multiple water uses in different jurisdictions, the central government has adopted several strategies for a unified approach to manage water resources in a river basin

context. The 2002 Water law is a signal of centralization of water resources management with the law providing that "the state shall exercise a water resources management system of a river basin management in conjunction with jurisdictional management" (Shen 2009:484). Additionally, the 2008 Water Pollution Prevention and Control Law also mandated water pollution control to be based on river basin and not provincial boundaries. However, these laws only refer to "voluntary mediation" and superior-level "administrative-handling" of disputes and doesn't provide any formal inter-jurisdictional dispute resolution mechanism (Moore 2014). In pararell with the progression of establishing central control and supervision mechanisms, the development of a market-based water rights system is supposed to contain provinces attempt to to escape the centre's water resource allocations in the YRB. A market-based water rights trading scheme presupposes several factors, however, including that each transaction operates under a highly competitive market with an efficient flow of market information where individuals cannot control price. Yet two features of China's water resources management deviate from these preconditions: information asymmetry and absence of coordination mechanisms (see Table 1).

China's water resources are governed by a dual leadership system (Figure 1). Formally, each level of government is hierarchically clearly defined, with core leadership at the top and individuals linked to vertical ministries that control units from the centre to the local level. In practice, however, this hierarchical chain of organization in the water management system is characterized by vertical and horizontal fragmentation. *Horizontally*, at every level of government several institutions are involved in water management. At the central level, the State Council play's an overarching role through enactment of laws/regulations and supervising their implementation and coordination. Furthermore, the dual track system is replicated at the local (province, prefecture, county) level. Water resource bureaus at the provincial level and water affairs bureaus (WAB) at the prefecture level, which are overseen by MWR at the central level, are responsible for the administration of water rights, the planning and operation of water utilities, and the protection of water bodies on the basis of water function zones. *Vertically*, the existing regime of water resource management is mainly based on administrative boundaries of different levels of government rather than at the river basin level. Thus, the offices and agencies of the

two bureaucracies with the same administrative rank *buji* 部级 cannot issue binding order to each other. Individual functional units at the vertical chain receive administration guidance from their parent units above them; they are also subject to the leadership of the local governments to which they belong (Gang 2009:19). In all cases, it is the local government, not the higher levels of the water resources apparatus that provides local water bureaus with their annual budgetary funds. Thus, the ability of WABs to enforce laws is compromised by their dependency on local government for their authority and budget. Moreover, communication between functional units at the same territorial level is limited. For instance, the YRCC has no power to prevent provinces from exceeding the allocation of withdrawal quotas. In this light, Moore (2014) argues that China broadly lacks effective means to solve horizontal collective-action problems between administrative units of equal rank and that provinces in the YRB have managed to exploit loopholes in the system of vertical control to pursue inter-regional competition for scarce water resources.

As a result, the water resources allocation system that encompasses allocations at the river basin/regional level, at the abstractor & farmer level not only requires perfect coordination at the vertical and horizontal levels of government & ministries but also reliable hydro-ecological and water-use information which are detailed, costly to collect and difficult to analyze. When information about main streams, tributaries and groundwater are not clear, actors act under incomplete information which run counter to a functioning market where market participants have reliable information about prices, supply and demand. In addition, the three-tiered allocation system, which forms the basis for a water rights market, is guided by administrative rather than market forces.

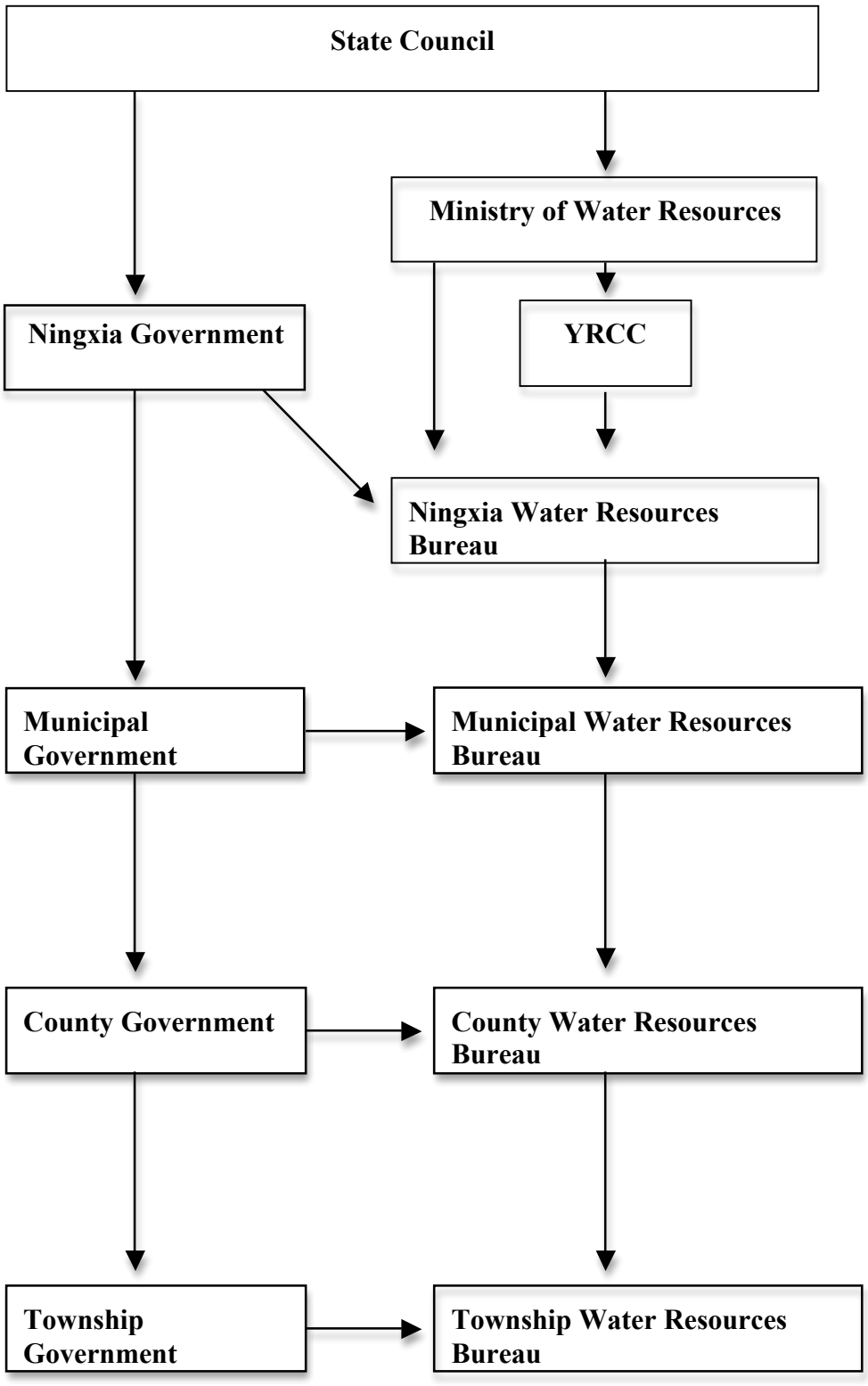

Figure 1. China's Water Management Apparatus

Source: Modified from Chen Gang 2009:20 & Circle of Blue

Table 1. Analytical framework: Constraints on water rights trading

Potential problem	*Mitigating strategy*	*Ningxia*
incomplete or poorly defined water rights (1,2)	register and secure water rights	1. How strong is the linkage of water allocation from the YRCC to the water permit at local level? 2. Are water diversions to IMB, defined through permits issued by YRCC, clearly defined to WUAS?
Lack of infrastructure (3)	investment in infrastructure	3. Is there a flexible infrastructure that allows transfer of water use-rights at low costs?
Opposition from irrigation districts (4)	strengthening and capacity-building of WUAs	4. What is the role of WUAs? Can farmers coordinate collective action through WUAs?
Third party effects (5)	compensate third parties financed with levies on transcation	5. is there a compensation system in place? Is groundwater managed in conjunction with surface water when irrigation water is transferred to industries?
Imperfect or asymmetric information about water transfer (6)	strengthening and capacity building of WUAs, promoting stakeholder involvement	6. Is there any framework established for the exchange of information, mutual monitoring and frequent interactions?
Lack of coordination mechanisms (7)	promoting stakeholder involvement	7. Is there a 'unified management' approach to water rights transfer between the YRCC and Ningxia Water Resources Bureau? Is there lack of a institutional process within the YRCC?

5. FINDINGS

This chapter presents the fieldwork findings from Ningxia. It starts with an overview of the Yellow River Water Resources Allocation plan and China's water right's system from both legal and institutional perspectives, followed by a brief general description of the Hui Autonomous Region of Ningxia. It then describe's the current water rights and transfer framework and how it is working in practice in Ningxia. Subsequently, I use excerpts from the interviews to discuss opportunities and constraints for a water rights transfer framework in Ningxia.

5.1 Yellow River Water Resources Allocation and Regulation

Ningxia's water rights transfer system has to be seen in light of (1) the Yellow River Water Resources Allocation Plan (*Huanghe shuiliang fenpei fangan)* 黄河水量分配方案 and (2) the extent for transferring water rights under current planning and regulatory framework. The Yellow River Basin is located in semi-arid areas and flows through ten provinces with an average annual runoff of 58 billion m^3. Beginning in the early 1980s, the conflicts between the limited availability of water resources and the expanding demand led the Central government together with the local governments to devise an inter-provincial water allocation plan in 1987 (Table 3). The total available for allocation was determined 37 billion m^3 by setting aside 21 billion m^3 for sediment transportation (Shen et al., 2009:216). The water resources allocation plan for the Yellow River Basin then is the key regulatory instrument for determining the volume of water available for consumption, as well as for prescribing the environmental flows. However, the plan is usually prepared based on the expected water supplies for the year. This mean, for instance, that if the expected water availability for the year is 10 % lower than the historical average water availability, the water allocation to each province will be 10 % smaller than the quantity assigned in the initial plan (Yang 2008:270). Moreover, the framework for the allocation and management of the YRB is established by the 2002 Water law which provide that water resources are owned by the State with ownership exercised by the State Council on behalf of the people.

Table 2. Monthly Water Allocation Plan from the Yellow River (billion m^3)

Province	Qinghai	Sichuan	Gansu	Ningxia	Inner Mongolia	Shaanxi	Shanxi	Henan	Shandong	Hebei+Tianjin	Total
Water Allocation	1.41	0.04	3.04	4.0	5.86	3.8	4.31	5.54	7.0	2.0	37.0

Source: Gao et al., 2004.

Under the 2002 Water Law, water resources in the Yellow River Basin are allocated at three connected levels:

- *Regional water rights* – water within the river basin is allocated to Ningxia and at provincial-level water is prepared and implemented by Ningxia's Water Resources Bureau and approved by Ningxia Government to prefectures, and prefecture-levels plans allocate water between counties. The allocation plan is based on water consumption for each province but provinces can abstract a larger volume if they return much of that to the river system (Ibid).

- *Abstractor rights* – is managed through a water abstraction permit system where individual factories or irrigation district agencies that take water directly from rivers, lakes or underground sources must apply for a water abstraction permit that is granted by appropriate level of river basin or Water Resources Bureau's (prov, pref or county). The State Council's 2006 Water Abstraction Regulation requires that the grant of permits in Ningxia is consistent with the Yellow River Basin Allocation Plan (4 billion m^3). More importantly, the Water Abstraction Regulation sets requirements when water permit can be transferred. Water rights transfer is allowed at the abstractor level only if the permit holder can demonstrate that water use has been reduced. For example, a permit holder can reduce water through adjustments to production or industrial structure, technology innovation or the promotion of water-saving measures (Speed 2009:272). In Hangjin Irrigation District (HID) in Inner Mongolia, the district's abstraction permit used to be 410 million m^3. However, savings of 130 million m^3 per year from canal lining, traded out of the irrigation districts to industries, has reduced the water

abstraction permit to the HID from 410 million m^3 to 280 million m^3 (Hang et al., 2009:375). Throughout this process, the industrial users involved in the canal lining got new water abstraction permits.

- *Certificate-level rights* – granted to farmers within an irrigation district which represents each farmer's share of the water available to the district under the irrigation district's water permit. The user-level rights are prepared and implemented by Irrigation District Management Bureau and approved by Water Resources Bureau at appropriate level (WET 2006:4).

In reality, water transfers are possible between regions, between abstractors and between farmers but initiatives have not been conducted under a systematic framework and water rights in most cases are not well established. The challenge in the Yellow River Basin has been to grant abstraction permits without exceeding quotas set by the Yellow River Water Allocation Plan. Against this background, the Yellow River Water Resources Regulation from 2006 sets monthly allocations for each province (both an abstraction and consumption volume), reservoir release requirements in the upstream/midstream as well as required flows at the provinicial boundaries.

5.2 General Description of the Hui Autonomous Region of Ningxia

> "The Yellow River is the life-line for many provinces and its natural that localities ask for more water. But we cannot let them exceed the allocation limits so if they want to develop industries, they have to save more water." (Official, International Cooperation, Science and Technology, YRCC, March 3th 2014)

The Hui Autonomous Region of Ningxia is located in the northwest part of China, upstream of Inner Mongolia and downstream of Gansu in the Yellow River Basin.[3] Ningxia is one of China's underdeveloped minority autonomous regions where three quarters are arid with 4 billion consumptive allocation from the Yellow River. As of 2014, 91 percent of the water in Ningxia is used for agriculture and industry and urban water use account for 6 and 3 percent of the regions's water consumption respectively (Official, Water Saving Office at Ningxia's Water Resources Department, Interview March 18th 2014). Currently, Ningxia's recoverable coal reserves amount to 31.5 billion tons, ranking 6th nationwide and highest per capita with Ningdong area in

[3] See Appendix 2.

eastern Ningxia producing majority of the coal output (Ibid). In this context, coal and minerals are the cornstones of the government's 'Open Up the West Campaign' (*Xibu Da Kaifa*) 西部大开发 and the 'Send Western Electricity

East Campaign' (*Xi Dian Dong Song*) 西电东送 to develop Ningxia through an extensive economic programme. However, water is a constraint for developing regional energy industries and Ningxia's allocation of water from the YRCC (4 billion m^3) was already fully committed. It was under such circumstances that led the YRCC to propose a programme involving the transfer of water rights in Ningxia:

> "Originally it was Inner Mongolia that initiatied the water rights transfer and this idea spread to Ningxia in the same time-period. They wanted to extract more water from the original water allocation plan but we thought their submitted plan would overuse water. Thus, we suggested Ningxia Province to consider the pilot programme of water rights transfer undertaken in Inner Mongolia. After that, Ningxia also initiated their pilot projects to let enterprises invest in projects to improve irrigation channels that reduce water waste which can be used for industrial production." (Official, International Cooperation, Science and Technology, YRCC, March 3th 2014).

5.3 Water Rights Transfer Framework

With the establishment of the water allocation plan for the Yellow River obtaining additional water within the basin is difficult for Ningxia. One option for new sources of water is in agricultural sector, since the potential for water saving is considered high given the low irrigation water use efficiency. For example, it takes 1 m^3 to produce 0.85 kg food and only 19 % of the main irrigation channels and 22 % of the distribution channels has been lined (Xue et al., 2009:416). With lower economic returns (0.97 yuan/m^3) in agriculture than for the industrial water use (57.9 yuan/m^3) (Wang 2012:180), it becomes a natural choice to reallocate water from agriculture to industry through "investment for water saving and water rights transfer" measure. Since 2003, Ningxia's Department of Water Resources Governance has overseen the programme in which water saved through canal lining in Qingtongxia 青铜峡 East Irrigation Area and West Irrigation Area is transferred to industries, with the cost of lining met by the industrial beneficiaries. The role of governments – both at central and local level – in establishing and maintaining a framework for water-rights transfer has consisted of:

- Enterprises submit proposal's of their water requirements to Ningxia's Department of Water Resources Governance which has the main responsibility for examining and approving applications for the pilot programmes;

- Department of Water Resources Governance undertakes assessment with the Irrigation Bureau at Ningxia's Water Resources Department. Depending on Ningxia's development priorities successful applicancts are chosen by the local government of Ningxia. Construction of big industrial projects, such as power plants, needs final approval from the National Development and Reform Commission;

- If canal lining can save water through investments by an enterprise and agreement is reached between an enterprise and the Department of Water Resources Governance the work is assessed by the YRCC;

- The YRCC then confirm whether savings can be realized and is responsible to give the final water abstraction permit to the irrigation district. The water abstraction permit is then adjusted to the irrigation district and a new abstraction permit is given to the purchaser (enterprise). The water rights transfer is set for 25 years and for every 5 years the water abstraction permit has to be checked and approved by the YRCC. If the enterprise don't reapply the water right, then it goes back to the original seller (Official, Ningxia's Department of Water Resources Governance, Interview March 17th 2014; Speed 2009:274).

Based on the "Guidelines for the Water Rights Transfer of Main River of Yellow River in Hui Autonomous Region of Ningxia and Inner Mongolia Autonomous Region" and the "Implementation Method for Yellow River Water Rights Transfer" made by YRCC, Ningxia has developed the following principles for implementing the water rights transfer:

- Gross volume control – the transfer must not result in the 4 billion consumptive allocation from the Yellow River being exceeded;

- unified control principles – both parties of the water transfer must follow the law;

- clarified water rights – the seller must have a water abstraction permit
- unified management – The Ministry of Water Resources, The YRCC, and Ningxia Water Resources Department must agree on management of the transfer;
- sustainable use;
- consultation with all parties democratically, openly, equally and fairly;
- transfer with financial compensation;
- combining government regulation with market mechanisms (WET 2006:157).

Moreover, in accordance with the Ningxia Yellow River Water Rights Conversion Master plan, implementation of water rights transfer projects were supposed to make 330 million m^3 available to industries by 2010 and by the end of the second phase of the project in 2015, 494 million m^3 made available. 53 industrial projects were planned to invest in water saving and transferring water rights from Qingtongxia 青铜峡 East & West Irrigation Area and Weining 卫宁 Irrigation Area. The initial water saving-transfer arrangement's were based on the water that could be saved through canal lining in Qingtongxia and Weining Irrigation Area's from the following irrigation schemes: Tanglai 唐徕 irrigation area 97.1 million m^3, West main 西干 irrigation area 39.2 million m^3, Huinong 惠农 irrigation area 51.5 million m^3, Hanyan 汉延 irrigation area 40.5 million m^3, Qin 秦 irrigation area 66.3 million m^3, Taimin 泰民 and Daqing 大清 irrigation areas 12.4 million m^3, Qixing 七星 irrigation area 17.9 million m^3, Yuejin 跃进 irrigation area 23.2 million m^3, Zhongwei 中卫 irrigation area 11.3 million m^3 and Tangxi 唐西 irrigation area 134.5 million m^3 (Ningxia Water Rights Transfer Feasibility Report 2011:2-3).

In 2004, 3 enterprises were approved by the YRCC to invest 151 million yuan in water saving projects in the existing irrigation schemes in exchange for the rights for use of the 53,9 million saved water (Ibid:9). As of 2014, out of the 53 enterprises that have applied for the water-rights transfer programme only 8 got approval from the YRCC[4]. The designed total volume of water transferred is 88 million m^3/year and the unilateral water transfer price used to be 3 yuan per cubic meter in 2003 but has gradually been

[4] See Appendix 3.

raised to 25 yuan per cubic meter (Official, Ningxia's Department of Water Resources Governance, Interview March 17th 2014). The current price includes fees for:

- A construction fee for the channel lining
- Operation and Maintenance fee
- Renovation fee
- Compensation fee for Other users and for Ecology

Once the fee's are paid by the enterprise the Irrigation District Agency is responsible for maintaining the channel lining. However, all cost's are not paid by the purchaser, the government also made some contribution to the channel lining. Out of the three original pilot projects – Ningxia Daba Power Plant, Maliantai Power Plant and Lingwu Power Plant – two thirds of the primary water rights transfer investments were done by the companies and one third by the local government (Circle of Blue 2011). Apart from reforming irrigation infrastrucutre to promote water conservation, the Government of Ningxia has also made air-cooling technology a required feature for all new coal-fired power plants, saving 75 to 85 percent of the water needed to cool a conventional coal-fired power plant (Official, Water Saving Office at Ningxia's Water Resources Department, Interview March 18th 2014).

5.4 Water Rights Transfer in Practice: Insights from the Field

> "To establish a water rights market is basically an issue of power. It depends if the local government want to hold on or give use-rights to end users. As for now in Ningxia, its controlled by the local government and not a true market, its only water-transfer" (Professor, Tsinghua University, Interview March 25th 2014).

While China's water resource allocation system is a shift towards a right's based approach to water management, including defining water entitilements at the farmer level within irrigation districts and initiating water trading projects, insights from the field in Ningxia have shown in practice that the water right transfer programmes are mainly driven by government and not a free market. Despite more than 10 years of developing a water rights trading system, reallocation of water is still limited to water

saved by engineering measures in the irrgation areas and water right transfer is limited in the same city district of Ningxia. In this context, a system of clearly defined, secure water rights provided to farmers to lay the foundation for a water rights trading market has not been put in place. Thus, individual farmers and water users associations are not involved in the water rights transfer framework to release water to industrial users. As an Official explained:

> ”Water rights transfer is a risky process because it can undermine food production. At present, we are just saving water by repairing irrigation channels and no need to involve water user associations or farmers. On the other hand, since water is a constraint for our development and more water can only be released by improving agricultural water use, the next step should be to involve farmers. ” (Official, Water Saving Office at Ningxia’s Water Resources Department, Interview March 18th 2014).

Although farmers and water user associations are not involved in the water rights transfer projects, the idea of reallocating water from agriculture to industry through investing in water savings has transferred water from low-valued to higher valued uses and to some degree helped reduce the burden of farmers by saving water and reducing farm costs. The agricultural water price for gravity irrigation is 0.012 yuan/m^3 while the agricultural water price for pumping irrigation is 0.054 yuan/m^3. After the implementation of the three first water transfer projects in Ningxia, calculations have shown - based on the existing gravity irrigation cost of 0.012 yuan/m^3 - that farmers water expenditure has been reduced with 717 000 yuan annually due to improved water speed along the channels (Wang 2012:180). Moreover, up to now the channel lining in Qingtongxia East & West Irrigation Area’s has also improved water utilization coefficient of the channels from 0.4 to 0.6. As a result, about 40 % of the water is wasted compared to 60 % before the lining of irrigation channels were completed (Professor, China Institute of Water resources and Hydropower Research, Interview April 3th 2014). However, as in similar channel lining and water transfer projects being conducted in Inner Mongolia, water rights transfer in Ningxia has increased water use efficiency between users but irrigation remains inefficient. An Official confirms this:

> ”Before the channel lining and water transfer projects the water that was wasted within irrigation districts were of no use for agriculture. The industry has made use of it now. The projects has given farmers benefits as well, such as saving time to get water to their farmland. But we have a long way to go before agriculture water use is really improved ” (Official, Ningxia’s Department of Water Resources Governance, Interview March 17th 2014).

5.4.1. Third Party Impacts of Water Right Transfers

> ”Water rights transfer using market mechanisms in Ningxia and Inner Mongolia are practical solutions to meet the water resource demand in the energy sector. But how to determine water available for transfer or trading is risky. How about the ecological flow of the Yellow River Basin and how to expand water markets without increasing overall water use?” (Jia, Interview February 26th 2014).

On paper, tradable water rights are supposed to be embedded in a legal and institutional framework that can regulate external effects, such as to protect other users who might be affected by a transfer and to ensure minimum flows in a river for environmental protection. At present, however, the Ningxia experience highlights a number of issues that undermine the strength and effectiveness of channel lining and water rights transfers. In particular, when water is transferred there have been some negative impacts on third parties. Both surface and groundwater should be managed in an integrated way but in practice the implementation of water rights transfers have had some impacts on the groundwater system in Qingtongxia. As observed by an Official from the YRCC who has assessed the work in Ningxia:

> ”The groundwater tables in Ningxia and Inner Mongolia are fragile. When you are lining the channels the water cannot enter the groundwater system and this have had negative effects on the grass and trees along the channels. To my mind the linkage between surface and groundwater has not been managed well in the transfer programmes” (Official, Department of Water Resources Management and Regulation, YRCC, Interview March 4th 2014).

Little consideration to surface and groundwater connections is also raised by an Official in Ningxia:

> ”It’s true we have had some problems with water transfers leading to reduced groundwater recharge but overall I dont think it's a serious problem. If it would be a serious problem we wouldnt continue with the programmes” (Official, Water Saving Office at Ningxia’s Water Resources Department, Interview March 18th 2014)

Thus, it is possible that the water that was considered ”lost” through channel leakage and could be used for water-savings projects was in fact recharging groundwater. For each water-transfer contract a fee was made up of compensation for other users and ecology which demonstrates an awareness of taking third-party effects into account.

However, the impacts on the surface and groundwater linkages arising from water right transfer calls into question the effectiveness of using fees as an mechanism to address third party effects for large scale transfers.

5.4.2. Water Consumption vs Clearly Defined Water Abstraction Targets

As described on page 12-13, a robust water rights and transfer system depends on the consistency and integration of *regional water rights, abstractor water rights* and *certificate-level rights*. Thus, the key is to encourage as much transfer/trading of water rights as possible by issuing water abstraction licenses while at the same time constraining water consumption. At present, the Yellow River Water Resources Allocation plan do not define rights to water in a way that enables local Water Resources Bureau's to issue water abstraction permits that will be in accordance with the grander scheme set by the river basin plan. In particular, the tributary water quantity allocations are not clearly defined meaning that provinces can extract water from tributaries of the Yellow River Basin before it enters the main stream (Moore 2014). In this light, control over water permits from the tributaries of the main river is under the charge of local WRB's while the YRCC can only reject or approve plans of abstraction from the main stream (Lohmar et al., 2003:7). As explained by an Official at the YRCC:

> "For the downstream – Henan and Shandong provinces – all the water abstraction approvals are issued by the YRCC. They have to come to the YRCC to apply their licenses. However, for the upper or middle part of the river, its more difficult because there are many tributaries. Certain amount of water is approved by local governments and certain amount of water is approved by us" (Official, Department of Water Resources Management and Regulation, YRCC, Interview March 4th 2014).

Though the final approvals for the water transfer projects are under the YRCC, most authority is retained by local government since the YRCC's main focus is to control overall water use that flows in and out from Ningxia. In Ningxia, the YRCC can with its regulatory mechanism "the cross-section control-system" monitor the flows at the entry and exits points of Ningxia to make sure that Ningxia meet the 4 billion m^3 consumptive allowance. For example, if the volume of water that flows into Ningxia from Gansu is x billion m^3, then the flow out from Ningxia to Inner Mongolia must not be less than (x-4) billion m^3. However, in practice, there exist inconsistencies between the Yellow River Water Resources Allocation plan and abstraction permits in Ningxia.

Permits should be based on the consumptive allowance 4 billion m^3 but this is not currently the case with permits, which are higher than the 4 billion allocated water volume. According to Ningxia's Water Rights Transfer Report (2011) the average annual abstractive volume is 8.269 billion m^3 for irrigations areas, which is more than double the 4 billion m^3 water consumption target for the whole province.[5] Though its common that provinces can abstract a larger volume than the actual water consumption volume as long as certain amount of water is returned to the system, the 8.269 billion m^3 for irrigation alone in Ningxia shows the inefficiency of the irrigation system and the challenge of achieving the control of 4 billion m^3 water consumption volume. Moreover, a recent Environment & Energy Publishing report asserts that due to lack of monitoring the coal industries can use more water than allowed because the water saving projects that companies invest in are close to one stream, while their coal operations get water from another source (E&E 2013). As a result, the weak connection between the Yellow River Water Resources Allocation plan and abstraction permits in Ningxia pose a problem to the development of a water rights market.

5.4.3. Management of Water Right Transfers

The weak linkage between the Yellow River Water Resources Allocation Plan and actual water use in Ningxia is partly due to the institutional friction imposed by different governmental agencies. A unified management approach to water rights transfer between the YRCC, The Ministry of Water Resources and Ningxia Water Resources Department has been difficult to achieve because the YRCC lacks a process to get local information on water consumption and abstraction permits on a regular basis. Generally in China local authorities do not disclose to the River Basin Commissions data on existing hydrology and the annual amount of abstraction licenses that have been approved (Wei et al., 2011:961). The lack of coordination and information sharing is acknowledged by an official at the YRCC:

> "When we went to Qingtongxia 青铜峡 the local authorities had changed the location for channel lining without informing us. This caused difficulty because then we didn't know if enough water can be saved through channel lining from that specific area. Normally it should be assessed by both the local water department and us before channel lining can

[5] See Appendix 4.

> start" (Official, Department of Water Resources Management and Regulation, YRCC, Interview March 4th 2014).

More importantly, there exist no legal definition or institutional arrangement's within the River Basin Commissions that enables a commission to involve stakeholders from provincial, prefectural and county levels (Shen 2009:493). In Ningxia, Ningxia Water Resources Department has established a Co-ordination group for the water rights transfer projects with the Vice Governor of Ningxia Province as the chairman of the group. However, this co-ordination group is not a formal standing organisation and only has membership from different sectors in Ningxia (WET 2006:158). In this light, the YRCC has formal links with the Irrigation Management Bureau's of Ningxia but weak coordination with the Department of Water Resources Governance, which has the main responsibility for examining and approving applications for the water-rights transfer projects. The weak coordination between the YRCC and Ningxia's Department of Water Resources Governance is recognized by an official in Ningxia:

> "The YRCC are seldom here and we seldom conduct work with them. At present, they are mainly undertaking work with Irrigation Management Bureau's" (Official, Ningxia's Department of Water Resources Governance, Interview March 17th 2014).

In this context, the lack of regular procedures for discussing and sharing information on hydrology and abstraction licenses granted to enterprises, particularly between the YRCC and the Department of Water Resources Governance, reflects the absence of a robust framework for managing water rights transfers and remains a constraint for developing a water rights market.

5.5 Summary

In reference to my main research questions that is guided by the analytical framework developed in the previous chapter, I will here sum up the findings from Ningxia (Table 2). Interviews and secondary data suggest that the channel lining and water rights transfer projects as a policy option for addressing water scarcity has allowed the water to shift to the most productive and efficient users in Ningxia. At the same time, water rights are a requirement for a market-based water trading system but WUAs and farmers are not involved in the pilot projects and clearly defined and secure water

rights have not been provided to the end users while the government controls the full property rights over the entire water resources.

In addition, my interviews indicate that the water rights transfer projects have improved water-use utilization coefficient of the channels in Qingtongxia 青铜峡 from 0.4 to 0.6 and improved water speed along the channels to farmers land. However, the Ningxia experience also highlights structural problems that hampers the development of a robust water rights transfer market. These include: inconsistency and lack of integration between Yellow River Water Resources Allocation Plan and abstraction permits, lack of consideration to groundwater and surfacewater linkages, and lack of coordination and information sharing between the YRCC and Ningxia's Water Resources Department.

Table 2. Analytical framework: Constraints on water rights trading

Potential problem	*Mitigating strategy*	*Ningxia*	*Results*
incomplete or poorly defined water rights (1,2)	register and secure water rights	1. How strong is the linkage of water allocation from the YRCC to the water permit at local level?	Weak connection
		2. Are water diversions to IMB, defined through permits issued by YRCC, clearly defined to WUAS?	Water rights to WUAs and farmers are not clear
Lack of infrastructure (3)	investment in infrastructure	3. Is there a flexible infrastructure that allows transfer of water use-rights at low costs?	Inadequate information
Opposition from irrigation districts (4)	strengthening and capacity-building of WUAs	4. What is the role of WUAs? Can farmers coordinate collective action through WUAs?	At present WUAs have no role
Third party effects (5)	compensate third parties financed with levies on transcation	5. is there a compensation system in place? Is groundwater managed in conjunction with surface water when irrigation water is transferred to industries?	Compensation exist but the effectiveness to internalize externalities is questionable
Imperfect or asymmetric information on water rights transfer (6) Lack of conflict resolution mechanisms (7)	Strengthening and capacity-building of WUAs, promoting stakeholder involvement	6. Is there any framework for the exchange of information, mutual monitoring and frequent interactions?	Informal forum with weak links to the YRCC
		7. Is there a 'unified management' approach to water rights transfer between the YRCC and Ningxia Water Resources Bureau? Is there lack of a institutional process within the YRCC?	Lack of coordination and information sharing

6. DISCUSSION

This chapter links the findings from Ningxia to the aim of the thesis, namely a better understanding of what factors facilitate or constrain market-based water rights allocation in the YRB. The findings will shed light on what can be learned from Ningxia's experience with market-based instruments to water shortages in the YRB in an era of growing pressures on water resources from energy production and climate change.

6.1 Ningxia's Experience with Water Rights Transfer

New Institutional Economics (NIE) highlights the importance of institutions for creating effectively functioning markets. According to (NIE), institutional control over transaction costs enables or limits water markets to efficiently allocate water from low-valued to higher valued uses. One key strength with Ningxia's water rights transfer schemes is their ability to transfer water from lower to higher value uses. The economies of scale in undertaking water efficiency measures that has been achieved with the channel lining and water rights transfer model in Ningxia is attributable to the institutional arrangements under which water is managed. All transfers have a cost and are linked to infrastructure transfer capabilities and the institutions governing various aspects of water transfer. These costs include: field-inspections and hydrological studies by the YRCC and Ningxia Water Resource Authority, constructing, operating and maintaining infrastructure to measure and transfer water; coordinating between central-local level, coordinating between buyer (enterprise) and seller (government), negotiating & enforcing contracts and other decision making costs. What makes Ningxia able to allocate water rights to their highest valued economic use is through lowering transaction costs by lining irrigation channels rather than devolving property rights over water resources to actors at lower levels of political organisation that give farmers rights and capacities to trade water. Transferring rights and capacities to farmers to take part in trading water involves high transaction costs due to high land fragmentation in China and may have discouraged the development of water markets at the farmer level in Ningxia.

The strength of the channel lining and water rights transfer model in Ningxia, however, is also its weakness. Transfers are embedded in a legal and institutional framework – which is determined by the 2002 Water Law, the 2006 Water Abstraction Regulation and the Yellow River Water Resources Allocation Plan sanctioned by the YRCC – that has left several theoretical principles unfulfilled such as: (1) the integration of the three levels of allocation as basis for water rights trading, (2) the definition of water rights to end-users, and (3) the recognition of environment as a legitimate user, particularly the hydrologic connectivity between groundwater and surface waters. While the channel lining and water rights transfer model has improved water-use utilization coefficient of the channels in Qingtongxia 青铜峡 from 0.4 to 0.6, the impacts on groundwater levels in some cases show that the leakage reduction programs through channel lining might not generate ”real” water savings. Hence the water rights transfer projects involve tradeoffs between economic efficiency and ecosystem protection. In addition, allocating a socially and physically interconnected resource to highest valued economic use at a time when more than a third of the rural population – about 1.5 million people – lack access to safe water, indicates that social equity is another weak point of the current framework (SEI 2014).

The flaws in the performance of Ningxia's water rights transfer system stems from two distinctive features of China's water resources management which decisively shape water markets: asymmetric information and lack of cross-sectoral coordination. Under a three-tiered allocation system made by administrative decisions, transparency of water availability in each sector is a prerequisite for efficient inter-sectoral water transfers. However, asymmetric information, when one party lacks access to another party's information, manifests itself in several ways both at the river basin and the local level through: limited disclosure of information and transparency regarding how water is allocated, the details of permits and the monitoring of water abstractions. The cost of imperfect or asymmetric information subsequent externalities and inefficiency is the result of insufficient knowledge about how much water is available. As a result, market distortions are created by informational gaps between the YRCC and Ningxia government over how to reconcile water abstraction permits with the 4 billion m^3 water consumption target. As Appendix 4 shows, the 8. 269 billion m^3 for irrigation alone does not conform to the consumptive objective, leading Ningxia Water Resources Bureau – who has more control over hydrological and abstraction

information within their jurisdiction than the YRCC – to issue abstraction permits with little consideration to limit water consumption. Lack of transparency and information disclosure on water resources and water-related behaviors of various stakeholders not only raise the cost of defining tradable water rights but also pose obstacles of creating a more flexible water market. Consequently, the absence of formal mechanisms for inter-governmental consultation on hydrology and abstraction licenses as well as little institutional representation of stakeholders between the YRCC and Ningxia means that water available and consumed are not clear and establishing an efficient water rights market without a high degree of information about resource availability, and strong market oversight becomes difficult.

Finally, asymmetric information and lack of coordination mechanisms embedded in China's water resource management are constraints for developing a market-based water rights trading system. Under growing pressure for more flexible water-rights trading, the institutional framework is further likely to mirror greater difficulties to manage collective action challenges of exclusion and coordination that stem from balancing multiple goals: i) energy production vs food production, ii) tradeoffs between economic efficiency, equity and environmental water needs. As demand for water increases and pressure for inter-sectoral water-transfers rises, adaptation in the institutional design of water-transfers as a response to balance multiple goals will become more pressing. However, effective change in the existing institutional arrangement to a new institutional option involve transaction costs which need to be weighed against the benefits of balancing multiple goals.

6.2 The Future of Water Rights Trading in the Yellow River Basin

Agricultural water management is at the heart of China's response to water scarcity in the 21st century. In an era of urbanization and expansion of large-scale industry, the challenge for the provinces along the YRB is to put in place a legal and institutional framework in which water can more contribute to economic growth than in the past whilst sustaining environmental outcomes. Driven by growing urbanization and industrialization, the energy sector will continue to expand and transboundary-water resource disputes over developing hydropower, coal, shale gas or oil will shape the allocation of water resources in the YRB. Coal-based thermal power capacity in Gansu,

Ningxia, Shaanxi, Shanxi and Inner Mongolia is expected to reach 290 GW in 2015 compared with 145 GW in 2010, which is double in increased installed capacity (Provincial Governmental Reports 2011). Even with the mandatory implementation of air cooling technologies that reduce water consumption by 85 % for new power plants compared to closed-loop water technologies, these water saving technologies alone cannot decouple the future freshwater demand in the industrial sector. As economic development extends from the east-coast to the arid western provinces along the YRB, water resources pressures are likely to increase and pressure for tradable water rights to allocate water within and across productive sectors will likely continue to rise. Yet because the average water use efficiency is about 49 % for irrigation systems in the YRB compared to the national average of 47 %, there is plenty of room for pricing mechanisms and tradable water rights systems to improve water-use efficiency (National Irrigation Water Use Efficiency Measure and Analysis Report 2006). However, the effective functioning of pricing mechanisms and water rights trading systems depend on the presence of enabling conditions as clearly defined ownership rights and a well-functioning market (Chen et al., 2014:548). Overlooking this legal and institutional dimension while unleashing market forces will prove risky in an era of climate change.

The results from a recent paper on the impacts of climate change on water stress situations in the YRB indicate that a small change in climate will result in a big change in irrigation water demand, or water surplus/deficit conditions. With little decrease in precipitation in 2030 and 2050 respectively, total irrigation water demand from both surface water and groundwater will increase due to the increase in evapotranspiration, by 14-15 % in future scenarios for 2030 and by 22 % in future scenarios for 2050 (J. Mu et al., 2013:554). Though various measures must work together to improve agricultural water use efficiency, the unwillingness of the government to increase farmers' burdens has constrained the adoption of pricing mechanisms and made tradable water rights system a more attractive alternative (Chen et al., 2014:549). Moreover, as the experiences from Ningxia has shown, a greater push towards a water rights market would benefit from defining and securing water rights to end users; bringing water resources allocation plan and abstraction permits into closer alignment; establish formalized mechanisms for inter-governmental consultation between the

YRCC & other stakeholders; as well as developing mechanisms to hold localities responsible for meeting environmental flow requirements within their jurisdictions.

7. CONCLUSION

In tackling the water scarcity problems in the Yellow River Basin, traditional command and control instruments have struggled to achieve their intended goals with closing the supply and demand gap, in part due to costly exclusion and collective action problems stemming from inter-jurisdictional competition over water resources. Reflecting these shortcomings, the Yellow River Basin Commission has initiated a number of water marketing strategies to induce Inner Mongolia and Ningxia to reallocate available supplies from agriculture to industries whilst adhering to water quotas allocated from the Yellow River Water Allocation Plan. Though studies have been made on transferring and trading water rights in Inner Mongolia, few studies have investigated Ningxia's implementation of similar pilot projects. This thesis employs the case of Ningxia to address this empirical gap by examining factors that facilitate or hinder market-based water rights allocation in the YRB.

The findings of this study suggest that the channel lining and water rights transfer model deployed by the YRCC as an incentive scheme has led the local government in Ningxia to increase the allocative efficiency of water between agriculture and industry since it conforms to Ningxia's development priorities. At the same time, the expansion of Ningxia's water rights transfer system has been made without involving WUAs and farmers and the water rights remain ambiguous as in the case of Inner Mongolia. In absence of a well defined property rights regime, the water rights transfer has led to third party impacts which indicate that there exist a tradeoff between economic efficiency and ecosystem protection. While these transfers have reallocated water to the most productive users, they do little to address structural problems that underlie the water rights transfer system.

The flaws in Ningxia's model, including inconsistency and lack of integration between the Yellow River Water Allocation Plan and abstraction permits; little consideration to groundwater and surface water linkages (ecological flows), stems from asymmetric information on hydrology and abstraction licenses and lack of coordination mechanisms embedded in China's water resource management. The importance of

these barriers for market-based water-rights trading in the YRB are likely to increase as China move forward to close the development gap between the coastal and western-inland with increasing pressure to reallocate water from agriculture to industry. Though increasing water prices yields water conservation benefits when irrigation water use efficiency is on average 49 % in the YRB, raising prices runs counter to raising rural incomes and grain self-sufficiency. Because of these social and political constraints, the development of water-rights trading will likely continue to be an attractive alternative to the adoption of water pricing mechanisms in meeting the industrial water demand without putting extra burden on farmers.

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Appendix 1: Informed Form

调查问卷

本问卷旨在对促进或阻碍宁夏自治区“水权交易”的各种因素进行调查研究。该研究将通过在中国进行一段为期 2 到 3 个月的实地考察,力图了解宁夏自治区的“水权交易”在实践中的情况。这项研究由瑞典隆德大学赞助, 我在隆德大学的导师是 Dr. Stefan Brehm。如果此问卷的受访者希望保持匿名我将会进行专业的保。

1) 宁夏的“水权交易”在实践中是如何进行的?

2) 目前一共有几个“水权交易”项目?

- 现在被交易的水量是多少? 真正被利用的水量又是多少?

- 每个“水权交易”试点项目的投资是多少? 每立方水的价格是多少?

3) “水权交易”的利弊各是什么?

4) 怎么确定哪些企业可以被授权使用这些水资源? 标准是什么?

5) 宁夏当地的水利局是如何从企业收取费用的?

6) “用水者协会”在宁夏的“水权交易”中扮演什么角色?

7) “水权交易”是否使得宁夏的灌区对提高水资源的利用效率更有动力?

- 节余的水资源被转移给工业之后灌溉用水是否依然效率低下?

8) 在“水权交易”的同时,宁夏如何保证达到生态用水的要求?

9) 总的来看, 作为一项政策工具,“水权交易”是否对宁夏不超过黄河水利委员会规定的用水限额有所促进呢?

Questionnaire

The purpose of this Master-thesis is to examine factors that facilitate or hinder water-use rights trading market in Ningxia. By conducting fieldwork in China over a period of 2-3 months the aim of the research is to understand how water-rights trading work in practice in Ningxia. The research is sponsored by Lund University and my supervisor is Dr. Stefan Brehm at Lund University. If the respondent wishes to remain anonymous then professional secrecy is being held.

1) How does water-use rights trading work in practice in Ningxia?

2) How many water-trading projects exist?

- How much water is traded annually?

- What is the water rights trading investment for each pilot-project?

- What is the price per cubic meter?

3) What have been the strenghts and weaknesses of water-use rights trading?

4) How are the enterprises that would be granted permits to the saved water selected? What are the criteria?

5) How does the Local Water Authority in Ningxia collect water resource fees from the enterprises?

6) What is the role of Water User Associations in the water-use rights trading in Ningxia?

7) Has the water rights trading in Ningxia created incentives for more efficient use of water within irrigation districts?

- Does irrigation remain inefficient when saved water is transferred to industries?

8) How are ecological water requirements being met during water-use rights trading in Ningxia?

9) Overall, has water rights trading as an policy-instrument induced Ningxia to not exceed their water quotas issued by the Yellow River Basin Commission?

Appendix 2: Map of Ningxia

Appendix 3: Water Right Transfer Project's in Ningxia

Nr	Project Name	Capacity (MW)	Approved Water Transfer Projects	
			Water Conversion (million m^3)	Irrigation Water Saving Areas
1	Lingwu Powerstation	2×600MW	14,4	line 13,824 km of Tanglai main channels, 245,65 km of distribution channels
2	Lingwu Powerstation Expansion	2×600MW	6,2	line 8,2 km of East main channels, 30 km of distribution channels
3	Daba Powerstation	2×600MW	12	line 32 km of Hanyan main channels, 142,4 km of distribution channels
4	Maliantai Powerstation	4×300MW	14,3	line 25 km of Huinong main channels, 26,2 km of distribution channels
5	Shuidonggou Powerstation	2×600MW	6,2	line 16km of Malian main channels, 66,2 km of distribution channels
6	Yuanyanghu Powerstation	2×600MW	6,2	line 13,123 km of Daqing main channels, 30,8 km of distribution channels
7	Lingzhou Powerstation	2×135+2×600MW	18	line 4,3 km of West main channels, 27,9 km of distribution channels
8	Ningdong Baofeng Powerstation	2×600W	10,7	line 13km of Qin main channels, 43 km of distribution channels
Total			88	

Source: Ningxia Water Resources Department (2014)

Appendix 4: Allocation of water diversion rights and water consumption in irrigation districts in Ningxia that divert water from the YRB (100 million m^3)

频率		多年平均		95%		75%		50%		25%	
灌域	渠道	引水	耗水	引水	耗水	引水	耗水	引水	耗水	引水	耗水
合 计		82.39	35.94	56.69	24.73	73.91	32.24	82.39	35.94	98.21	42.84
	自流灌区合计	71.42	29.69	49.14	20.43	64.06	26.63	71.42	29.69	85.13	35.39
青铜峡灌区	青铜峡河西灌区	43.11	18.68	29.66	12.85	38.67	16.75	43.11	18.68	51.39	22.26
	唐徕渠	14.22	6.16	9.78	4.24	12.75	5.53	14.22	6.16	16.94	7.34
	惠农渠	10.67	4.51	7.34	3.10	9.57	4.05	10.67	4.51	12.71	5.38
	汉延渠	7.35	3.09	5.06	2.13	6.59	2.77	7.35	3.09	8.76	3.68
	西干渠	6.61	2.94	4.55	2.02	5.93	2.64	6.61	2.94	7.88	3.50
	大清渠	1.93	0.76	1.33	0.52	1.73	0.68	1.93	0.76	2.30	0.91
	泰民渠	1.42	0.67	0.98	0.46	1.27	0.60	1.42	0.67	1.69	0.80
	河西总干渠	0.93	0.55	0.64	0.38	0.83	0.49	0.93	0.55	1.11	0.66
	青铜峡河东灌区	14.02	5.73	9.64	3.94	12.57	5.14	14.02	5.73	16.71	6.82
	河东总干渠	0.07	0.03	0.05	0.02	0.06	0.03	0.07	0.03	0.08	0.04
	秦渠	5.46	2.43	3.76	1.67	4.90	2.18	5.46	2.43	6.51	2.90
	汉渠	2.67	0.97	1.84	0.67	2.40	0.87	2.67	0.97	3.18	1.16
	马莲渠	1.43	0.53	0.99	0.36	1.29	0.47	1.43	0.53	1.71	0.63
	东干渠	4.38	1.77	3.02	1.22	3.93	1.59	4.38	1.77	5.22	2.11
卫宁灌区	卫宁灌区	14.29	5.29	9.83	3.64	12.82	4.75	14.29	5.29	17.03	6.31
	七星渠	5.39	1.90	3.71	1.31	4.83	1.70	5.39	1.90	6.42	2.26
	跃进渠	2.79	1.04	1.92	0.72	2.50	0.93	2.79	1.04	3.33	1.24
	中卫各渠	6.11	2.35	4.20	1.62	5.48	2.11	6.11	2.35	7.28	2.80

Source: Ningxia Water Rights Transfer Feasibility Report (2011:50)