

**Does water rights trading promote economic efficiency of water resource?
: A global literature review**

Chunmei Zhang¹ Yuanfeng Zhao¹, Changbai Xiu²

1. Department of Economics and management, Inner Mongolia Agricultural University,
Hohhot, China.

2. Vice president, Inner Mongolia University For The Nationlities, Changbai Xiu is the
corresponding author (e-mail: cbxiu@126.com).

Abstract: Intense competition of different increasing industrial water demand highlight the water shortage a big issue threatening the sustainable development of the arid and semi-arid regions all over the world. Water rights trading or tradable water market is seen as an important way to promote economic efficiency of water resource, and finally to ease water shortage. Especially, agricultural water rights trading¹, the main part of water rights trading, is seen by academia as a critical way to promote water utilization efficiency and allocation efficiency. However, the global water rights trading practices reflect that the actual performance of water rights trading is far below the optimistic expectation by the academia. In order to find these reasons of the gap between theoretical expectation and the actual practice, global literatures on water rights trading are summarized into 6 kinds in this thesis to find out its research gaps for further research. These literatures are as followings: (1) the principle of water rights trading; (2) the simulation of potential benefits of water rights trading in developing countries; (3) the ideal and practical water rights trading patterns in developing countries; (4) assessment of the global water rights trading markets' performance; (5) the prerequisite of water rights trading and lessons from actual water trading market; (6) the institutional reform in water rights trading. Answers about whether water rights trading can promote economic efficiency of water resource are discussed in the paper, they are as followings: (1) water rights trading can promote the utilization and allocation efficiency of water resource by microeconomic theoretical deduction and model simulation; (2) it really promotes the utilization and allocation efficiency of water resource in the relative mature market in America and Australia by the assessment of the performance of their markets; and conclusions are controversial when immature market are considered in developing countries since there are not sufficient data to verify; (3) scholars highlight that transaction cost is the most critical factor constraining the effectiveness of water rights trading markets, which leads to market failure in the economic language; (4) central and local governments play the most critical role to eliminate water rights trading market failure, thus government behaviors and institutional reform are key determinants of the effectiveness of water rights trading markets. It is obvious that current academic research does not explore deep enough about the water rights trading mechanism and thus cannot provide deep insights and absolute evidence to show water rights trading indeed promote the economic efficiency of water resource. Shortcomings of current research are summarized by literature review, and they are: (1) lack of multi-angle theoretical perspective; (2)

¹ Based on current global literatures and economic principle, water rights trading happens from low-value use to high-value use, currently, irrigation use is low valued compared to non-agricultural use, but irrigation water have to be secured because of its attribution to food safety, thus, saved irrigation water from low-value agricultural production to high-value agricultural production or to non-agricultural use is the nature of water rights trading market, namely, the current water rights trading market is the agricultural water rights trading market.

lack of applied theories; (3) lack of robust evidence; (4) lack of exploration of government's behavior and dynamics of institutional reform. Future research topics should be broadened and deeply explored are: (1) broaden the theoretical horizons; (2) put the theories down to the earth; (3) carry out robust positive research; (4) explore deeply about government's behavior mechanism in water management and water rights trading market cultivation.

Key words: agricultural water rights trading market; water resource; economic efficiency; literature review

Recently, lasting increase in industrial water demand leads to fierce competition among different water resource use, and this is seen as the fact of global water shortage especially in arid and semi-arid regions (Bekchanov M, Bhaduri A, Ringler C.,2013). Promoting utilization and allocation efficiency of water resource is the inevitable choice faced with the increasing demand. Water rights trading is seen as market-based tool to promote the economic efficiency of water resource(M.W. Rosegrant, H.P. Binswanger , 1994; Yahua Wang,2002; X. Diao, T. Roe, R. Doukkali , 2005; Qupei Ma,2007;Harou J J, Pulido-Velazquez M, Rosenberg D E, et al.; 2009). Agricultural water rights trading almost exclusively stands for water rights trading because more than 70% of the total water demand is used as irrigation water, irrigation water utilization efficiency is very low and irrigation can only create out low value-added agricultural products, thus there is big room and economic incentive to promote irrigation water utilization efficiency and transfer the saved agricultural water rights to produce high value-added non-agricultural products(Xueyuan Wang,2008; Ziyao Xu,2017). In practice, water rights trading happened in United States, Australia, and then they are put down to earth in some developing countries such as Chile, Mexico in the 1970s. In China, it starts to work in some north-western provinces and autonomous regions due to their arid climate characteristic and thus water resource shortage, and in some south-eastern provinces due to their great water demand. Globally, water rights trading goes two way, one is from low value-added agricultural production to high value-added ones, the other is from the general low value-added agricultural production to high value-added non agricultural production. It works relatively well only in United States, Australia, and some other few developed countries, and its performance is far low away from their optimistic theoretical expectation in almost every developing country, even in Chile which is seen as a good example of water rights trading by World Bank. Faced with the huge gap between theoretical expectation and the actual practice, scholars by now have not yet definitely answered the question whether water rights trading can promote economic efficiency of water resource and the pursue of the answer is still on the way for the scholars.

The question whether water rights trading can promote economic efficiency of water resource is put on the center of the table in this paper, and 6 different topics are summarized to find out different degree answers for this academic question. 6 main topics summarized from current literatures are as followings: (1) the principle of water rights trading, which give the theoretical support to answer the question; (2)the simulation of potential benefits of water rights trading in developing countries, which give the simulation support to answer the question; (3)the ideal and practical water rights trading patterns in developing countries, which are the ideal path or practical path to achieve the goal of efficient water rights trading ;(4) assessment of the global water rights trading markets' performance, which provide evidence to verify the effectiveness of water rights

trading;(5) the prerequisite of water rights trading working and lessons from actual water trading markets, which explore the limiting factors that influence the effectiveness of water rights trading;(6)the institutional reform and change in water rights trading, which explore the institutional arrangements underpin the water rights trading. By classification and summarization of these literatures, answers of the question are become clear and some fresh topics are suggested to further explored for Chinese scholars.

1. The principle of water rights trading

Proponents argue that water rights trading can promote economic efficiency of water resource, and thus can improve social welfare. They think that water rights can be seen as regular economic goods to trade in the market since water shortage bring the economic attribute of water resource to the fore. The mechanism how water rights trading can promote economic efficiency of water resource are proved by market mechanism (World bank, 1993; Henning Bjornlund,2002). Firstly, water rights trading under the clear definition of water rights can promote the utilization efficiency of water resource. Water rights trading leads to the marketed-based pricing mechanism and it exclude the government pricing by nature, which will economically stimulate users decrease their demand, and give incentive for suppliers to invest water saving infrastructures to save more and sell more. Secondly, water rights trading under the clear definition of water rights can promote the allocation efficiency of water resource. With the high efficient use of irrigation water, water rights from the saved irrigation water rights can be transferred from low value-added agricultural products to high value-added agricultural products, from farmers with low utilization efficiency to high ones, and from lands with bad quality to high ones (McCann L., Garrick D., 2014); these transfer can improve the effective use of labor and land, and finally increase output and farmer's income. Water rights can also be transferred from agriculture to non-agriculture use, especially to industry use, and this can increase farmer's revenue from selling water rights and promote non-agricultural economic growth, and finally promote agricultural economic growth indirectly (Bauer C. J., 1997). Thus the reallocation of water resource can make a positive feedback between water resource utilization efficiency and allocation efficiency. Advocators of water rights trading suggest the establishment of tradable water institution and argue that governments have to regulate the market and carry out trading rules rather than direct control.

Opponents argue that tradable water market only play a subsidiary role and government still play the main role when water governance is concerned due to widely market failure happened in the tradable water market (Young M., 1997). These reasons of market failures are as followings: (1) water resource is public good by its nature, and there is huge and wide externality when water is produced or consumed and it cannot automatically internalized into consumers' and producers' behaviors , thus governance is necessary(Howe C .W. , 1986,1986); (2) there are different shareholders with different water resources usage aim ,thus it require government to balance their relations, especially, water rights trading might threaten the poor's welfare which need governments regulation; (3) water rights trading is sensitive to transaction cost, high transaction cost lower the possibility of water rights trading, and government play the critical role in lowering transaction cost; (4) investment in water infrastructures needs large fixed cost and long time to recover the total cost, thus it is natural monopoly which need regulation, and mostly governments build up these infrastructures using national tax since irrigation water price is too low to be profitable for private investors(Bauer C. J., 1997); (5) the absolute clear definition of water rights is impossible, water rights system by nature is public water rights institution, thus water use in

many cases is collective action which needs government's regulation; (6) the profitability of selling water rights may stimulate farmers to leave away from farming and thus threaten food safety, government have to keep an eye on the stable supply of food production(Jin Mian Han, 2009).

2. The simulation of potential benefit from water rights trading in developing countries

These successful water rights trading practices in United States and Austrian mould economists' and policymakers' optimistic expectation ,and they, especially under the help of World Bank, put water rights trading down to earth in some developing countries such as Chile. In order to promote the rational development of water rights trading, economists simulate these potential benefits each developing country could get mainly using CGE model(M.W. Rosegrant, H.P. Binswanger , 1994; X. Diao, T. Roe, R. Doukkali, 2005) and mathematical planning model(A. Garrido, 2000). According to these models, water resource is seen as a factor of production to help water traders achieve their utility maximization goal or profit maximization goal. By resolving the maximization problem, the market price, equilibrium trading quantity, and welfare gain from water rights trading can be calculated out. All these simulations show that there are huge potential benefits getting from water rights trading within irrigation or between agriculture and industry(X. Diao, T. Roe, R. Doukkali, 2005; A. Garrido, 2000; C.K. Seung, T.R. Harris, 2000; M. Müller,2006; T. Roe, A. Dinar, Y .Tsur, X. Diao, 2005). However, the rigid assumption of zero transaction cost and completely competition make simulation conclusions less convinced.

Chinese scholars follow the above paradigm to simulate the potential benefits of water rights trading if it happens in the Yellow river which stands for the highest level of Chinese water rights reform, from upstream to its downstream, within one province or autonomous region to among provinces or autonomous regions (Heaney,2006;Li Zhen Wang, 2015). Two analysis frameworks are chosen by Chinese scholars. One follows the total benefit or profit maximization process (Heaney, 2006). Scholars take some water rights trading typical cities or areas as examples to show that there are tremendous gains will be picked by water rights trading. The other follows the total cost minimization process. They show that water rights trading, instead of directly building up water-saving infrastructures, can achieve the water-saving goal at a much lower cost. Moreover, they shows that cost saving happens only if water transaction cost is low enough to make the benefits of water rights trading notable, and this is difficult for farm-level irrigation water rights trading, and their policy suggestion is to lower transaction cost(Yahuawang,2011).

3. The ideal water rights trading system assumption and the practical pattern choice in developing countries

There is no huge difference in pattern choice between ideal water rights trading system and the practical ones in developed countries and in Latin-American developing countries, the former can relatively easy put ideal water rights trading system down to earth because it has long history of mature market system so that they are relatively experienced to cultivate water rights trading system and their citizens are relatively easy to accept seeing water rights as proprietary right to trade, the latter actually almost directly copy the former's water rights trading pattern since they ideologically accept the economic liberalism theory. As far as China is concerned, ideal patterns are different from actual ones, since the ideal one are learned from suggestions rooted in western new-liberalism economics while actual ones are chosen under the constraint of Chinese geographical and institutional context. Chinese scholars focus on three types of topics: the definition of water rights, the explorations of ideal pattern, and the exploration of practical ones

under the national level and provincial level constraint of institutional and geographical context. These three topics are detailed introduced as below.

The clear definition of water rights is the prerequisite of water rights trading. When it requires that water resource has to be seen as commodity to trade since water resource is becoming more and more scarce, Chinese scholars give the deeper and more concrete definition of water rights. Before the opening of water rights trading, water rights is just seen as ownership possessed by the whole national people, and the right of use based on the national ownership can be entitled to individual users by government. In the very first infancy of water rights trading, water rights become a bundle of rights to meet the needs of trading, but by now, it still has no real right for usufruct which can be totally defined clearly and completely transferred (Manhong Shen, 2002, 2004; Yuanyuan Sun, 2016). Some scholars argue that water rights are completely defined if they are exclusive, transferable, clearly divided, and they are exercised, saved, and bounded (Yunkun Chang, 2001; Xisheng Huang, 2005; Liping Pei, 2007). Such water rights are well qualified to be tradable in the market.

The ideal water rights trading market is the blueprint created out by Chinese scholars. And they sum up water rights markets into “two levels” and “three patterns”. Initial water rights allocation and reallocation of water rights are two levels in water rights market. There are trading among regions, among different industries, and among farmers as far as reallocation of water rights market is concerned and this is so-called “three patterns”. The initial water rights means a bundle of water rights based on the right of use. The principle dominates initial water rights allocation is that equity is preferred to efficiency. and it is better achieved by government allocation rather than market allocation (Lili Rong, 2007). National government gives top priority to water rights for living, then water rights is given for ecological use, agricultural use and other industrial use. Agricultural water rights surplus, other water rights for industrial use, and unallocated water rights can be transferred from each other only if they abide by relevant laws and regulation (Jiajun Liu, 2012). Demanders are local governments, non-agricultural individual users, irrigation farmers, suppliers are non-agricultural individual users, irrigation farmers. Price is determined by government in the markets’ infancy, and then is determined by market itself. The main role of government in the water rights trading system is to regulation and deal with market failure (Jinmian Han, 2008). Water rights trading could happen within agriculture, between agriculture and non-agriculture sectors, and from individual users to governments (Liping Pei, 2007; Lili Rong, 2010).

In reality, water rights trading pattern is strongly affected by Chinese national context. Firstly, citizens are reluctant to treat water resource as regular commodity to pay more in the long public water rights institutional history with great subsidy for their water expense expenditure. Secondly, local governments have not enough incentive to carry out water rights trading plan since it is costly while trading benefit is long-run and not clear, although central government would prefer to water rights trading to achieve the efficient use of water resource. Thus the ideal cultivation of water rights markets needs far way to go. There are three characteristics of current water rights trading under the above constraints. Firstly, water rights is not the completely tradable ones but the right of use in limited period of time. Secondly, local governments not only make trading rules but also act as the supplier in the trading, thus current water rights trading is quasi- market trading, it is not the free market between supplier and demander with equal legal status (Liping Pei, 2007). Although there are some limited number of trading happened among irrigation farmers in the

north-western provinces and autonomous regions, there is still no complete system of two-lever and three-type water rights trading market in China.

4. The assessment of water rights trading market's performance and efficiency

Evaluation of water rights trading market's performance tries to provide evidence that trading really achieve the economic efficiency of water resource. Since it is well developed in United States, Austrian, and Chile, the quantitative assessments are done in these countries. The key index to assess is the maximum net benefit from trading. Scholars take all agents in water trading into consideration; they calculate the surplus between all total benefits each agent can get and all costs of trading. As far as trading benefits are considered, water resource is seen as factor of production to produce agricultural output for farmers involved in water trading, thus farmers' benefits getting from water resource use can be initially shown by the value of marginal product (VMP is the demand curve of farmer to the water resource), the bought quantity of water rights multiplied by the water rights price are the market value of buyer's payment. The net welfare (net benefit from water rights trading) is that the market value of buyers' payment minus the market value of supplier getting, and then minus all other different transaction costs (Bekchanov M.,2013). According to the calculation, there are positive net benefits in United States and Austrian, thus water rights trading really promote water resources' economic efficiency (Hearne R. R., Easter K. W., 1997; Henning Bjornlund, 2003; Settre C., Wheeler S. A. ,2016). There are arguable opinions when the performance of water rights trading in developing countries is concerned. Here Chile is taken as a typical example since its water rights trading market it the most mature in all developing countries. World Bank hold that there are active water rights trading and positive net benefit from trading, while some local scholars hold that water rights trading market is much less active than theoretical expectation, and there is not robust evidence to verify water markets' performance. Chinese scholars use qualitative methods and case studies in some experimental areas in north western provinces to show its performance, however they cannot firmly prove that water rights trading market promote the economic efficiency of water resources(Xiao you Sheng,2007;Liange Zhao,2007; Jinmian Han,2009; Jianbin Zhang,2014; Zhi Cai,2015;Tengfei Shi,2015;Min Liu, 2016;) Based on water rights trading happened all over the world, the only one qualitative global assessment of water markets' performance by now is done(Grafton,2010), 19 indexes from three dimensions of institution base, economic performance, and environmental sustainability are used to evaluate the market performance of United States, Austrian, Chile, South Africa, and China. its conclusion is that United States and Austrian rank first, followed by Chile and South Africa, and China is at its very early infancy.

5. Prerequisites of and lessons from water rights trading market

Scholars rethink the effectiveness of water rights trading market and focus on learning from experiences and lessons why water rights trading has not improved efficiency since it performs far below the optimistic anticipation(J.J. Pigram , 1993; R.E .Howitt , 1994; K.W. Easter , 1998). Basically, they realizes that a effective water rights trading market is strongly embedded in a wider institutional and historical context, which require co-working of market and government, and thus government is faced with the new challenge in the trend of decentralized water governance, government have to focus on the cultivation of incentive system to stimulate traders participate in the water rights trading, and turn to regulation other than direct control. When they think back about reasons why water rights trading are effective in developed countries, they find the basic dynamic of co-working of government and market. With the rapid increase in different water

demand, users prefer to see water resource as regular commodity, and it can be allocated by market to resolve the fierce competition among different uses, thus there is strong incentive for water resources users to trade water rights. Meanwhile, it is more and more costly to build up water infrastructures and to centrally manage water resources for governments, thus governments also want to loosen their rigid control of water management, help cultivate water market to save their budget. Finally, the co-working of government loosening control and market trading together put water rights trading market down to the earth. The successful experiences are summarized in the work of *American Water Market* finished by World Bank (Simpson L., Ringskog K., 1997), in which 8 prerequisites are mentioned: (1) huge increase in water demand and fierce competition among different usages; (2) clear definition and equal allocation of initial water rights bundles; (3) well-equipped water infrastructure to transfer water resource; (4) high efficient water administration system; (5) the mechanism of dispute mediation; (6) dealing with the third party effect; (7) nurturing of the citizens' consciousness of regarding water resource and rights as commodity; (8) stable and abundant budget.

Market failure in the water rights trading market is analyzed by scholars. Reasons of market failure in the water rights trading market includes transaction costs, externality, turn flow, market power, trading risk and uncertainty, among which transaction costs is strongly emphasized by scholars (R.R. Hearne, K.W. Easter, 1997; B.G. Colby, 1990; J.E. Nickum, K.W. Easter, 1991; Easter, K.W.; Rosegrant, M.W.; Dinar, A., 1999; McCann L, Garrick D., 2014). However, research on transaction costs in water rights trading is still at its early infancy, scholars only give its definition, qualitatively explain how it constricts water rights trading, quantitatively calculate its percentage compared to trading price, find factors influencing transaction costs. Some scholars hold that transaction costs is all costs happened before, during, and after trading, it generally include the cost of building up and maintaining water infrastructure, the cost of finding out traders, the cost of defining the complete attributes of water rights for trading, the cost of bargaining on price and other trading conditions, and the law cost (Colby B. G., 1990; Robert R. Hearne, 1997; Bauer C. J., 1997). Some scholars define transaction cost as institutional costs (McCann L., Garrick D., 2014), including the cost of building-up, maintaining, using, and changing institutions relevant to water rights trading. Transaction costs can make water rights trading less possible to happen and it make the price discreteness worsen which make the price less effective as trading signal. Factors influencing transaction cost are comprehensively summarized in the work of *Water Market in the 21th Century*.

6. Water rights trading institution reform

It is much easier to put water rights trading system down to earth in developed countries since there is long history of mature market working system which have already accumulated experiences for water rights trading and have cultured citizen's consciousness of accepting water rights as a regular commodity to trade, while it is mainly dependent on government, especially central government, to initiate the systematic water rights trading institutional reform to put water rights trading down to earth in each developing country. Thus, institution changes, including mandatory ones and induced ones, should be well discussed by scholars in developing countries. The fact is that scholars in Latin-American developing countries such as Chile do not focus much on the role of institution, the possible reason may be that Latin-American developing countries almost copy the water rights trading pattern already well-performed in United States, and there is no big innovation in water rights trading institution. However, Chinese scholars attach more

importance on the role of water rights trading institution change dominated by different levels of governments than scholars in other developing countries, since China has long history of public water rights institution and the cultivation of water rights trading system is a total new creation process, thus the whole build-up of water rights trading market is the supply of the new institutional system, and this public goods is definitely supplied by central government. Meanwhile, local governments are reluctant to lose their controlling power on water resource management. Thus the dynamics of government's behavior and the institutional change initiated by government are two topics discussed by Chinese scholars.

Chinese scholars' researches mainly focus on two aspects. Firstly, they discuss the role of government and market and their relations in the water rights trading market. The consensus is water rights trading market is complicated, Chinese scholars have not deeply understood the water trading market mechanism, and their attitudes to water rights trading market are cautious, thus they argue that currently government should still play its dominant role on water rights market cultivation, even directly take part in trading as market entity to achieve equity and efficiency (Shucheng Wang,2000; Angang Hu,2001;Yahua Wang, 2017). Under this guideline, current rational pattern of trading is quasi-market in which local government instead of individual farmers or their associations sell saved irrigation water to industrial firms or to other cities. Their arguments well support and explain the current quasi-market pattern, nevertheless, they are far from the ideal design, Chinese scholars still believe the decentralized water management and cultivation of water rights trading market, they strongly call for the reform carried out by central government, yet there are no enough deep applied theories which can help ideal design down to earth, and the lack of water rights trading practices constraint scholars further theoretical research. Secondly, they give a theoretical explanation from the perspective of institutional economics to show the whole picture of water rights trading market and its future possible choice. Chinese scholars use SCP paradigm widely used in industrial economics for reference to put forward the hypothesis that the complicated trading attributes of water resource determine its right bundle regulation structure, under the right bundle structure, water rights trading behavior and thus water structure are determined, and then market performance or institutional performance of market mechanism is determined, the institutional performance conversely influence market behavior which call for the improvement in the right bundle entitled structure to satisfy the efficient allocation by market mechanism. Guoxing Xiao(2004)argues for the complete tradable initial water rights allocation which gives the individual water users definite Usufructuary Right to equally trade with others, and he believes that the equal right is the prerequisite of free market trading, and free market trading means price is determined by market which will be much higher than current ones controlled and strongly subsidized by government, and private suppliers will invest in building up water infrastructure and water saving technology driven by the high price and possible profit, thus, he strongly argue for the improvement in initial water rights allocation. Qupei, Ma(2007) hold that bad definition of initial water rights allocation and the lack of appropriate organization involved in the management in irrigation water resource are two key reasons for the low efficient allocation of rural water resources. Because of the high transaction cost, it is quite difficult to clearly define the initial water rights, and some rent of unallocated initial water rights will definitely leave in the public area and finally disappear, and the appropriate organization to capture this rent is a key method to improve the economic efficiency of water resource. He gives a empirical research in Zhangzhou irrigation district in Hubei province

which verify his hypothesis. Rui Ye (2012) compare the relative cost of clear definition of water rights and the cost of government control during the whole trading process, and he thinks the clear definition of water rights under the technological and budget constraint cost too much, thus government choose the less expensive way to improve economic efficiency of water resource, in which government only directly sell saved irrigation water to firms, other than allocate initial water rights to farmers and let them trade.

7. Literature Review and future research topics

Global scholars attach high importance on the positive effect of water rights trading market in improving the economic efficiency of water resource to resolve the water shortage threatening the sustainable development in arid and semi-arid areas all over the world. However they by now have not deeply understood how water rights trading market works due to the very immateriality of water market practices all over the world. And the water rights trading markets which are strongly decided by government reform has not been well implemented since governments are cautious when they do not get firm support of applied theories. The strong positive feedback between applied theories and trading practices has not established by now which shows the big gap between optimistic theoretical expectation and less satisfactory practical performance, and possible improvement for future research can be summarized.

The first gap is that there are no enough applied theories to further boost the practices of water rights trading. The theoretical research of water rights trading mechanism is for the resolution of competing use of water resource due to water shortage, which decides its nature is the applied theory. Although researchers logically deduce that water rights trading market can improve economic efficiency of water resource, and simulates the huge potential benefits of water rights trading can obtain, they have not found the appropriate way to put water rights trading market down to earth, especially the ones most suitable to local geographical and institutional context since water rights trading market are strongly embedded in the local context. Scholars should struggle to find factors constraining water rights trading, and explain how they limit water rights trading and how to break them.

The second gap is that there are no robust empirical studies to verify or disprove the effectiveness of water rights trading market, neither deep understanding about water rights trading mechanism. Scholars only can collect enough data in developed countries mainly in western America and Austrian, while they cannot collect enough data in developing countries due to inactive market trading, thus researchers only make their judgment of water rights trading market's effectiveness convinced when the situation of developed countries are concerned, and they only can give some case studies in most developing countries where water rights trading market exists and cannot achieve consensus about the effectiveness of water rights trading market, but scholars come to consensus that water rights trading market are still in their infancy, especially in developing countries, and more precise and effective institutional and policy improvement should be carried out in both developed and developing countries.

The third gap is there is no clear analysis about the role of interacted stakeholders in the water rights trading market, especially the interaction between governments and other stakeholders. The formal water trading practice only started 50 years ago, and water rights trading based on the private water rights system is a small fraction of the total water rights use, thus water rights system has always been dominated by public water rights institution; governments are and will be the chief actor in supplying, managing, and regulating of water resource, and they possess

administrative discretion which give them stronger power over the usage rights entitled to farmers and other rights owned by other agents, meanwhile, they are reluctant to give up their power over the control of water resource; Therefore, academic focus should be put on the role of governments and explore their goal functions and their behaviors. Currently, scholars' research emphasize farmers' behavior more than governments' behavior; one possible reason is that it is difficult to get data to explore governments' behavior, but more academic research about government should be furthered in the future.

The last-but-not-least gap is that there is no flexible, comprehensive and multi-angle research on the behavior of water users and governors. Although scholars point out that scare resource allocation theory, natural monopoly theory, public goods theory, property right theory, externality theory, transaction cost theory, collective action theory should be used in the analysis of interactions of stakeholders, the reason of market failure and government failure; comprehensive and flexible researches are still rare and they are deserved to be further explored in the future.

References:

1. Bekchanov M, Bhaduri A, Ringler C. How Market-Based Water Allocation Can Improve Water Use Efficiency in the Aral Sea Basin?[J]. Social Science Electronic Publishing, 2013, 11(11):1501-4.
2. Harou J J, Pulido-Velazquez M, Rosenberg D E, et al. Hydro-economic models: Concepts, design, applications, and future prospects [J]. Journal of Hydrology, 2009, 375(3):627-643.
3. Ya hua Wang. Water rightss and water market: new trend in water management [J] Review of Economic Research. 2002,(20):2-8.
4. Qupei Ma. The economic analysis of agricultural water resource efficient allocation. [D].Huazhong Agricultural University, 2007.
5. Xueyuan Wang, Hongyun Han. Prerequisites and their influencing factors of agricultural water rights trading: a foreign literature review [J]. Journal of China University of Geosciences (Social Sciences Edition) 2008(02):66-71.
6. Zi yao Xu, Yan Wang, Yunjie Liu et al. The framework of agricultural water rightss trading markets and case studies of market trading. [J] Journal of Economics of Water Resources.2017, 35(4):38-45.
7. World Bank (1993), 'Water Resources Management', A World Bank Policy Paper, Washington DC.
8. Henning Bjornlund. Efficient water market mechanisms to cope with water scarcity[J]. International Journal of Water Resources Development, 2003, 19(4):553-567.
9. Mccann L, Garrick D. Transaction Costs and Policy Design for Water Markets[M]// Water Markets for the 21st Century. Springer Netherlands, 2014:11-34.
10. Bauer C J. Bringing water markets down to earth: The political economy of water rightss in Chile, 1976–1995[J]. World Development, 1997, 25(5):639-656.
11. Young M. Water rightss: An Ecological Economics Perspective[J]. Working Papers in Ecological Economics, 1997.
12. Howe C. W., Schurmeier D. R., Jr. W. D. S. Innovative Approaches to Water Allocation: The Potential for Water Markets [J]. Water Resources Research, 1986, 22(4):439-445.
13. Jinmian Han. The third effect of water rightss trading [D]. Northwest University, 2009.

14. ROSEG RANT M W, BINSWANGE R H P. Markets in tradable water rightss: potential for efficiency gains in developing country water resource allocation [J] . World development, 1994, 22(11) : 1613 —1625.
15. X Diao, T Roe, R Doukkali. Economy-wide gains from decentralized water allocation in a spatially heterogenous agricultural economy. [J] . Environment and Development, 2005
16. GA R RIDO A. A mathematical programming model applied to the study of water markets within the Spanish agricultural sector [J] . Annals of operations research, 2000, 94(1) : 105 — 123. Economy-wide gains from decentralized water allocation in a spatially heterogenous agricultural economy
17. C.K. Seung, TR Harris, JE Englin, NR NetusilImpacts of water reallocation: A combined computable general equilibrium and recreation demand model approach. [J] . The Annals of Regional ScienceDecember 2000, Volume 34, Issue 4, pp 473–487
18. M. Müller, A general equilibrium approach to modeling water and land use reforms in Uzbekistan, . [D] . 2006
19. T. Roe, A Dinar, Y Tsur, X Diao Feedback links between economy-wide and farm-level policies: with application to irrigation water management in Morocco .[J]. Journal of Policy Modeling, 2005
20. Lizzhen Wang, Yuefei Huang, Guangqian Wang, and Jianshi Zhao. The modeling of water rightss market trading in the city of Bayannaoer[J]. Journal of Hydroelectric Engineering. 2015,34(06):81-87.
21. Hearne R R, Easter K W. The economic and financial gains from water markets in Chile[J]. Agricultural Economics of Agricultural Economists, 1997, 15(3):187-199.
22. Wang Y. A simulation of water markets with transaction costs[J]. Agricultural Water Management, 2012, 103(1):54-61.
23. Manhong Shen. Research on the water rights trading institution: Chinese case studies[D]Zhejiang University, 2004.
24. Manhong Shen. The initial regional water rightss allocation: taking the equal division of initial water rightss allocation in Heihe as an example [J]. Research of Institutional Economics,2004,(03):64-80.
25. Yuanyuan Sun, Shaofeng Jia. Water rightss entitlement basis and classification of water rightss [J]. Resource Science, 2016, 38(10):1893-1900.
26. Yunkun Chang. Cutting off of Yellow River and the research of its water rightss institution [M]. China Social Sciences Press, 2001.
27. Xisheng Huang. Research of Chinese water rightss institution [M]. Sciences Press, 2005.
28. Liping Pei. Research of tradable water rightss. [J]. Law Review, 2007(4):44-54.
29. Lili Rong. Research of the quality of water rightss and economic efficiency of water resource [D]. Shandong Agricultural University, 2010.
30. Jiajun Liu. Research of Chinese water rightss institution. [D].Wuhan University,2014.
31. Jinmian Han et al. Symbiosis and transition: the framework and its working of Chinese water market [J]China Population Resources and Environment, 2008(05):161-167.
32. Hearne R R, Easter K W. The economic and financial gains from water markets in Chile[J]. Agricultural Economics of Agricultural Economists, 1997, 15(3):187-199.

33. Setter C, Wheeler S A. Environmental water governance in the Murray-Darling Basin of Australia: the movement from regulation and engineering to economic-based instruments [C] // Handbook of environmental & sustainable finance. 2016: 67—91.
34. GRAFTON R Q, LANDRY C, LIBECAP G D, et al. An integrated assessment of water markets: Australia, Chile, China, South Africa and the USA [R] . National Bureau of Economic Research, 2010.
35. Xiaoyou Sheng. Research of farmers' rights protection in the water rightss trading. [D]. Chinese Academy of Agricultural Sciences , 2007.
36. Liange Zhao, Congshu Hu. The economic effect of Dongyang-Yiwu water rightss trading. [J]. Issues in Agricultural Economy, 2007, 28(4):47-54.
37. Jianbin Zhang. Positive effects of water rights trading: theoretical analysis and empirical studies. [J]. Rural Economy, 2014(3):107-111.
38. Zhi Cai. The influences of water institution reform on the agricultural structure in YongChang County. [D].Lanzhou University,2015.
39. Tengfei Shi. The connection between irrigation water rightss trading and farmer's interests. [J]. Chongqing Social Science, 2015(1):15-20.
40. Min Liu. "quasi-market" and regional water resource management: the sociological analysis of water rights trading in Qingshui District in Inner Mongolia. [J]Issues of Agricultural Economics,2016,37(10):41-50+110-111.
41. J.J .Pigram, Property rights and water markets in Australia: An evolutionary process toward institutional reform. [J] Water Resources Research, 1993
42. R.E. Howitt Empirical analysis of water market institutions: The 1991 California water market. [J] Resource and Energy Economics, 1994
43. Easter, K.W.; Rosegrant, M.W.; Dinar, A., 1999: Formal and informal markets for water: institutions, performance, and constraints. World Bank Research Observer 14(1): 99-116
44. Simpson L, Ringskog K. Water markets in the Americas [M] . World Bank Publications, 1997.
45. Colby B G. Transactions Costs and Efficiency in Western Water Allocation[J]. American Journal of Agricultural Economics, 1990, 72(5):1184-1192.
46. NICKUM J E , EASTER K W . The application of transaction cost economics to Asian-Pacific metropolitan water-use issues [J] . Regional development dialogue, 1991, 12(4) : 3 — 15.
47. Easter, K.W.; Rosegrant, M.W.; Dinar, A., 1999: Formal and informal markets for water: institutions, performance, and constraints. World Bank Research Observer 14(1): 99-116
48. Mccann L, Garrick D. Transaction Costs and Policy Design for Water Markets[M]// Water Markets for the 21st Century. Springer Netherlands, 2014:11-34.
49. Colby B G. Transactions Costs and Efficiency in Western Water Allocation[J]. American Journal of Agricultural Economics, 1990, 72(5):1184-1192.
50. Hearne R R, Easter K W. The economic and financial gains from water markets in Chile[J]. Agricultural Economics of Agricultural Economists, 1997, 15(3):187-199.
51. Bauer C J. Bringing water markets down to earth: The political economy of water rightss in Chile, 1976–1995[J]. World Development, 1997, 25(5):639-656.

52. Angang Hu and Yahua Wang. Public policies of water resource allocation in the economical transformation: quasi-market and political democratic consultation [J]. China Soft Science, 2000,(05):5-11.
53. Yahua Wang, Quanfeng Shu et al. Literature Review of water market and research prospect water market with Chinese characteristics. [J].China Population, Resources and Environment, 2017, 27 (06):87-100.
54. Shucheng Wang. Water rightss and water market: economic tools of high efficient allocation of water resources. [J]Chinese Water Resource, 2000,(11):6-9.
55. Guoxing Xiao. Chinese water rightss trading and its institutional reform [J]. Management World. 2004(4):51-60.
56. Qupei Ma. The efficient allocation of agricultural water resource [D].Huazhong Agricultural University, 2007.
57. Rui Ye. The research of water resource reallocation [D]. Northwest University, 2012.