

Formalization of land and water rights combinations to deal with the consequences of climate change in the rural & urban areas in China

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Abstract

Climate change in China means higher temperatures, more droughts in the rural areas and because of an increased volatility of the rains sometimes flooding in the urban areas. People have developed adaptation mechanisms and it will be argued that adaptation requires titling of land and water rights. This would facilitate water trading, which has been used in several countries to mitigate the consequences of drought. We show that land and water rights are related because an improved allocation of water by stakeholders requires them to know that they are entitled to sell surpluses. Our research in rural China will be presented where dealing with more severe droughts was an issue. Then our research in urban China is presented to show climate change adaptation mechanisms in urban areas and the implications for land and water rights. Finally, some conclusions will be presented. China wants to move to a unifying land titling system. Such a system would integrate the registration of all land resources, including what is on the land and what is below, meaning the water and the minerals. It is important to allow the development of adaptation strategies, helping people in the urban and rural areas in China to deal with the consequences of climate change.

Introduction

Climate change in China means higher temperatures, more droughts in the rural areas and because of an increased volatility of the rains sometimes flooding in the urban areas. All kinds of adaptation mechanisms have been developed. However, adaptation requires titling of land and water rights. This would facilitate water trading, which has been used in countries like Australia, Chile and the United States (US) to mitigate the consequences of drought. We will show that land and water rights are related because an improved allocation of water by stakeholders requires them to know that they are the owner and entitled to sell surpluses.

After an introduction on climate change a theoretical framework will be provided, distinguishing different categories of land and water entitlements. Subsequently research in rural China will be presented where more severe droughts were an issue. This has led in Australia to reforms allowing water markets to work. Formalization of land and water rights, or titling, means that existing arrangements are put in a legal framework, which allows determining who own the land and the water and makes trading more easy. We will first deal with the methodology of this study and describe the rural areas, where ongoing climate

change requires adaptation. After summarizing evidence of this in China (Li and Van Dijk, 2012) we analyse experience in Australia, where they faced the Big dry and draw the lessons from Australia's efforts to deal with these serious droughts between 1997 and 2009.ⁱ The country has gone through a series of institutional changes and using a combination of more detailed planning of water use and allowing water markets. We will argue that in the rural areas in China more drought also requires reform of land and water policies, this requires titling of land and water rights.

Then research undertaken in urban China is presented to show the climate change adaptation mechanisms in urban areas. Finally, some conclusions will be presented. China wants to move to a unifying land titling system. Such a system would integrate the registration of all land resources, including what is on the land and what is below, meaning the water and the minerals.

Climate change requires adaptation in rural and urban areas

Climate change has different effects for different parts of China. The International Panel on Climate Change (IPCC, 2007) predicts that in the South of China climate change will lead to less rain and more erratic rain patterns. What does climate change mean? According to the IPCC:

1. Changes in the average temperature and more volatility
2. Sea level rise and coastal flooding
3. Inland flooding
4. Drought and water scarcity
5. Changes in the social and environmental determinants of health
6. higher temperatures, in particular in the cities

Climate change in Southern China means in particular, more droughts in the rural areas and because of an increased volatility of the rains sometimes more flooding in the urban areas.

Categories of water and land entitlements

Griffin (2006: 120) notes that water law establishes the rules by which agents behave with respect to water. This behaviour may include the exchange of water rights if the law allows it. Our research question is how the farmers deal with water transaction in the rural areas and how they can adapt so easily in the rural areas, given the existing land and water rights and the methods used in this study is largely a literature study, taking a comparative perspective. We also use Green (2003), who suggests the main types of land and water entitlements (table 1). The last three are in particular relevant for China, and in parts of Europe and the United States.

Table 1 Main types of land and water entitlements

Category of entitlement (Green, 2003)	Description (Van Dijk)
Open access	Without control leads to over use
Common property	Only group members can use it, but not allowed to trade

State property (if water scarcity and number of conflicts are frequent; Griffin, 2006: 123)	Water used by state bodies or by individuals under usufructory entitlements, this is the situation in China
Limited individual ownership entitlements	Granted by the state, but can be sold, inherited. This is UK model of Anglo-Saxon property rights
Unrestricted individual ownership entitlements	Based on: entitlements to land in particular are the natural law. Any restriction or limitation is considered an infringement of their rights. This US libertarian view of property rights

Existing legal systems

Griffin (2006: 120) distinguishes surface and ground water law, but also emphasizes certain communalities (table 2).

T table 2 A comparison of surface and ground water law

Different water doctrines	Surface water law	Ground water law, often depletable
Common property: Riparian doctrine (in a case of no scarcity and infrequent conflicts)	Only riparians are legally entitled to make use of surface water; these water rights are not quantitatively fixed, but use should be 'reasonable'	Under the reasonable use doctrine of ground water use, overlying landowners form an exclusive common, but water use is constrained
Private property: the prior appropriations doctrine, based on first in time, first in right	Key features: Seniority Quantification Transferability: rights may be sold independently of any land on which the water is used	In some US states this system is also used for managing ground water, including the inefficient and dispensable elements such as beneficial use and forfeiture clauses
Correlative shares: private property	Transferable shares in the resources	Correlative rights in ground water mean relative to absolute ownership & reasonable use (California)
Other state property interests	Concern rival and non rival use of water left instream: fishing, wildlife & vegetation	Concerned environmentalists, they care
Absolute ownership doctrine (also called rule of capture: you own what you can capture), based on private ownership of land	Assigns owners of the land the right to use as much as they can use .	In Texas: assigns every owner of land overlying an aquifer the right to pump as much ground water as desired. This is encouraging wasteful use.

Source: Based on Griffin (2006).

Green (2003) adds: when there is no more water, the doctrine of prior appropriation (first in time, first in right) is problematic reform is necessary. Only in certain states of the United States we see unrestricted individual ownership entitlements. In the Anglo-Saxon system rights to abstract water may exceed the drought flows. Hence in Australia, where the legal system is based on the Anglo-Saxon tradition, reforms of the water sector were needed and will be discussed.

In many countries the principle to use your own water as not to do injury to others has been replaced by administrative law when water became scarce. However, the Eastern part of the US continued with English riparian law, while in western states irrigation is important and the riparian law could not be applied for downstream users.

In the Netherlands land is private, but Water boards determine the level of ground water use and specify how much landowners can pump up, which is only limited quantity per day (the famous Mrs. Jorritsma incident, which concerned a politician and former minister, who pumped up more than allowed). In a period of climate change (in China this often means droughts) it is important that the use of water does not do injury to others and hence to define land and water rights.

Climate change and available water resources in rural China, the case of the Yunnan province

The current system of water rights in China is described in Ho (2016: 30): “water resources were nationalized early in the history of the People’s Republic: (...) in 1954 for water resources (Constitution, Article 6). Article 9 of the Land Administration Law determined that additional land (and water) resources would be addressed with separate laws. Ho (forthcoming: 157) adds: ‘The use rights to fisheries and the embankments around fisheries would thus be addressed by the Fishery Law and thus by the Ministry of Agriculture. However, oceans and seas within national boundaries would be encompassed by the State Oceanic Administration (since 2013, merged with the Ministry of Land and Resources). Water resources are state-owned and fall under the Ministry of Water Resources, although there is contention whether underground water falls under the Ministry of Land and Resources.’

Ho (forthcoming: 157) also notes that: ‘The Provisional Measures on Real Estate Registration effective beginning March 2015 (State Council, 2014) stipulate that from that time forward, the registration of land, (...) and water resources was required to be performed under the auspices of a single ministry: the Ministry of Land and Resources.

Adaptation to climate change policies from above have not always reached the farmers' level (Smith and Lenhart 1996). Many of these adaptation policies initiated by higher levels of government in China have been implemented in the Yunnan province (YPG 2008), but Li and Van Dijk (2012) conclude to that drought policies in Yunnan province have not always been effective.ⁱⁱ They suggest to strengthen market force in resource allocation or to create water markets in China. However, the use of market mechanisms is still at a nascent stage. Currently only small parts of the climate change policies are implemented based on market agents and stakeholders input. However, the creation of water market should be considered, given its role in dealing with drought in for example Australia.

China promotes water pricing, water trading, adoption of market mechanisms and involving stakeholders in decision making. These are the trends in China's drought policies. However, examples can hardly be found in places without big water infrastructure and without titling. Hence there is a need in the rural areas to define land and water rights more clearly. This would facilitate water trading, which has been used in several countries to mitigate the consequences of drought (Australia, Chile, South Africa and the United States; Hung et al., 2014).

Van Dijk and Li (forthcoming) take the lessons learned from Australia's reaction to the Big dry (Box 1) to analyse current drought policies in China. The need for policy reforms, improved governance, stakeholder involvement and using market mechanisms is identified, just like the changing farmers' practices and the necessary transition to more pro-active risk management strategies. Drought needs a comprehensive policy, which should be formulated at the national level, in the way the Australians came up with a new water law, which also contained the instruments to deal with the consequences of droughts.

Box 1 Characteristics of Australia's reaction to the Big dry (1997-2009)

The essential characteristics of the Australian approach are:

1. Policy reforms carried out at different levels of government to integrate agricultural and environmental concerns
2. The implementation of the drought policy can only be achieved if all stakeholders are continuously involved (horizontal integration)
3. Improved governance (vertical and horizontal integration) is necessary
4. It is important to limit the distortions and to introduce incentives to allow market mechanisms to do part of the job
5. Farm level practices need to be changed, which is often difficult
6. The Australian government moved from a crisis management approach to a pro-active and strategic risk management approach

The new thinking about water trading needs to take shape at lower levels of government, where in Australia local catchment plans would help to determine sustainable water diversion levels for each catchment. It appears that farmers in China now try more than ever to organize themselves to cope with drought (Van Dijk and Li, 2015). The presence of the Chinese government in the rural areas has diminished, however. For example, many offices in villages have been closed after the abolition of the agricultural tax. Subsequently the role of these officials needs to be taken over by nongovernmental organizations (NGOs), community based organizations (CBOs), local companies and the farmers. With the retreat of governmental organizations from many affairs at the local level, the relation between governments and farmers became looser than before, which means that it has become difficult for some policies to reach the farmers.

However, insufficiently developed rural water markets constrain farmers' role in water allocation, or resource management at the natural village level. Unlike the administrative systems under which resource allocation is based on orders, the market system could and should be a good platform for farmers' participation in the water allocation process. We noted the current limited use of market mechanisms in drought areas. The challenge is

involving the private sector more and putting in place more flexible and compatible incentive systems. Although China promotes water pricing, water trading can hardly be found in places without a big water infrastructure, which offer irrigation services to farmers.

The introduction of market mechanisms to allow markets to do part of the job would also be a shift in emphasis in the dominant paradigm in water governance and management in China, from a technological and more central government-led management paradigm to the adoption of more adaptive and sustainable water management practices.ⁱⁱⁱ This can be summarized as: from an emphasis on the role of the government (in the traditional integrated water management approach) to more attention to the actual management of drought and ecological challenges. It is clear that the market plays a more important role in Chinese agriculture and water management since the economic reforms started in 1978.^{iv} There are benefits from allowing more water market transactions (see below).^v

The “value” of water has not become the major factor in water allocation in China, though government try to use water tariff to influence water users' decision. But it was seldom found in irrigation, especially with small and scattered system. The government should try to involve companies, water user associations and communities more in irrigation water allocation to resolve long term and emergent water scarcity based on completed and advanced small irrigated system Seed and agricultural machine companies are playing a role in drought relief, which results from the market economy reform and show that it can work. In the end these changes in farm level practices will reduce the vulnerability of the rural population.

Reforms in water sector in Australia

Australia had the "Big Dry" or "Millennium Drought" from 1997 to 2009. Several studies have derived the lessons from the approach to drought management that emerged during this period. The long period of drought convinced many that these are not normal fluctuations in the weather, but that the drought is related to climate change and requires a different approach than the dominant approach until the late 1980s of disaster relief (Kiem, 2013: 1616).

The water challenges due to climate change are known in Australia: a drier climate means less rainfall and runoff, but also higher temperatures. However, severe droughts have compromised the existing governance structures. The key to successful governance and overcoming threats to water security is institutional change. This requires water reforms. Connell and Grafton (2011) analyze the water reform process in the Murray Darling Basin, which started with the water law in 2007, which was meant to reenergize the reform effort. It postulated that a comprehensive river basin plan would be developed for the Murray Darling Basin to be the basis for implementation of anti-drought plans. The lesson learned is that policy responses in the past have not always worked and it is necessary to pay more attention to the social dimension of climate change (Sherval and Askew, 2012). The challenge is reducing risks for the farmers and dealing with their vulnerability (Kiem and Austin, 2013).

The Australian experience is special, since a lot of attention is paid to assuring the necessary environmental flows. Unique is that the Australian government would receive 50% of water savings from infrastructure subsidies in the form of water entitlements. Furthermore, the

approach to different issues takes place at different levels of government, although not always in a coordinated way.

Some characteristics of the Australian approach (Box 1) are not yet relevant in the Chinese context. We have left out the role of the 2007 Australian water law and the comprehensive river basin plan announced in it as an instrument for achieving integration and for determining sustainable water diversion levels (SDL). We note a limited interest in China in the environmental consequences of droughts and the need for managing environmental flows, nor do we observe a similar process of 'unbundling' land and water in China (Kiem, 2013: 1619). to allow trading.

Other lessons from the reforms in Australia

Drought management is often put on equal terms to better water management, not just for agriculture, but also "to halt ongoing decline of environmental conditions" (Connel and Grafton, 2011). Too little is known currently about the farmers' level irrigation practices and how they are influenced by more frequent droughts. This would require more anthropological type of studies^{vi}

Wei et al. (2011) study the interaction between water policies, agricultural policies, irrigation practices and drought management in Australia. They analyse whether farmers are prepared to dispose of less water for irrigation. They note that the role of the local actors cannot be underestimated. Farmers' practices, attitudes and capacity to manage their assets during prolonged droughts determine the impact of the reform policies. In the Australian case introducing water markets caused many adjustment problems because farmers sometimes bought too much water or at the wrong moment (Hung et al., 2014). Also the use of soil moisture measuring tools and the formulation of sustainable water diversion levels were major improvements at the farm level. Finally the social consequences of drought are very important as shown by Kiem and Austin (2013) and Sherval and Askew (2012).

The lessons drawn from functioning water market are according to Kiem (2013: 1619):

- a. Reforms were based on the faith in markets that would lead to water being allocated to its most valuable use
- b. Water reforms have continued the process of unbundling of water from the land, to create a water market of tradeable and saleable water
- c. However, the functioning of the system was not always easy

Conditions for a good functioning water market are summarized by Hung et al. (2014: 724):

1. Entitlements are defined and distributed among the users
2. A monitorable and enforceable quantity cap is placed on the market that limits the amount of resources in a defined area
3. A market is created to enable trading of entitlements

Van Dijk and Li (forthcoming) suggest that the use of water markets can help to mitigate the consequences of climate change in Southern China, namely drought, but requires the definition of land and water rights and an unbundling, to allow trading of water, in the same

way the reforms in Australia created the conditions for dealing with droughts in a more effective way.

The urban areas in China

Land is an important tool for both rural (agricultural) and urban development. The rapid growing urban population and the high economic growth has resulted in high demand for land in China. The estimations are that by 2025 64% of the Chinese population living in cities. The absence of a clear system of transfer rights for rural land has led to a widening urban-rural gap and inefficient land use. It meant the acquisition of too much land for urban purposes: 200,000 ha per year concerning 2 million farmers. Furthermore, the farmers do not receive (equal) compensation for their land

An important reason for rural land acquisition in the urban areas is that cash strapped local governments are not allowed to raise money from capital markets directly. Hence municipalities generate a high revenue by acquiring the rural land at low cost, and leasing out at a higher price. Loosing 'face' (status) is very important for mayors who are judged on the ambitious plans for their city. However, there is a lack of transparency, which leads to insufficient implementation of policies and control on local level fuels, which lead to illegal practices like not compensating farmers properly, which may lead to unrest and demonstrations.

Kamminga and Van Dijk (2014) studied the experiments with land titling in a more participatory way in Chengdu. Land titling in Chengdu was carried out there as a participatory process, which worked because land titling at the grassroots level takes place with the involvement of the villagers. The process brings more transparency and information to the land markets.

We also learned in Chengdu that stretching the bundle of rights creates more land transfer possibilities and increases the efficiency of the land market. However, there is a need for inspection/control of lower levels of governments by an independent authority taking into account national level standards and specific local circumstances.

In the urban areas too much agricultural land is converted in China and this process would also benefit from titling land rights and formalizing water rights, as demonstrated by the experiments in Chengdu and the practices of the farmers in the Yunan province to sell water in times of need.

Possible solutions: changing land use rights, towards a real urban market for user rights?

Changes in the rural land-use law create the possibility to transfer user rights (policy documents 2008 and 2009). An indefinite length of land-use rights contract would stimulate long-term investment and stimulate trade in land markets. It would result in a more transparent system where compensations and payments are known to everybody. The important changes in the land transfer system introduced after 2009 are:

- A focus on systematic participatory land titling & a registration system for all land and buildings

- Farmers were permitted to trade their village construction land directly to interested parties
- Villagers were allowed to trade user land rights using a district trading platform, giving
- Access to market-driven, deliberate land trade system for non-agricultural purpose land

Finally, villagers were not forced to leave their land behind when leaving the countryside. What are the implications of Chengdu experiment? It means allowing a more equitable and market driven urban expansion through the Chengdu land tenure experiment is possible (Deininger et al. 2013) and there is more scope for agricultural upscaling because farmers have titles and they can transfer these titles. The process is more clear and transparent and reversible. We conclude that land titling as a participatory process may work, because it gave titles to the farmers and a cadaster to the city. A trading platform was established to facilitate the transactions. Further the suspending of the *hukou* system for the people concerned provided equal rights to urban and rural inhabitants and made the land market function. It made migration of labor (from rural to urban) possible. Hence it is important to also use this approach for other cities in China.

Some conclusions

We concluded that using markets and putting in place more flexible and compatible incentive systems may help adaptation to the consequences of climate change. The definition and flexibilisation of land and water rights may help people in the rural and urban areas to adapt better to climate change. China wants to move to a unifying land titling system. Such a system would integrate the registration of all land resources, including what is on the land and what is below, meaning the water and the minerals. This is important to allow adaptation to the consequences of climate change in the urban and rural areas in China.

In a period of climate change, it is good to have opportunities for markets to allocate scarce water in the rural areas, while it needs to be clear who owns the water from rain water harvesting (Liang and Van Dijk, 2012c) and wells in urban areas. Would these owners also be allowed to trade surplus water? Markets could and should also be a good platform for farmers' participation in water allocation. However, the introduction has been constrained by the degree of development in the rural areas. Implementing policies for climate change at the provincial and local level is not easy and many national climate change policies have not been translated to lower levels of government. Hence, a different approach is necessary. There is a lack of involvement of the farmers in the decision and policy making process and the challenge is involving farmers and other stakeholders more in decision making. Only when the interests or viewpoints of all stakeholders have been fully taken into consideration can the policy be expected to realize its original objectives. Therefore, public participation is critical important in each step of the policy cycle. This importance has been particularly clear in experiences with formulating and implementing policies on environmental change (Bastakoti et al., 2014).

The creation of water market should also be considered in China. Water trading can hardly be found in places without big water infrastructure. The use of market mechanisms is still at a

nascent stage, however, the adoption of market mechanisms and involving stakeholders in decision making are obvious trends in China's drought policies. But only small parts of policies are implemented based on market agents and stakeholders input, which have been proved it is success. In addition, informal institution still plays so important roles in local drought management that transferring or incorporating them into policies could improve farmers' adaptive ability. Participation needs to improve in China. Real participation only takes place when the stakeholders are part of the decision-making process. The drivers mentioned have created the enabling environment for new actors to build their own governance structures and to take the initiative.

The focus should be more on the adaptive capacity to deal with droughts or flood hazards, and we suggest adaptive reactions regarding the water sector, such as constructing additional water infrastructure and starting other water management systems (Keshavarz et al., 2010). Shifts from traditional integrated water governance to adaptive eco-dynamic water governance will improve the local ability to deal with drought. Adaptive water management is needed and should be integrated in existing water governance structures (Van Dijk, 2012).

Increasing resilience of different ecosystems requires better management, strong formal (public) and informal institutions, public private partnerships (PPPs), sharing of knowledge, leadership and additional sources of finance. It is also important to enhance coordination between different departments and levels of government and other stakeholders, and to improve the implementation of drought policies, to reduce the cost of interventions. There is a strong emphasis by the Chinese government on technocratic solutions, but the effectiveness of these measures is limited. We conclude China should try to enhance the adaptive capacity of institutions and individuals to prepare them better for droughts and floods as the major expected result of climate change and to include environmental considerations in the policies.

Recommendations

Recommendations are formulated to deal with challenges such as collaboration between different levels of government and other governance challenges, such as using the contribution of all actors, the challenge of using market forces more, the challenge of putting in place more flexible and compatible incentive systems, and of identifying additional financial sources for implementing drought policies. We recommend strengthen market force in resource allocation, provide more effective incentives When titling land & water rights is happening, we should also limit distortions and introduce incentives to allow market mechanisms to do part of the job.

Implementation of policies can only be achieved if more stakeholders are involved. Public inputs in a participation process do not mean all the farmer wishes will be honoured. However, it is important to engage in a dialogue with the public and to convince them of the necessity of certain changes.

At the same time officials should listen whether the wishes and objections of the residents make sense and could be taken into account and lead to a different approach of the issue. There is also a need for stronger contract rights to enhance tenure security, a lesson from Chengdu and there is a need to streamline administrative procedures & to assure that farmers benefit more from urban land acquisition.

We favour formalization of land and water rights combinations and several experiences in rural and urban areas point to the importance of the formalization of land and water rights combinations. In rural areas titling creates the conditions for water trading, in particular the necessary unbundling of land and water rights.

In the urban areas titling is necessary for urban climate change adaptation strategies such as (Xiao Liang and Van Dijk, 2012a, b and c):

- a. Decentralized waste water treatment
- b. Rain water harvesting
- c. Separating grey and brown water

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Notes

ⁱ Recent efforts to deal with drought have been documented extensively for Australia (for example Kiem, 2013, Kiem and Austin, 2013 and Wei et al., 2011).

ⁱⁱ Drought policies emphasized by all levels of governments in China include:

1. Reform of agricultural technology by putting in place an innovation promotion system
2. Reform of the management of Small Rural Water Infrastructure, towards more private involvement (CCC and SC 2011)
3. Helping the transfer of free labour from rural to urban areas
4. Provide subsidies for improved seeds and conversion of farmland to forest in mountain areas
5. Dealing efficiently with emergencies by providing temporary assistance and project funds, for example for Small Rural Water Infrastructure (SRWI) construction

ⁱⁱⁱ The paradigm shift is related to a change in the dominant underlying societal ideology, it is an example of an ideological shift to a more neo-liberal approach.

^{iv} Successful implementation of a policy depends on the right incentives. The incentives should change as a function of local bio-physical and social conditions.

^v Treating water as a commodity has led to public-private interactions and changes in the use of bilateral investment treaties, trade and investment laws and international arbitration.

^{vi} Examples of that kind of research are given in Zhang and Voon Phin Keong (eds, 2013).