

# China's drought strategies in rural areas along the Lancang River

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## Abstract

Given that climate change is likely to exacerbate drought in certain parts of the world, a critical issue is how appropriate context-relevant drought policy can be developed and implemented. This paper examines how China is developing policies to help local communities in the Lancang River Basin to cope with the problems of climate variability and change. The research process includes (a) content analysis of relevant policies at different levels of administration and (b) stakeholder interviews to examine how effective policies are at the local level along the Lancang River in Yunan Province. The paper concludes that China needs to provide more emphasis on (a) enhancing the adaptive capacity of institutions and individuals, (b) drought risk rather than disaster management, (c) enhancing coordination between different departments and levels of government, (d) decentralization in policymaking as local governments can make context-relevant comprehensive policies more easily and are less hierarchical in their relationships, (e) involving farmers or other stakeholders in decision making, (f) building up grass root organizations to support policy implementation to compensate for the retreat of governmental organizations from the local level and (g) adopting market mechanisms which are still in a nascent stage now.

*Keywords:* Drought policy; Governance; Incentive; Institutional framework; Organization

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## 1.. Introduction

One potential impact of climate change is drought. The Lancang River Basin (LRB), which is the upper reach of the Mekong River Basin, flows through the Yunnan province in China and is prone to seasonal drought. This risk may be further exacerbated by climate change (Snidvongs *et al.*, 2003; He & Zhang, 2005) as well as existing vulnerabilities, namely basin vulnerability (e.g. the karst landform) and rural socio-economic vulnerability limiting local adaptive capacity (IPCC, 2007a).

The impact of climate change in general has been documented (IPCC, 2007b) and on China in particular (Ding *et al.*, 2007; Lin *et al.*, 2007). Rural drought management instruments have also been

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addressed, such as crop diversification (Benioff *et al.*, 1996; Chiotti *et al.*, 1997; Downing *et al.*, 1997; Parry *et al.*, 1998), changing cropping intensity, crop mix, type and location (Smit & Skinner, 2002), constructing water infrastructure (Smith & Lenhart, 1996), crop insurance (Goodwin & Smith, 1995), developing market efficiency (Eriksena & Silva, 2009), trade and investment promotion (Rosenzweig *et al.*, 1993; O'Brien, 2000), extension services (Mizina *et al.*, 1999), diversification of income earning and employment opportunities (Barretta *et al.*, 2001), defining land use and tenure rights (Smit & Skinner, 2002; Smucker & Wisner, 2008), technology development and promotion (Houghton *et al.*, 1990; Rosenberg, 1992), and weather forecasting (Lemos, 2003). There is also some literature providing information on drought policies and organizations in rural China covering national drought relief measures (Zhang *et al.*, 2005), water scarcity management systems (Qu *et al.*, 2010), promoting water saving and agricultural technology (Blanke *et al.*, 2007; Huang *et al.*, 2009), analysing water users associations (WUAs) (Wang *et al.*, 2010), initiating water pricing measures (Yang *et al.*, 2003; Zhong & Mol, 2010), popularizing agricultural subsidies (Du *et al.*, 2011) and experimenting with policy-oriented microfinance and agricultural insurance (Du, 2003; Zeng & Mu, 2010).

However, there is very little literature on the effect of multi-level drought institutions on rural areas (Mwinjaka *et al.*, 2010), while such research is critical for enhancing the long-term adaptive capacity of such societies (Gupta *et al.*, 2010). Against this background, the research question is: How are Chinese institutions developing policies to help local communities in the LRB to cope with drought caused by climate variability or change?

The research initially involved content analysis of 93 government policies from national to county level to uncover how these policies unfold at different levels of administrative governance and what kinds of institutions and incentives are included in these policies (see Table 1). Subsequently, household interviews were undertaken to assess whether the multiple levels of governance actually lead to effective policies at the ground level. To do so, a structured questionnaire was designed around (1) how farmers recognize the onset of a drought disaster and what measures are taken by farmers to cope with it, (2) what role policies, organizations and instruments play in these measures and (3) what factors facilitate or constrain the adoption of measures? Sixty households were randomly selected to be interviewed face-to-face in six natural villages.

This paper discusses the policy structure at multiple administration levels (see Section 2) and analyses the impact of these policies at the community level (see Section 3) before drawing some conclusions (see Section 4).

Table 1. Study areas and materials.

Administration levels	Study area	Number of selected policies or households
Nation	China	39 policies
Province	Yunnan province	22 policies
Municipality	Pu'er	22 policies
County	Simao	10 policies
Township	Nanping, Yixiang	60 households
Administrative village	Nandaohu, sankezhuang, dazai	
Natural village	Dawopu, Matang, Dapingzhang, Yangtianjing, Hanjiazai, Laoxiongjing	

## 2. Policy structure at multiple administration levels

### 2.1. Introduction

Drought has been a long-standing problem in China, which has adopted relevant policies to tackle it. This section analyses the policy framework (see Section 2.2), the incentives for changing behaviour (see Section 2.3) and the governance trends implied in policies (see Section 2.4).

### 2.2. The policy framework

*2.2.1. Policies at the national level.* Drought policies include (a) general long-term climate change mitigation and adaptation policies, (b) drought relief policies and (c) policies to improve the adaptive capacity of local people.

(a) *General policies on climate change:* In 2007, under the Climate Convention regime (UNFCCC, 1992), China prepared its National Climate Change Programme (NDRC, 2007) including strategies to cope with increasingly serious drought. China also formulated a special report on technical activities for coping with climate change (MST et al., 2007) and a national assessment report on climate change (Ding et al., 2007; Lin et al., 2007) which identify research areas and potential drought relief adaptation measures. Since 2009, China has published annual reports on its policies and activities to cope with climate change (NDRC, 2009, 2010) which disseminate information on successful examples of policies, measures and experiences on climate change adaptation.

(b) *Drought relief policies:* Some policies aim, *inter alia*, to regulate weather modification and early warning information dissemination to deal with drought, which includes the Meteorology Law (SCNPC, 1999), the Ordinance on Management of Weather Modification (SC, 2002), a policy on issuing early warnings of meteorological disasters (CMA, 2007) and a Weather Disaster Relief Ordinance (SC, 2010a). Since 2007, a national soil moisture monitoring network evaluates and issues information on drought.

In order to respond well to droughts, there are policies on how to allocate the central government special funds to cope with big droughts (MF & MWR, 1999), a national emergency response plan for flood and drought relief (SC, 2006a) which aims to use all resources controlled by governments to offer direct help to disaster victims. Since 2008, China has been preparing drought relief planning for the drought relief system at all government levels (MWR, 2008).

The 2009 Drought Relief Ordinance (DRO) (SC, 2009) strengthens all levels of government responsibilities, asks all local governments to set aside a special budget for drought relief activities and, for the first time, gives equal priority to risk reduction as well as emergency responses. In addition, the 2010 Natural Disaster Salvation Ordinance (SC, 2010b) deems drought as one kind of natural disaster and institutionalizes government responsibility to help people cope with serious droughts.

(c) *Improving adaptive capacity:* Capacity building policies are usually designed and implemented by one department, which aims to enhance the adaptive capacity of farmers. For example:

- Water availability and use efficiency are encouraged by (a) demand management and water allocation (SCNPC, 2002a); (b) market measures and private investments in small rural water infrastructure (SRWI) (MWR, 2002; MF & MWR, 2009) and (c) water levies for direct withdrawals, thus ending free water use (SC, 2006b).

- Dissemination of drought relief knowledge and technology is encouraged by funding agricultural and water saving technology promotion and demonstration projects (MWR, 2004, 2007; SCNPC, 2012), improving the agricultural and water saving technology promotion system (SC, 2006c; MWR, 2007) and subsidizing improved seeds (MF, 2010) and drought relief machines (MF & MA, 2005).
- Farmers' income is better improved through temporary jobs in urban areas, enhancement of farmland use rights (MA, 2005, SCNPC, 2002b) and conversion of farm land to forests which is supported by the 'Grain for Green' programme<sup>1</sup>(SC, 2003, 2007).
- Reducing drought risk through drought hazard loans is implemented by the People's Bank of China's (PBC) quotas for commercial banks, which make loans to small farmers (PBC, 2010), subsidized loans from the central government for farmers to reduce poverty (PBC, 2001) and agricultural insurance financed from a central budget (MF, 2007).
- The social capital of local communities is enhanced through the establishment of local drought relief teams (DRT) (MWR, 1996), WUAs, since 1995, to promote irrigation subsidized by the World Bank and the United Nations Developments Programme (UNDP) (MWR et al., 2005) and rules on 'one issue, one decision'<sup>2</sup>, which encourage communities to raise money and labour to offer public goods (MA, 2007).

2.2.2. *Policies at local levels.* China's centralized policies either operate directly at the appropriate level (e.g. the central government subsidizes farmers directly although the county government will help farmers in applying for the subsidy) or will give space to sub-national authorities to pick and choose elements of central government policy which they wish to promote and provide subsidies for accordingly. The policy structure at multiple levels of governance is presented in Table 2.

(a) *General policies on climate change:* As a response to national general climate change policies, there is a general assessment report and an action programme on climate change in the Yunnan Province, which identify the potential impacts of drought and main measures that can be adopted. For the first time, the action programme requests provinces to consider climate change in socio-economic development planning. In 2010, Yunnan was selected as one of the five Green GDP priority provinces<sup>3</sup> for experimenting with the climate change programme.

(b) *Drought relief policies:* The Yunnan provincial government had a DRO that predates that of the central government, a meteorology ordinance that corresponds to the national law and a regulation on appropriate subsidies for big drought disasters. The other drought relief policies fall under the framework of these three policies. At all sub-provincial levels, drought relief and emergency plans have been established according to national and provincial DRO. At the municipal level there are policies on spreading drought information through the telephonic short message service (SMS) as an effective way of issuing early warning on drought. In addition, there are annual plans for weather modification based on national and provincial regulation.

<sup>1</sup> The 'Grain for Green' programme is designed to shift about 15 million ha of low-yield farmlands to forest land and to afforest another 17 million ha of barren mountains and land in China.

<sup>2</sup> 'One issue, one decision' is a policy requiring that local governments offer communities the necessary materials and money as an award on condition that community members make an agreement amongst themselves on raising money or labour for village public affairs, such as road or irrigation channel construction.

<sup>3</sup> In 2004, the Chinese government announced that the Chinese GDP would be replaced by green GDP which takes the cost of environment and resources into account.

(d) *Improving adaptive capacity*: Adaptive capacity is being improved through a number of measures. First, in order to encourage private capital to invest in water infrastructure and then improve water availability, the management reform of the SRWI has been enthusiastically promoted at all sub-provincial levels since 2010. At the same time, regulations on implementation of national water law and water-withdrawal permits were established to regulate demand management at the provincial level. But the policies on funding of the Water Saving Society (WSS)<sup>4</sup> are apparently not being implemented at the provincial and local level.

Second, in order to improve local technology on drought risk avoidance programmes, to promote agricultural technology and improved seeds, can be observed from the provincial to the local level. The other policies on technology improvement are mainly carried out only at the provincial level, such as improving water saving technology, subsidies for agricultural machinery and so on. But this does not imply that these policies have no impact at the local level, because they are based on local stakeholder participation.

Third, in order to reduce the loss caused by drought risks, the Yunnan province has integrated many sources of funds from central government and pursued an emergency response policy on transferring labour from rural to urban areas since 2009. Like other funds from the central government, local governments are responsible for apportioning funding for the ‘Grain for Green’ programme. To improve revenue from farmland and investment in agricultural infrastructure, provincial and municipal governments have made detailed regulations on farmland use rights trading even including the format of the contract.

Fourth, except for a regulation on subsidized loans for poverty alleviation which is implemented at the provincial level, other drought hazard loans and insurance are not found at the provincial level. This is because the policy on low premium agricultural insurance requires a 50% contribution from provinces, which these provinces find too expensive, and the policy on promoting rural microfinance is constrained by high loan risks that accompany the small size of agricultural production.

Fifth, regarding policies on enhancing the social capital of local communities, only a tailored regulation on ‘one issue, one decision’ was established, while other such policies have not been adopted at the provincial level (see [Table 2](#)).

### 2.3. Incentive structure

In order to implement drought policies effectively, policies include incentives (regulatory and economic) that could become applicable at all levels of administration.

*2.3.1. Incentives.* Regulatory incentives included in drought policies are (a) guidelines on climate change mitigation and adaptation of local banks on promoting small loans and for the establishment of WUAs; (b) water-withdrawal permits; (c) enhancement of farmland use rights and property rights of SRWI to encourage infrastructure investment; and (d) legally binding obligations to provide early warnings of drought, to offer direct help to potential victims and to reform the agricultural technology

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<sup>4</sup> The ‘Water Saving Society’ is a project of the central government aiming to spread water saving technologies and ideas in selected priority counties or municipalities.

Table 2. Policy structure at multiple administrative levels.

		International	National	Provincial	Municipal	County
P <sub>1</sub>	CC assessment report and programme	★	★	★		
P <sub>2</sub>	Special report on technical activities for coping with CC; annual reports on policies and activities for coping with CC	★	★			
P <sub>3</sub>	Laws on meteorology; ordinances on drought relief, disaster salvation, weather disaster relief		◆	◆		
P <sub>4</sub>	Ordinances, regulations and annual plans on weather modification		◆	◆	◆	
P <sub>5</sub>	Policies on issuing early warnings of meteorological disasters		◆	◆	▼	
P <sub>6</sub>	Regulations on subsidies for large flood and drought disasters		◇	◇		
P <sub>7</sub>	Flood control and drought relief emergency plan		◆	◆	◆	◆
P <sub>8</sub>	Drought relief planning		☆	☆	☆	☆
P <sub>9</sub>	Soil moisture monitoring programme		☆			
P <sub>10</sub>	Water law; ordinances and regulations on water- withdrawing permit		▽	▽		
P <sub>11</sub>	Policies on investment and managements reform of SRWI		▲	▲	▲	▲
P <sub>12</sub>	Policies on agricultural technology promotion system reform		◆	◆	◆	◆
P <sub>13</sub>	Policies on improved agriculture and water saving technology promotion		☆	☆		
P <sub>14</sub>	Policies on improved seeds promotion		◇	◇	◇	◇
P <sub>15</sub>	Policies on subsidies for agriculture machines		◇	◇		
P <sub>16</sub>	Project on construction of WSS		☆			
P <sub>17</sub>	Water saving planning		☆	☆		
P <sub>18</sub>	Programme on transferring labour from rural to urban areas		☆	☆	☆	☆
P <sub>19</sub>	Policies on enhancement of farmland use rights		▲	▲	▲	
P <sub>20</sub>	Grain for green programme		☆	☆	☆	☆
P <sub>21</sub>	Guidance on microfinance promotion in rural areas		★			
P <sub>22</sub>	Policies on subsidized loan for poverty alleviation		◇	◇		
P <sub>23</sub>	Policies on subsidized agricultural insurance		◇			
P <sub>24</sub>	Regulations on DRT		☆			
P <sub>25</sub>	Guidance on WUAs and other professional associations	★	★			
P <sub>26</sub>	Policy on 'one issue, one decision'		△	△		

★ Guidance; ◆ legally binding obligations; ▼ payment for services; ◇ subsidy; ☆ funds; ▽ administrative permit; ▲ enhancement of property rights; △ award.

promotion system. Economic incentives include (a) government funds for drought relief mechanisms and infrastructure, DRT, converting farmland into forests, establishing the WSS, setting up soil moisture monitoring stations, improved technology promotion, labour force immigration and other activities delegated to local governments; (b) government subsidies to farmers for improved seeds and equipment, for coping with big drought disasters and on loans and insurance fees; and (c) government awards to encourage public initiatives at the community level. In addition, beneficiaries make payments for drought relief services provided by non-state actors and DRTs.

*2.3.2. Financial arrangements at the local level.* There are five types of financial arrangements at local level. These include: (a) subsidies for improved seeds and agricultural machines and funds for converting farmland into forests come from the central government and the local government then distributes these between counties; (b) joint funds from central and local governments to support soil moisture monitoring, improved agricultural and water technology promotion, transferring labour from rural to urban areas, early warning information transmission and developing DRTs; (c) climate change funds from sub-national governments at each administrative level to support drought relief plans, drought emergency plans, water saving plans, management reform of SRWI, agrarian reform and to develop WUAs; (d) cost sharing of weather modification and SRWI construction by beneficiaries and the government; and (e) funds to implement policies derived from beneficiaries who withdraw water directly from rivers or purchase SRWI.

Policy effectiveness is promoted through evaluating government officials in terms of their policy implementation achievements. This gives them a personal stake in ensuring policy effectiveness. The subsidies or funds from central or local governments usually need to be self-monitored by the governments themselves and the distribution of subsidies to farmers also needs to be monitored by villagers themselves.

#### *2.4. Governance trends in drought management*

The content analysis of policies reveals several trends in drought management. These include an increasing preference for more integrated policies and coordination committees to improve policy implementation, encouragement of stakeholder participation and strengthening of policymaking at other levels of governance. These are discussed below.

*2.4.1. From separated policies to integrated policies.* Since the 1950s, drought management policies in China included plans and guidelines which provided principles and measures for coping with drought (ADB, 2009). Different functional departments in central and local government crafted their own separate policies based on departmental responsibilities. This led to overlaps and gaps in drought governance (ADB, 2011). In redesigning the framework, the more powerful national DRO was used to integrate separated policies and to strengthen responsibilities of local governments.

*2.4.2. From hierarchical to coordination bodies.* Since the policy process is so wide, diffuse and competitive, the government has constituted comprehensive coordinating committees in the State Council including representatives from relevant ministries, administrations, banks, scientific bodies, social associations, non-governmental organizations (NGOs) and even the army. Four such committees relevant to drought management at the national level are the State Council Leading Committee on Poverty Alleviation and Development (SCLCPAD), the National Headquarters of Flooding Control and Drought Relief (NHFCDR), the National Leading Committee of Disaster Alleviation (NLCDA) and the State Council Leading Committee of Coping with Climate Change (SCLCCCC).

In addition to these committees, the Yunnan province has set up four other coordinating committees on reforming SRWI, providing subsidies for improved seeds, transferring labour from rural to urban areas and promoting the 'grain-for-green' program. Column 1 of Table 3 lists the policies implemented by coordinating committees.

Table 3. Governance trends in drought policy development and implementation.

	1. Are policies implemented by coordinating committees? (yes/no)	2. Do policies imply non-governmental actors' participating in decision making? (yes/no)	3. Which level plays the main role in policy implementation, international level (I), national level (N), or local level (L)?
P <sub>1</sub>	Y	Y	L, I
P <sub>2</sub>	Y	Y	L, I
P <sub>3</sub>	Y	Y	L
P <sub>4</sub>	N	N	L
P <sub>5</sub>	N	Y	L
P <sub>6</sub>	N	N	N
P <sub>7</sub>	Y	N	L
P <sub>8</sub>	Y	Y	L
P <sub>9</sub>	N	N	N
P <sub>10</sub>	N	N	L
P <sub>11</sub>	Y	Y	L
P <sub>12</sub>	N	N	L
P <sub>13</sub>	N	Y	N,L
P <sub>14</sub>	Y	Y	N
P <sub>15</sub>	N	Y	N
P <sub>16</sub>	N	N	N
P <sub>17</sub>	N	Y	L
P <sub>18</sub>	Y	Y	L
P <sub>19</sub>	N	Y	N
P <sub>20</sub>	Y	N	N
P <sub>21</sub>	N	Y	N
P <sub>22</sub>	Y	N	N
P <sub>23</sub>	N	Y	L
P <sub>24</sub>	N	Y	N
P <sub>25</sub>	N	Y	I, L
P <sub>26</sub>	N	Y	L

*2.4.3. Participation of multiple stakeholders.* There are about 17 groups of policies that provide a role for non-governmental actors to participate in decision making (see column 2 in Table 3). NGOs like Red Cross and WWF have contributed to national drought relief efforts. At the regional level, market agents, such as commercial banks and private companies, are supported by central government funds to enable participation in drought management. At the community level, public agents and CBOs (community-based organizations) are appointed by several policies to mediate between government and households, including WUAs, DRTs, technology cooperation associations and natural villages. Increasingly, larger numbers of non-state actors are participating in drought management, encouraged by property rights promotion of SRWI and farmlands.

*2.4.4. Strength of international and local actors.* The simultaneous movement of political power up to transnational levels and actors and down to local communities is a common characteristic of multi-level governance (MLG) (Pierre, 2000). Column 3 in Table 3 shows that three groups of policies rely mainly on international actors while 16 groups rely on local actors. For example, as a party to the United Nations Framework Convention on Climate Change (UNFCCC), China has drafted a national action



plan on mitigation and adaptation. Increasingly, international organizations can cooperate directly with local communities and such policy experiments help to support national policymaking. For example, the idea of the WUA was introduced by UNDP and World Bank to improve irrigation ability at community level (Wang *et al.*, 2010). After 10 years of experimentation, the WUA has demonstrated its ability to organize irrigation and reduce drought hazard risks. In 2005, the central government decided to formally support WUAs.

Furthermore, local governments were assigned drought management responsibilities in the National Drought Relief Ordinance in 2009. This drought management is to be led by the local government chief; the county is the unit for coping with drought, whilst the central government only offers technology guidance and funds to local government. Policy measures are also strengthening the role of other local organizations, such as CBOs.

### **3.. Policies implemented at community level**

#### *3.1. Introduction*

Chinese rural communities, usually at the level of the natural villages, have a certain degree of autonomy. They participate in decision making by selecting their own community leaders, whose role it is to defend the interests of the farmers at the level of the administrative village. This polity structure presents challenges for the existing local, hierarchical, bureaucratic government.

Based on the results of the household survey, this section analyses the structure of farmers' activities on drought relief (see Section 3.2), the influence of drought policies (see Section 3.3), the incentives implied in farmers' activities (see Section 3.4), the organizational framework embedded in these activities (see Section 3.5) and the potential for transforming these institutions (see Section 3.6).

#### *3.2. Farmer's activities*

The household survey reveals 14 drought relief activities that can be categorized into seven groups in terms of functions: (1) shift employment to non-agricultural work and livestock cultivation to reduce agricultural dependence; (2) adopt rice–maize rotation, adjust crop structures and change land use type to reduce irrigation dependence; (3) change planting schedules and adopt improved seeds to reduce crop vulnerability; (4) install a centralized drinking water supply system and facilitate the construction of water storage infrastructure to improve the water supply reliability; (5) dig wells, transfer water by pipeline or vehicle and pump water from channels, and so on to improve the ability to access water resources; (6) apply water saving technologies to reduce irrigation water consumption; and (7) store grains to ensure local food security.

#### *3.3. Implemented policies*

The household survey shows that only 13 out of 26 sets of policies have influenced local farmers' drought relief activities (see Table 4).

Table 4. Influence of policies on farmers' drought relief activities.

	1. Engage in non- agricultural work	2. Livestock, or fish culture	3. Rotations	4. Change crop structure	5. Change land use type	6. Change planting schedule	7. Adopt improved seed	8. Change drinking water supply mode	9. Construct water storage infrastructure	10. Apply water saving technology	11. Water transfer	12. Dig well	13. Change irrigation method	14. Food storage
P <sub>3</sub> , P <sub>6</sub> , P <sub>7</sub>											+	+		
P <sub>5</sub>						+								
P <sub>11</sub>								+	+					
P <sub>13</sub>				+										
P <sub>14</sub>			+	+			+							+
P <sub>15</sub>				+							+		+	
P <sub>19</sub>				+	+				+	+				
P <sub>20</sub>				+										
P <sub>23</sub>		+												
P <sub>25</sub>				+										
P <sub>26</sub>								+	+	+	+			

*3.3.1. Implementation of general climate change policies.* In spite of the Chinese government engagement in climate change adaptation strategies recently, most policies focus mainly on mitigation. Investment in local adaptive capacity building is relative small. It is thus evident that this survey did not see any direct impact of national adaptation policy on farmer activities.

*3.3.2. Implementation of drought relief policies.* The initiation of drought relief emergency action and disaster alleviation, which aims to offer direct help to afflicted farmers, has provided farmers with pumps (sometimes including diesel oil) for irrigation and even tube wells which only accounts for two of the 14 farmers' drought relief activities. Although these policies are effective, the degree and extent of influence on farmers' activities is relatively small in the surveyed areas. According to the interviews, only one tube well, funded by local governments, has been constructed in the last five years. Although four of the six villages have received pumps from the local government, one pump is usually shared by several natural villages. The survey also shows that almost all farmers have received weather or hazard-related information through SMS or TV. However, few of them (six of 60 households) actually change their seeding time in accordance with the information received, reflecting both poor weather forecasts and the slow learning ability of the farmers to adjust past practices. The absence of appropriate and effective channels to spread information on weather modification and soil moisture monitoring also results in a low influence on farmers.

*3.3.3. Implementation of adaptive capacity building policies.* Table 4 shows that policies aiming to improve the farmers' ability to prepare for drought have influenced farmers' activities greatly. Through enhancement of use rights of SRWI and farmlands, farmers have more incentives to invest in water infrastructure construction and apply water saving technology. Subsidies through market agents for improved seeds (36 of 60 households adopt) and agricultural machines (all households receive at least one agriculture machine) are very popular. The policies promoting CBOs have improved collective action at the community level. For example, the policy on 'one issue, one decision' has successfully helped farmers transfer water from other mountains by pipeline and construct small channels, reservoirs

Table 5. Organizations backing up farmers' activities.

	Activities\organizations	Community	Market agents	CBOs	Lineage/neighbours
1	Engage in non-agricultural work				+
2	Livestock, or fish culture		+		
3	Rotations				
4	Change crop structure		+	+	
5	Change land use type		+		
6	Change planting schedule				
7	Adopt improved seed		+		+
8	Change drinking water supply mode	+			
9	Construct water storage infrastructure	+			
10	Apply water saving technology	+			
11	Water transfer	+			+
12	Dig well				
13	Change irrigation method	+	+		
14	Food storage		+		

or dams for irrigation. Interestingly, the ‘grain for green’ programme, which was not originally a drought-relief measure, activates farmers who want reforestation subsidies to plant drought resistant tea trees instead of grain in mountain areas.

Some policies do not appear to have much influence at the community level. Although local governments try to help farmers engage in temporary work in urban areas by offering them skill training courses, few farmers attend these courses and/or migrate. Migration results primarily from better employment opportunities or family relationships. Measures, such as WSS project construction and subsidized loans were not seen as being effective in the surveyed areas.

### *3.4. Incentives and farmers’ activities*

Linking the incentives implied in policies (see Section 2.3) to the farmers’ adaptive activities, one can see that funding is the main way to influence farmers. Of 13 policies that are being implemented at the local level, seven policies had funding which allowed eight of the 14 farmers’ adaptive activities to be realized. This illustrates that these funds are used by governments as an important tool for effective drought management. But it is noteworthy that the same fund means different things in different local conditions and for different households. For example, in the past five years, 36 of 60 (60%) households have used the funds for improved seeds, but only one-third of them used the funds for drought-resistant seeds. Usually, changing rice seeds is motivated by the desire to improve the taste of rice, while maize seeds are used to enhance productivity rather than drought resistance.

The economic benefits coming from the market appear to be another powerful incentive to improve policy performance. According to interviews, five observed policies have had an impact on 10 of 14 farmers’ activities. The policies on WUA and ‘one issue, one decision’ have had an impact on five of 14 farmers’ activities. Almost all interviewed nature villages have been supported by the ‘one issue, one decision’ policy.

### *3.5. Organizations and farmers’ activities*

The household survey shows that, in addition to government, three kinds of formal organizations and one kind of informal organization play crucial roles at the community level. The activities of rotation and changing planting schedule are adopted by individual farmers. Private seed companies are the main source of improved seeds and a private agricultural machine company can access subsidies from the central government for drought relief machines. The community is responsible for damming water or digging canals in the drought season and raises money and labour from the villagers. Local agencies, such as tea or orange planting associations, help farmers to master the relevant planting method. Although WUAs and DRTs are popular in China, they are not active in the villages surveyed. Meanwhile, members of the community often help each other when facing drinking water shortages.

In the surveyed area, there is no DRT and no agricultural technology demonstration stations or other organizations with governmental background. This indicates a retreat of government organizations from administrative and natural villages, leading to shrinking local organizations with government support (Göbel 2012).

### 3.6. Institutional transformation and farmers' activities

The transformation of local institutions in recent years has changed farmers' behaviour in drought management. The policies on changing property rights of SRWI have greatly increased investment of non-governmental actors in water infrastructures and improved the stability of water supply. The reform of land use rights<sup>5</sup> has improved the farmland revenue. This has led farmers to change their crop structure and land use type as well as to invest more in infrastructure and water conservation technology. The formal setup of rules on how to organize WUAs and other professional associations at the community level has given farmers more choices on planting economically viable crops. The shift from decision making in family and community systems to more standardized decision making processes encouraged by the 'one issue, one decision' policy has increased the ability of a natural village to offer public services, such as constructing small drinking water tanks, digging new irrigation channels, constructing water transfer pipelines, and so on. This implies that the local institutions play a critical role in drought management and their transformation gives farmers more options for taking collective actions which can, if continuously implemented and maintained, successfully improve their adaptive capacity.

## 4.. Discussion and conclusions

This article has aimed to investigate the changing multi-level policy architecture to deal with drought and climate variability in China based on content analyses and interviews. The research reveals that first, in response to multiple hierarchical organizations operating independently in the field leading to policy gaps and overlaps, the central and local governments are increasingly using leading committees and integrated policies. However, the hierarchical structure constrains effective collaboration at a horizontal level. Therefore, a shift from a vertical to a horizontal government system could facilitate adopting more integrated measures, such as integrated water resources management (IWRM).

Second, the highly centralized government structure with its powerful resource allocation ability focuses more on disaster management (than disaster prevention) which is, nevertheless, constrained not only by local undeveloped local economies and the governments' fiscal ability, but also by the farmers' ability and local biophysical conditions (see Section 3.3.2). This implies that direct help from the government is efficient but not effective enough at the local level, especially when the local level faces moderate to light drought. In contrast, policies on risk management which activate farmers' preparation for drought could amplify the influence of government funds. The policy on 'one issue, one decision', for example, successfully encourages farmers to offer public services when facing drought through small government awards. Furthermore, farmland tenure reform incentivises private investment in water infrastructure without any government investment. Emphasizing both disaster and drought risk (prevention) management is especially necessary in China because of its extremely large territory.

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<sup>5</sup> Before the reform of farmland use rights, the trade of farmland use rights was illegal. This implied that farmland trade occurred mostly between community members without formal contracts. Under this situation, farm land revenue was generally low. The national agricultural land tenure reform has allowed private companies and big planters to purchase and combine small plots of farmland, leading to greater revenues and greater ability to invest in advanced agricultural and water saving technologies. However, there may be negative impacts on small farmers who lose their lands.

Third, the successful implementation of a policy depends on the choice of appropriate incentives that are relevant to the local biophysical and social conditions. Funds are a very efficient way for governments to achieve results but results on drought relief may be different or even contrary to the policy's original objectives (see Section 3.4). As drought relief depends on local knowledge, local government should be given more space to craft and implement policy. The market is gradually becoming an effective way to improve farmers' adaptive capacity (see Sections 3.4, 3.5 and 3.6). However, vested interests may resist changes. CBOs, which fully use local knowledge, have influenced farmers' activities. But the lack of a democracy tradition and fiscal support will constrain its effectiveness (Sections 3.4 and 3.6).

Fourth, the retreat of governmental organizations from many social issues at the local level has reduced the close connection between government bodies and farmers, which makes it harder for farmers to access and benefit from national policies. As grass root organizations, such as NGOs and CBOs, can mediate well between government and farmers, some policies put emphasis on building up DRTs, WUAs and communities. But these organizations are still very weak at the local level as the setup of the household contract responsibility system<sup>6</sup> since 1981 uses households as a 'unit' and this conflicts with the customary practice of collective action.

Fifth, local institution transformation can effectively improve farmers' adaptive capacity (see Section 3.6), especially in the fields through collective action. It also raises the role of local organizations in drought management. But current transformations are mainly prompted by governments in a top-down way while the farmers themselves have seldom initiated transformations in the surveyed area. This means that the transformation needs a combination of government will and the power of local institutions; however, this has yet to be realized. In addition, the function of informal institutions should not be neglected in local drought management and incorporating these into policies could improve farmers' adaptive ability.

Sixth, China uses almost all of the measures suggested in the drought literature. In addition, it uses professional incentives in order to ensure that government officials have a personal stake in policy implementation. Having said that, there is a strong emphasis on technocratic solutions, better seeds and technologies on the one hand and geoengineering solutions, such as creating an artificial influence on local weather patterns on the other hand.<sup>7</sup> The effectiveness of these measures is limited by:

- The difficulty in balancing comprehensive centralized, hierarchical management structures with the different benefits and interests of individual departments which could perhaps be managed better within a more fluid MLG system.
- Financial challenges, including (a) limits on the financial resources provided by the central government, (b) reduced financial power of the local government following the cancellation of farmer fees and (c) the allegation of corruption.
- Organizational challenges, including the complexity of organizing drought management for over a billion people, through 10 ministries and 50 stakeholder organizations at the national level and by

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<sup>6</sup> The household responsibility system (Jiāntíng liánchǎn chéngbǎo zérènzhì), which gives farmers the right to make independent decisions about the use of a small piece of contracted land, was created by Chinese farmers in the 1970s. Against the background of bringing order out of chaos and concentrating on the economic development after the end of the Cultural Revolution, the Chinese central authorities respected the willingness of the farmers, actively supported the tryouts and then introduced the experience to the whole country within a couple of years.

translating these policies at five different administrative levels. While many national policies are translated down to the local level and the local level also takes initiatives, there are some policies that disappear as we go down the hierarchical system. However, some of the policies are having local effect, such as conversion of agricultural land to forest land, subsidies for new seeds and training in the use of new agricultural technology. In the meantime, farmers are using autonomous techniques to cope with climate variability.

- Participation challenges include the lack of involvement of farmers in decision-making. The absence of a tradition of public participation and clear participation procedures in policies has constrained farmers' input. Meanwhile, weak grass roots organisations also hamper farmers' participation in policymaking processes.
- Market mechanism challenges including the difficulty of using market mechanisms in drought prone areas. For example, although China promotes water pricing, water trading can hardly be found in places without large water infrastructure which could offer irrigation services for farmers. Nevertheless, seed and agricultural machine companies are playing a role in drought relief, which results from market economy reforms.

All in all, China needs to provide more emphasis on (a) enhancing the adaptive capacity of institutions and individuals; (b) drought risk rather than disaster management; (c) enhancing coordination between different departments and levels of government; (d) decentralization in policymaking as local governments can make context-relevant comprehensive policies more easily and are less hierarchical in their relationships; (e) and involving farmers or other stakeholders in decision making.

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