Villagers' Perceptions of Water Crises and the Influencing Factors of Local Perceptions:

A Case Study in the Shiyangriver Basin, Northwest China

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Abstract: *The integration of people's perceptions concerning water into policy and planning is essential for successful water resources management, however little is known about this topic. To redress this problem, interviews were undertaken with a total of 119 villagers in two different villages in the upper and lower reaches of the Shiyang River Basin, northwest China employing qualitative and quantitative research methods. This paper demonstrates a deeper and clearer understanding of local people's perceptions of water crises and their causes in arid and semi-arid regions. Results demonstrate that: (1) while most villagers are aware of local water crises, they are uncertain of the causes; (2) perceptions of local water crises are considerably heterogeneous both between the two villages and among different villagers (3) villagers' perceptions of different aspects of water crises including water access, control and affordability are affected by diverse factors in very different ways. Personal experiences together with physical, social-political and economic factors (location R^2=0.591, P=0.000; land area R^2=-0.327, P=0.01; income levels R^2=-0.26, P=0.01) have a more significant influence on villagers' water perceptions than ordinary demographic attributes. (4) Most of all, water crises are locally and socially constructed rather than physically determined. The conclusions are invaluable for water researchers and decision makers to better understand and solve water crises in more localized and effective ways.*

Key words: *Villagers' water perceptions; personal experiences; socio-political factors; water crises; transdisciplinary water research; Shiyang River Basin; Northwest China*

1. Introduction

Water crises have been one of the most pressing challenges that people have been and continue to be facing, especially in developing countries and in densely populated arid and semi-arid regions where rapid population growth and associated rising water demands will occur over the next few decades (Ostrom et al. 2011, Rijsberman 2006). However, as has been increasingly acknowledged, water crises today have been caused by a combination of diverse factors including physical shortage and inappropriate management (Lu et al. 2000, Varis and Vakkilainen 2006, Nickum 1998, Rogers and Hall 2003). Therefore, water management can no longer be just about increasing water supplies through traditional hard paths of infrastructure construction or exploitation of new water sources (Gleick 2003, Gleick 2000, Stanghellini 2010, Rosegrant and Cai 2002, Coward 1980), but about how to more effectively manage available water resources and improve performance of existing systems (Ostrom et al. 2011, Rogers

and Hall 2003), especially irrigation systems since agriculture remains the largest water consumer and accounts for 70% of global water withdrawals and even more than 90% in developing countries (FAO 2010).

Understanding villagers' perceptions is a prerequisite for effective water management considering that public perceptions will have significant influence in shaping or reshaping people's behaviours and responses (Zube and Sell 1986, McMillan et al. 1997, Lee and Zhang 2008, Ogunjinmi et al. 2012). Firstly, as Carvalho et al. (2002) describe, 'outsiders cannot necessarily identify local needs and priorities or figure out how best to meet them'. External assistance is not sufficient for ensuring appropriate resource management, without greater involvement and cooperation of local people especially farmers. Local communities' direct and long-term experiences, and detailed understanding of their environment is invaluable (FAO 2000, Ostrom 1990, Zube and Sell 1986). Secondly, – Understanding local perceptions facilitates identification of the process by which local villagers either individually or collectively respond to water problems and external interventions in their environment. A clear understanding of local people and extant working rules either formal or customary, is invaluable in enhancing efforts to deal with the 'tragedy of the commons' (Ostrom 1990). Third, – comprehending resource users' perceptions helps identify reasons for different stakeholders to co-operate or resist during the implementation of certain policy interventions and provide suggestions on appropriate planning and interventions in the future. Without grasping these perceptions, water professionals, officials and even practitioners may misapprehend local villagers as ignorant and conservative; may neglect the importance of local contexts in addressing these problems, or may even implement programs which are locally inappropriate and thus highly unlikely to work or be enforced as planned (Scott 1999).

Studies about factors impacting people's perceptions and attitudes towards environmental issues have shown that several variables have been directly related to social and demographic variables including age, gender, income levels, education, residence, occupation and social class (Van Liere and Dunlap 1980, McMillan et al. 1997). For example, a negative relationship has been found between age and environmental perceptions, showing that younger people tend to have better environmental awareness and more specifically pro-environmental attitudes than older ones (Lee and Zhang 2004). Residence or locations also have been considered as key factors in explaining differences in people's environmental concerns and attitudes (Larson et al. 2013, Slegers 2008). For instance, studies indicate that urban residents show better environmental awareness than rural people (Tremblay Jr and Dunlap 1977, Berenguer et al. 2005, Van Liere and Dunlap 1980). Research also has shown that gender is an important factor in explaining differences in people's environmental attitudes. Ogunjinmi et al. (2012) argue that gender plays a critical role in affecting local communities' environmental attitudes. It has also been found that higher income levels are related to higher levels of environmental awareness and part of the explanation of the roles of higher income levels is that with higher income people will have higher levels of education and thus better environmental awareness. According to McMillan et al. (1997), higher education levels will broaden people's horizons and encourage more open-minded perspectives. Van Liere and Dunlap (1980) and Ogunjinmi et al. (2012) further assert that education is the variable that is consistently associated with people's environmental attitudes. However, there has been no consensus reached so far on factors influencing people's environmental attitudes since different researchers choose different data collection and analysis methods in very different contexts.

However, despite a large body of extant literature discussing challenges and solutions to improve irrigation system performances from a professional perspective, many of which have already shown ample evidence of the significant roles of local water stakeholders in water uses and management (Ostrom 1990, Vermillion 1997, Uphoff 2000, Jonsson 2005, Bandyopadhyay et al. 2010), little is known of local water perceptions (Lee and Zhang 2004, Zube and Sell 1986). Much less has been reported using rich empirical evidence. To the author's best knowledge, such information remains unavailable in China where water management has been overwhelmingly top-down and technocratic while critical questions such as how local villagers perceive local water crises have barely been asked (Barnett et al. 2006).

This paper aims to understand local water crises from a different angle and explore the relationship between different factors and their influences on people's water perceptions based on comparative case studies in northwest China. In the following sections, three aspects of villagers' water perceptions will be discussed 1) perceptions of local water shortage and influencing factors; 2) perceptions of different aspects of water crises and potential explanatory factors; 3) perceptions of the causes of local water crises and the effects of different factors on villagers' perceptions. Although locally based, the study will provide valuable insights on how water users in rural communities of arid and semi-arid regions perceive their water crises and what factors influence their perceptions. Moreover this research will provide some practical lessons concerning future water study and management in other countries and areas facing similar water issues.

2. Study Area

The Shiyang River Basin (101°41′~104°16′N, 36°29′~39°27′W) lies in Gansu Province, Northwest China, surrounded by the Badain Jaran and Tengger deserts (See Figure1). It covers an area of 41600 km^2, with a population of 2.27 million in 2003 (GPWRB 2007). Among China's inland river basins, the Shiyang River Basin has the largest population, the most developed economy, and the highest level of water resource development, water scarcity and environment vulnerability (Ma et al. 2005).

The Shiyang River starts from the upper reaches in the Qilian Mountains and disappears in the desert areas to the north (See Figure 1), with eight tributaries and an average annual runoff of 15.75×108 m^3. It is replenished by snow, glacier melt and seasonal rainfall mainly concentrating from June to September. The area is divided into three climatic zones: southern mountain area, with an elevation of 2000-5000 meters above sea level, average annual rainfall of 340-650 mm and evaporation of 720-1200 mm; middle arid and semi-arid region, with an elevation of 1500-2000 meters, average annual rainfall of 160-340 mm and evaporation of 2000-2200 mm; and northern arid zones surrounded by deserts, with an elevation of 1300-1500 meters, less than 150 mm of annual rainfall and 2200-2640 mm of evaporation (See Table 1).

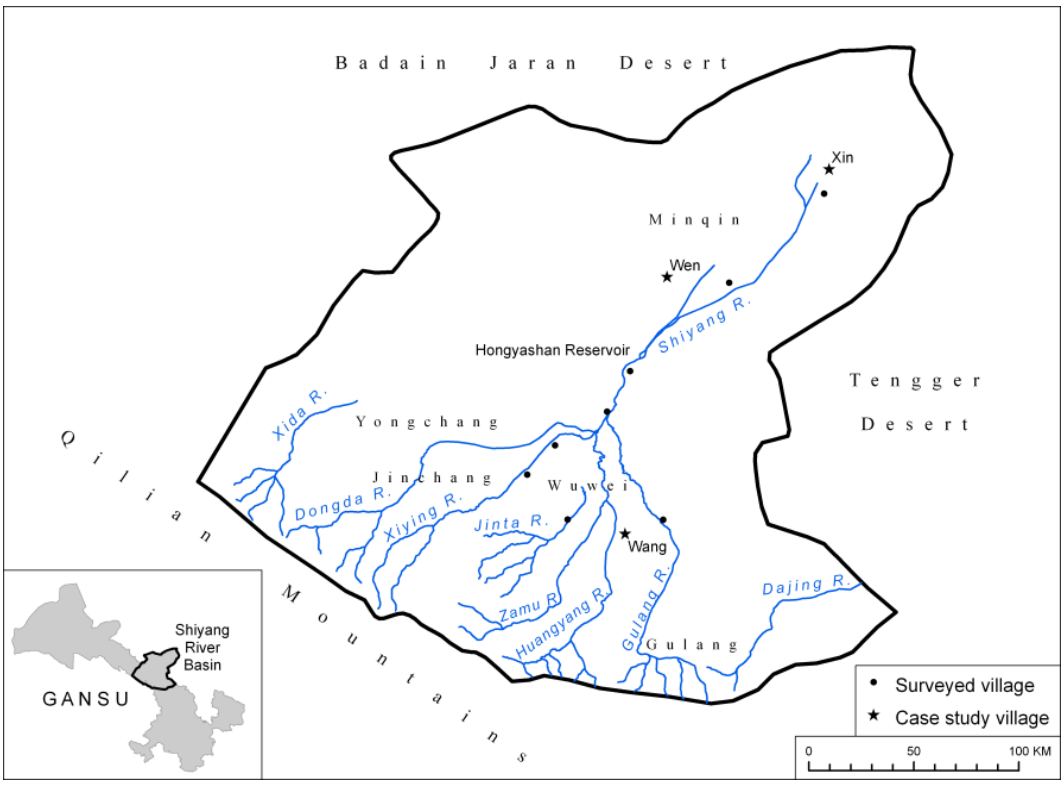

Figure1: *Location of the Shiyang river basin and studied villages (Wang and Wen)*

Table1: *Climate characteristics in different zones in the Shiyang River Basin*

Climatic characters in different zones in the Shiyang River Basin						
	T (□)	R (mm)	E (mm)	RD (days)	RH (%)	SH (hours)
Southern Mountainous area	0-5	340-650	720-1200	>80	46-48	2553-2700
Middle arid and semi-arid regions	5-8	160-340	2000-2200	50-80	45	2700-3000
Northern arid desert zones	>8	<150	2200-2640	<50	30-45	>3000

Notes: T means average annual temperature; R means average annual rainfall; E means average annual evaporation; RD means relative humidity; RH means relative Humidity; SH means annual sunshine hours

The Shiyang River Basin has a long and rich history of water resources exploitation and development since ancient times. A majority (>77%) of the population are still involved in farming, deriving all or a substantial part of their livelihoods from irrigated agriculture (GPWRB 2007). It has traditionally been one of the most important state commercial grain bases in both Gansu Province and China (Ding 2007). Over the past few decades, water stress has been increased considerably throughout the basin (GPWRB 2007). Numerous channels, dams and reservoirs have been built in the upper and middle reaches to deal with increasing water demands from population growth, land expansion, agriculture and economic development. As a result river inflow to the lower reach continues to drop (Lee and Zhang, 2004) and has decreased significantly by 74% over the past four decades (Kang et al. 2004) (See Figure 2). People began to exploit groundwater resources throughout the basin on a large scale, particularly in lower Minqin county (Edmunds et al. 2006), where over 11000 wells had been dug up until 2000 (Liu and Wan 2010), with groundwater exploitation increased from less than 0.19×10^9 m^3 per year in the 1950s to 1.1×10^9 m^3 in the 1990s (Ji et al. 2006). Groundwater tables keep falling at a rate of up to 1 meter per year and have dropped from 8.5 m below the surface in 1984 to 14.9 m by the mid-1990s (Ma and Wei 2003) (See Figure 3). Overexploitation, falling water tables and degrading water quality have been increasingly prevalent and worsening.

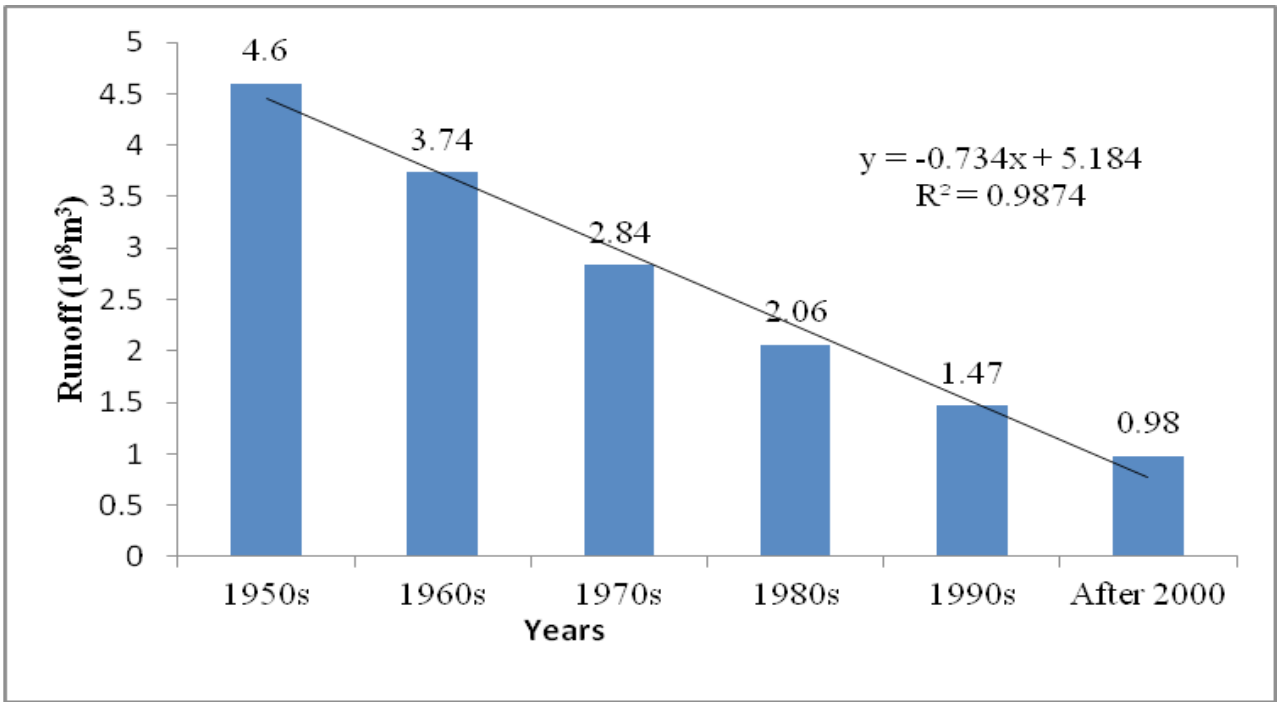

Figure 2: *Annual runoff to Hongyashan Reservoir in the Lower reaches (Unit: 10^8 m^3)*

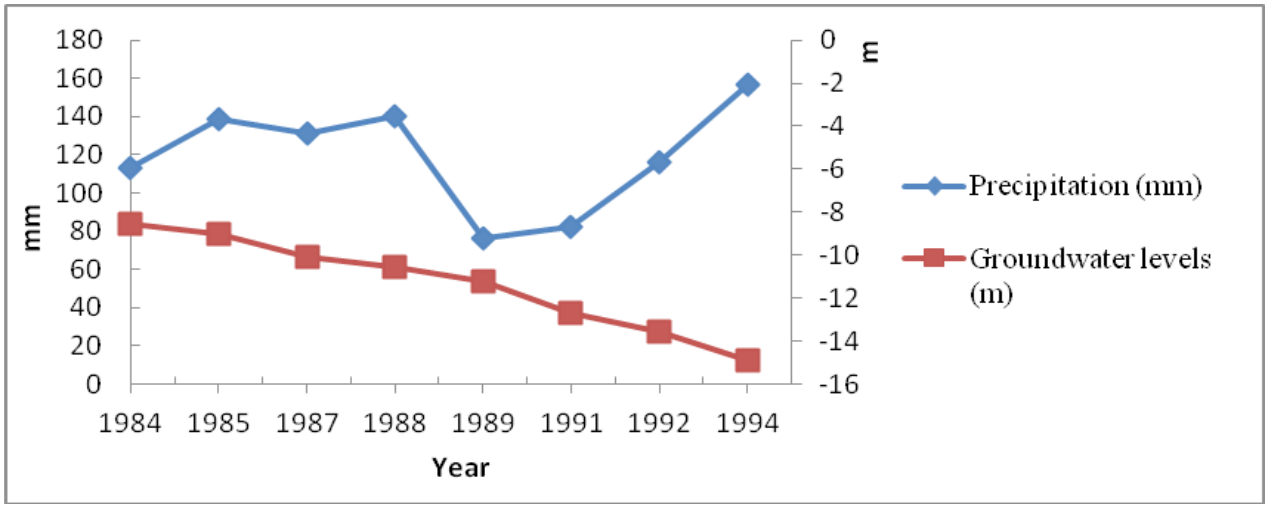

Figure 3: *Changes in groundwater levels and precipitation in Minqin County, adjusted from Ma and Wei (2003)*

The basin has been facing increasingly severe water stress and related environmental problems which are caused by a large and growing population, climate change, resource limits, and inappropriate water management to human activities and improper agriculture practices (Kang et al. 2004, Ma et al. 2007, Ma et al. 2005, Ma and Wei 2003, Aarnoudse et al. 2012). Local people's livelihoods, social and economic development and ecosystem balance have been continuously threatened (Ma et al. 2007, Ji et al. 2006). For example, in Minqin County, over 90% of the area suffers from desertification and many farmers have been forced to leave their communities and face great difficulties in securing their livelihoods (Wei et al. 2006, Aarnoudse et al. 2012).

To face the worsening water situations, especially in the lower reaches, water reforms towards integrated water resources management (IWRM) in the basin which were initiated and funded by the Chinese government and many international donors have been carried out by provincial and local governments throughout the basin since 2007. A series of policies were implemented including construction and rehabilitation of irrigation infrastructures, shutting down pumping wells, cutting down irrigated land areas, readjusting agriculture patterns to less water consumptive and more profitable patterns such as greenhouses and growing cash crops, introducing water rights and mandatory limit on farmers' irrigation uses, increasing irrigation water prices and reallocating more surface water to lower reaches concerning its ecological vulnerability and extremely severe water circumstances. All these attributes make the Shiyang River Basin a classic case study.

3. Research Methods

In contrast to most previous water studies of China, local water crises were studied from villagers' perspective employing qualitative and quantitative methods. Qualitative methods including semi-structured interviews, informal conversations, group discussions and participant observation were chosen to accurately record details in informants' water perspectives complemented by secondary data collection and textual analysis of relevant literature, regulations, documents and policies. Key informants include village council members, community leaders, local villagers, water practitioners, managers and officials at village, township, county, city and provincial levels. Interviewees were recruited using a stratified snowballing method to adequately cover the heterogeneity and composition of the community including cultural, social, political, economic, gender, age groups of the villages. Each interview ranged from 15 minutes to two hours based on how much time the respondents were willing to take. Each group discussion usually took 2 to 3 hours. Random questionnaire surveys together with secondary data collection enabled further insight and triangulation of data. Over 80 interviews and 119 questionnaires were conducted in two sample villages (51 in Wang village and 68 in Wen village) from September 2011 to September 2012 till the data reached theoretical saturation (Glaser and

Strauss 1967). Quantitative data was analyzed using descriptive statistics and Pearson correlation through SPSS 21 and qualitative data analysis was based on coding and content analysis to identify themes and interpretations.

Two sample villages, Wang village in the upper reach and Wen village in the lower reach of the basin (See Figure 1), were selected based on several principles including geographical location, agricultural patterns, water situations, village size and local irrigation management (See Table 2). In both villages, most people have been long-term inhabitants with an average residence time of 34 years. Agriculture production is still the most important source of livelihoods for the majority of villagers. Irrigation plays a central role in agriculture and food production, locals' income and livelihoods. The above mentioned water reforms towards IWRM such as management decentralization, enforcing water rights, compulsory irrigation quota limits and increasing water prices have been carried out in both villages starting from 2007.

Wang village has a population of 1845 in 12 location-based communities. With a distance of about 30 km away from the nearest city, it is more difficult for most local residents to seek off-farm job opportunities so most people are still mainly agriculture based. The average land holding per farmer is 5.85 mu (1 mu = 1/15 ha) while the official irrigated land limit is set at 2 mu per person. The main crop types are seed corn and wheat. Irrigation is indispensable for local agriculture production with an annual rainfall of 164 mm and an evaporation of 2000 mm. Groundwater is the only irrigation source for local farmers. The annual income per person on average is 6960 Yuan in 2011 (exchanging rate at 1 Pound =10 Yuan).

Wen village has a population of 1834 people divided into 10 production teams. It is 10 km away from the nearest county and some villagers pursue part-time off-farm employment. Irrigation is dependent on both groundwater and surface water resources. Actually increasing surface water supplies from upper reaches started over the past few years through government interventions assuming that if more surface water is transferred to the lower reaches, groundwater overexploitation in lower river basin will be reduced. Per capita landholding in Wen village is 2.7 mu comparing to the official limit of 2.5 mu per person. Unlike the uniformity of crop types in Wang village, in Wen village people have more freedom in crop selection. They usually grow a combination of wheat, corn, sunflower seeds, cotton and alfalfa. The average annual income for Wen villagers in 2011 was 5411 Yuan.

Demographic characteristics of respondents are categorized in Table 3. As shown, the age of respondents was more or less evenly distributed, with a clustering between the age 31-50 years (58.8% in Wang and 60.6% in Wen). The average age is 46 years old. Most informants have primary or secondary school education. It is also important to note that there are more male respondents because most of the surveys were carried out at household level and when both male and female members were present, normally it was the male member who chose to fill out the questionnaires and respond on behalf of the family.

Table 2: *Basic information of studied villages*

Village profile		
Village name	Wang	Wen
Population	1845	1834
Average annual precipitation (mm)	164	110
Average annual evaporation (mm)	2000	2644
Distance to nearest city/town (km)	27	10
Average annual income per capita (Yuan)	6960	5411
Land area per capita in mu (Actual/Official)	5.85/2	2.7/2.5
Official water quota per capita (m^3)	430	410
Irrigation sources	Groundwater	Groundwater and surface water

Source: Author's field study

Table 3: *Descriptive statistics of respondents*

	Age (years)	Education (level 1-7)	Family Numbers	Children Number	Land area	Income levels (level 1-7)
N Valid	119	119	119	119	119	119
Mean	45.88	2.73	4.76	2.14	17.80	3.75
Range	52	5	9	5	48	6
Minimum	24	1	1	0	2	1
Maximum	76	6	10	5	50	7

Note: **Education***: 1=no education, 2=primary school, 3=secondary school, 4=high school, 5=vocational education; 6=college and above);* **Income levels per household***: 1=<5000 Yuan, 2=5000-10000 Yuan, 3=10000-20000 Yuan, 4=20000-30000 Yuan, 5=30000-40000 Yuan, 6=40000-50000 Yuan, 7=>50000 Yuan, exchanging rate at 1 Pound=10 Yuan;* **Land area** *in mu, 1 mu= 0.067 ha.*

4.Results

4.1 Local Perceptions of Water Shortage

4.1.1 Perception Differences Between Two Selected Villages

Water shortage at local levels as a special element of local water crises was evaluated by villagers based on a pre-set five point scale, where 1 means no physical water shortage at all and 5 means extreme water shortage situations. Results from Figure 4 show that most (57%) of the 119 respondents consider water shortage in their area as high (water shortage mark with 4 points and above) while 43% consider it as medium/low (water shortage mark with 3 points and below). These results show that most villagers are aware of local water shortage situations.

It also shows that respondents' perceptions of water shortage may significantly differ from one village to another. For instance in Wen village, the water shortage mark ranges from 3 to 5 points (See Figure 4), with an average mark of 4.2 and a standard deviation of 0.745 (see Table 4). In contrast, the water scarcity mark in Wang village is more diverse ranging from 1 to 5 with an average mark of 2.6 and standard deviation of 1.296 (Table 4). While 79% of people in Wen village perceive there is high level of water scarcity locally only 27% of respondents in Wang village think their physical water scarcity is high

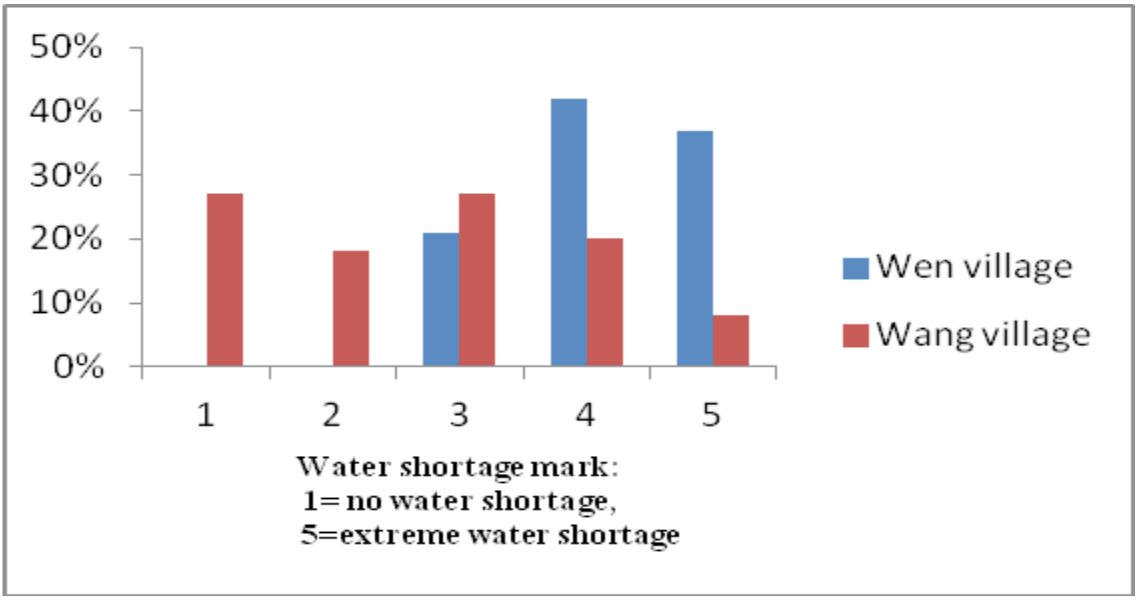

Figure 4: *Distribution of water shortage marks in Wen and Wang village*

Table.4 *Descriptive Statistics of water shortage mark in Wang village and Wen village*

	Village	N	Range	Minimum	Maximum	Mean	Std. Deviation
1- no water shortage	Wang	51	4	1	5	2.63	1.296
5-extreme water shortage							
Valid N	Wen	68	2	3	5	4.16	.745

(Chi^2=32.13, P= .000), which further implies that people from Wen village perceive that water shortage is more serious than in Wang village. The contrast of villagers' water perceptions between Wang and Wen village shown in Figure 4 is also consistent with the objective situations in both villages as the data presented in Table 2.

4.1.2 Impacting Factors for Perception Differences at Village Levels

Physical factors such as geographic locations, can impact human perceptions of environment (Tremblay Jr and Dunlap 1977, Zube and Sell 1986, McMillan et al. 1997, Burningham et al. 2008, Larson et al. 2013). Similarly, a correlation has been found between locations and people's water perceptions (Table 5) in this paper, showing that people's understanding of water crises is highly localized. For example people in Wen village at lower reach who experience higher evaporation, lower rainfall and many related ecological problems are more afflicted by water stress so that they may consider water shortage more serious. This is consistent with previous studies showing that people's environmental views can be related to their surroundings and experiences (Spence et al. 2011, Whitmarsh 2008).

Other potential factors that may have caused the perception disparities between the two villages include village related livelihoods diversification, dependence on agriculture production, different agriculture patterns, crops types and irrigation needs. Data analysis shows both villages have similar livelihood diversification with most families having three different income sources including agriculture production, livestock raising and part/full-time on-farm or off-farm employment. There is no correlation between how many types of livelihoods people have and their water shortage marks. Regarding dependence on agriculture, all respondents are agriculture-based and in both villages, most still depend on agriculture for a majority of their family income, which lessens the possibility of a correlation between stakeholders' dependence on agriculture and people's perceived water shortage marks.

It is also logical to expect that farmers' perceptions of water shortage will depend on their perceived irrigation needs and actual water availability. This means that people who grow more water-intensive crops with higher irrigation needs may perceive water shortage as more serious. However, results show the opposite. People in Wang village uniformly

Table 5: *Correlations between village and water shortage mark*

		Village code	Water shortage mark: 1-no water shortage 5-extreme water shortage
Village code	Pearson Correlation	1	.601**
	Sig. (2-tailed)		.000
	N	119	119
water shortage mark: 1-no water shortage at all, 5-extreme water shortage	Pearson Correlation	.601**	1
	Sig. (2-tailed)	.000	
	N	119	119

***. Correlation is significant at the 0.01 level (2-tailed).*

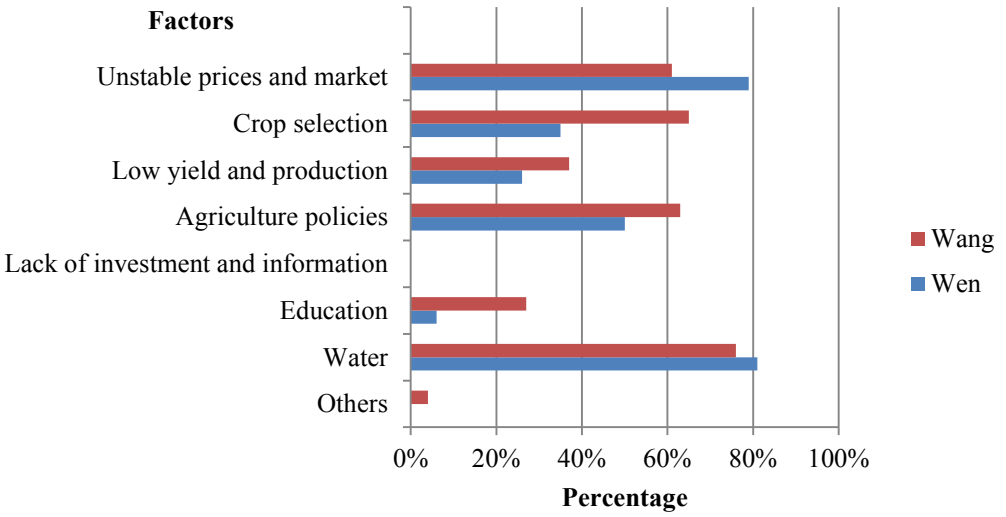

Figure. 5 *Factors constraining local livelihoods and income from villagers' perspectives*

grow seed corn which is more water intensive than most crops grown in Wen village, such as cotton and sunflower seed and yet they consider local water shortage less seriously than Wen villagers. This may be because locals perceived that water availability in their area was better.

Local socio-political contexts also have a profound impact on people's perceptions of water shortage situations. For instance, irrigation management in Wang village is contracted to group leaders, whose large majority of payment is based on the principle of 'using more water, charging more fees and getting more profit' so that contractors will always try to get more irrigation access for locals. In Wang village, the village council leaders, local government and water managers seem to share a closer relationship with mutual interests, which make acquisition of water access easier than in Wen village located in the lower reaches, where such networks are loose and water control is stricter. Obviously these context-based experiences lead many people to argue that the water problems that they are facing are not about water shortage, but networking and paying more for their water uses, whereas most people in Wen village facing difficult experiences in getting irrigation access consider water shortage issues more serious. These findings are in line with discussions in literature showing that experiences and power related contexts are associated with people's environmental knowledge and attitudes (Williams 1998, Bögeholz 2006, Maraglino et al. 2010).

4.1.3 Perception Differences within Villages

Data analysis also demonstrates considerable heterogeneity in perceptions of water shortage among villagers within the same village and water users groups showing that each individual has his or her own perceptions of environmental problems such as drought, desertification and flood (Maraglino et al. 2010, Burningham et al. 2008, Van Liere and Dunlap 1980). Among 51 respondents in Wang village, around one third marked one point for their water shortage which indicated that there was no physical water scarcity in their area at all, whereas about one third perceived that their water scarcity is extreme or very serious (Figure 4). Similarly, 37% of the 68 respondents from Wen village expressed that their water shortage situation is extreme, while 21% believed it is only medium (Figure 4).

4.1.4 Impacting Factors for Perception Differences within Villages

In contrast to most extant studies, impacts of demographic factors (gender, age and education levels) on villagers' perceptions of water shortage are rather weak or not significant at all in this study. For instance, people who are more educated may not necessarily be more water shortage conscious. One explanation for the inefficacy of education in shaping villagers' water consciousness may be that most of the respondents were between the age 40 to 50 and had received their education in 1980s and 90s, when water issues in China were generally not considered as a problem nor included in education programs. Almost no

respondents could remember any educational experiences related to water shortage. Some people still refer to water as an inexhaustible resource based on their previous education and experiences. The old ideology seems always entrenched and difficult to change (Larson and Edsall 2010). These evidence further indicates that current education forms such as public hearings, distributing pamphlets or public campaign slogans, have failed to foster positive water attitudes (Eagly and Kulesa 1997, Kearney and Bradley 2011). Strengthening people's awareness requires not only increased education or informational interventions but also the content and effective forms of education (Eilam and Trop 2012).

Interestingly, a negative correlation between participants' water shortage mark and current land area (R^2=-0.327, P=0.01) has been found, which indicates that respondents with bigger land holding find water shortage is less serious than relatively smaller landholders. There is also a very significant correlation between people's water shortage marks and their income levels (R^2=-0.26, P=0.01). When aggregating these relationships, we find that larger land-holders, with higher income levels tend to believe their water scarcity issues are less serious than poorer villagers and smaller landholders. Considering that economic wellbeing and social capital are closely associated (Ostrom 2002, Krishna 2002), people with higher income levels and more social capital may get irrigation access more easily which may lead them to consider local water shortage as less serious. However for those with relatively smaller pieces of land, lower income and less capital, water shortage situations are perceived as more serious.

Personal experiences, water needs and villagers' own definition of what shortage levels as low, medium or high will also have a profound effect on their perceptions of water shortage. In other words, water shortage or the intensity of water shortage can mean different things to different people. This again corroborates the great water perception disparity among different water users because even in the same community or water user groups, people can have very different water use and management experiences. This is also consistent with extant results showing that people's former experiences can have a great impact on their environmental attitudes and behaviours (Eilam and Trop 2012, McMillan et al. 1997, Taylor et al. 1988).

4.2. Perceived Aspects of Local Water Crises

"If you control water, you control us" (Interview, local farmer, male 49, Wen village, June, 2012)

Villagers were asked with open-ended questions to describe the forms of water crises of their areas. As shown in Figure 5, most respondents (81% in Wen village and 76% in Wang village) believe water crises to be 'the constraint for local livelihoods and income'. According to the results of interviews with villagers, local water crises can be categorized into three main groups from their perspectives: (1) unreliable and declining irrigation access/control; (2) insufficient irrigation and (3) increasing irrigation expenses. Their understandings of local water crises are not only physical but also socio-political. For instance, many respondents in Wang village do not believe water is scarce in their communities, but assert that they are facing increasing water crises such as failure to get appropriate amount of water at the required time. Moreover, others assert that the increasing irrigation fees over the past few years has made them suffer from significant income loss and made local water crises more serious.

It is also noteworthy that there are some common characteristics among respondents who believe that they are facing local water crises but not physical water shortage. They share: unsuccessful experiences to get appropriate irrigation include increasing government water control; experience an incapable team leader who is also the local water contractor not having a good relationship with water agents and local leaders or government officials; they themselves do not have a close connection with water managers and officials; or the undesirable location of their irrigated lands or incapability to influence collective decisions. It seems that what these respondents in both Wen and Wang village have in common is their lack of certain types of capital, particularly financial capital and social capital, such as social networks. This again proves that water crises are not purely natural conditions but are lived experiences that can be constructed differently for different people (Mehta 2007).

4.3. Perceived Causes of Local Water Crises

Villagers were further asked about causes of local water crises with the question of "What do you think are the main cause (s) of local water crises". Consistent with Heider's study (1982) which notes that some individuals incline to blame themselves for unfavourable events while others tend to blame other people or other sources, data analysis in this paper shows similar heterogeneity in people's perceptions of causes of local water problems, which can be categorized into natural or anthropogenic factors.

As shown in Table 6, villagers mostly (67%) perceived the causes of local water crises as being natural in general including water shortage, higher temperature, less rainfall, drier winters, and extreme unseasonal events during growing seasons, which they further assert are beyond their control so they should not be held responsible. This demonstrates a general lack of connection of stakeholders' own roles and activities with local water problems. On the other hand, local water crises are also perceived to be caused by anthropogenic factors. For instance some (32%) believe that the responsibility lies mostly with the villagers themselves including uncontrolled land extension, groundwater depletion over the years, or cutting too many trees which are supposed to attract rainfall. Still others (55%) believe their water issues are caused by political and social factors, such as government control, unreasonable water policies concentrating on environment rather than local villagers' welfare or livelihoods, inequitable water allocation among different water users especially between upper-middle stream users and downstream users or between well-connected and disadvantaged villagers.

In order to explain the individual differences in perceived causes of local water crises, quantitative analysis based on socio-demographic variables were also used to explore the relationship between respondents' characteristics and the perception differences. However results show no statistically significant relationships. But based on qualitative data analysis, some interesting patterns have been discovered. It seems that older villagers (age 50 and above) tend to attribute local water crises to natural reasons. They base their perceptions on their own direct experiences of living and farming locally, as mostly cited: 'the area is more arid because it is much hotter here in summer and so much warmer in winter than the past', 'it rains less and less during growing seasons' and 'with same irrigation amount, time interval between every irrigation for the same crop has to be shortened'. In contrast, answers of younger respondents about causes of local water crises however are more flexible and diverse. They tend to believe that their behaviour is very likely to have an impact. These findings are in line with study of Lee and Zhang's (2004) showing that compared with older participants, younger generations were less inclined to attribute desertification to climate change and have more diversified answers.

Table 6: *Villagers' perceived causes of local water crises*

Water competition among different sectors	3%
Government control	55%
Overuse and overexploitation	32%
Natural and climatic reasons	67%
Don't know or Not sure	10%

One of the potential explanations of the age based perception difference is their different existing experiences, habits and information sources (Van Liere and Dunlap 1980, Zube and Sell 1986). People construct understanding of their problems with the help of already constituted knowledge (Thomason and Bottomore 1982, Bird 1987, Taylor et al. 1988). As Taylor et al. argue (1988) local people may be criticized for behaving irrationally while according to their experiences, they are quite rational. After all, water situations used to be a lot worse based on many villagers' especially older generations' experiences and interaction with their environment, which constructed and restricted their understanding. For younger villagers with multiple information and knowledge sources such as the internet and a lack of such experiences with local environment, it seems easier for them to change or accept different ideologies.

5. Discussion and Conclusion

This study gains a clearer and deeper understanding of local perceptions of water crises and the contributing factors that influence them. Consistent with most existing studies showing public perception diversity in different aspects of environmental problems (Taylor et al. 1988, Lee and Zhang 2004,

Lee and Zhang 2008, Carvalho et al. 2002, Dessai and Sims 2010), it has shown that there are great perception differences concerning different aspects of local water crises between villages and among individual respondents. Firstly, there are significant perception disparities regarding local water shortage situations. For example, people in Wen village downstream believe their water shortages are more serious than those in Wang village upstream. Even in the same village and water user groups, some consider the water shortage as extremely severe while others regard it as not severe at all. Secondly, despite a general agreement of the existence of local water crises, individuals have different perceptions of aspects of water crises. Some express local water problems as physical shortages while others propose that it is about water access, control and affordability. Third, villagers' perspectives on causes of their water crises also diverge considerably. For instance, older respondents believe the causes are natural whereas the answers of young people are more diversified including both natural and anthropogenic factors.

Moreover, factors influencing villagers' perceptions of water crises can vary significantly among different subjects. More interestingly some factors matter more than others. For instance, location, direct personal experiences in local socio-economic and political contexts have the most significant impact on people's water perceptions followed by land area and income levels while gender, age and educational were not significant determinants. More specifically, only age difference seems to have a special effect on people's perceptions of causes of local water crises. In addition, possessions of capital, particularly social and financial capital seem to have a great effect on villagers' perceptions of forms of local water crises. All these indicate that it is prerequisite to understand the interaction between water resources, users and the local socio-political environment within which they are constructed to understand local water crises. More importantly these variables and their impacts when applied to particular situations may vary significantly and some variables that are relevant to one aspect of water issues in one context may not necessarily be applicable to another.

Instead of being physically determined, water crises are locally lived and constructed within specific social, economic and political situations. This means some of these perceptions may not be accurate reflections of local water situations; however this does not mean that they are useless. On the contrary, these local viewpoints, if properly used, can be very helpful in better understanding local water problems and addressing them more effectively. The present work shows that local communities lack the ability to grasp that their certain actions may be harmful or to connect them with causes of local water crises. It appears that villagers' water and environmental awareness can only be strengthened when it is substantiated by their experiences, and will be undermined when it shows otherwise (Taylor et al. 1988). In this regard, local groups may need support from higher level authorities and professionals to change their old ideologies so that real changes can finally take place. Although it may not be possible to get generalized conclusions based on findings from this study, these empirical results enrich extant understanding of locals' water perceptions and potential influencing factors in light of the micro-social political context, which can be invaluable in pursuing more effective water management in China and other regions and countries with similar water challenges, especially at local levels.

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