Partner Report Series No 2

Scoping assessment of knowledge needs in climate change adaptation in China

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ADAPTATION KNOWLEDGE PLATFORM

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The *Partner Report Series* highlights the insights and outcomes of studies, assessments and other field activities that our national implementing partners have undertaken in their countries to mainstream adaptation into plans, policies and programmes. The intention of the series is to disseminate their findings to partners and relevant professionals in Asia.

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Front Cover:
A typical village view in Guizhou, in hilly areas and terraced fields
Photo Credit: Xu Jiayi

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Cropland during summer drought in Ningxia
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Preface

During the last three years, the Regional Climate Change Adaptation Knowledge Platform (AKP) has worked towards building bridges between current knowledge on adaptation to climate change and the governments, agencies and communities that need this knowledge to inform their adaptation to the impacts of climate change. AKP's work has been carried out following three key objectives:

1. Promoting dialogue and improving the exchange of knowledge, information and methods within and between countries on climate change adaptation and linking existing and emerging networks and initiatives;

2. Generating new climate change adaptation knowledge, promoting understanding and providing guidance relevant to the development and implementation of national and regional climate change adaptation policy, plans and processes focused on reducing the vulnerability and strengthening the resilience of the poor and women: the most vulnerable segments of society in most Asian countries; and,

3. Synthesizing existing and new climate change adaptation knowledge and facilitating its application in sustainable development and poverty reduction practices at the local, national and regional levels.

This publication is a result of these objectives. AKP supported thirteen countries in the Asian region in strengthening their capabilities to introduce effective adaptation measures. This includes undertaking activities both at the national level to create an enabling policy, regulatory, planning and budgeting environment for the adoption of adaptation measures, and at a sub-national and local level where most adaptation activities are implemented. In each country, the platform facilitated adaptation action and strengthened adaptive capacity.

AKP is being facilitated by the Stockholm Environment Institute (SEI), AIT's Regional Resource Centre for Asia and the Pacific (AIT RRCAP), and the United Nations Environment Program Regional Office for Asia and the Pacific (UNEP ROAP) with funding provided by the Swedish Government through the Royal Swedish Embassy in Bangkok and the Swedish International Development Agency (Sida).

The scoping assessment in China is one of the initial activities conducted with national implementing partners to help AKP define the adaptation priorities for a partner country especially with respect to local research priorities, knowledge needs and capacity gaps. AKP believes that a clear identification of these issues will help in developing a proactive set of actions. AKP and its partners can then take these forward and implement them.

With the emergence of an expanded Asia Pacific Adaptation Network, AKP's actions on adaptation in the priority countries will be deepened and enlarged. This will ensure that the findings in this scoping assessment are followed up and emerging issues are addressed. Such a network will also provide a wider platform of experience and knowledge sharing. APAN's ultimate objective is to assist the region in building the climate resilience of human systems, ecosystems and economies through the mobilization of knowledge and best practices, enhanced institutional capacity and informed decision making processes, as well as facilitated access to finance and technologies.

The outcomes of AKP have been made possible by the active participation of partners and various stakeholders. SEI acknowledges the editorial assistance provided by Marion Davis, Paul Bulcock, and Skye Turner-Walker. SEI also expresses heartfelt thanks to John Soussan, Lailai Li, Kai Kim Chiang, Lisa Schipper, Sabita Thapa, Tatirose Vijitpan, Muanpong Juntopas, Nantiya Tangwisutijit , Chanthy Sam, and Dusita Krawanchid for their contributions to AKP.

A typical village view in Guizhou, in hilly areas and terraced fields
Photo Credit: Xu Jiayi

Executive Summary

This report scopes out knowledge gaps and unmet needs relating to climate change adaptation in China, and proposes ways to address them. It is the product of an international collaboration between Stockholm Environment Institute (SEI) Asia and Beijing Zhi Dao He Xie Management Consulting Co. Ltd., and their work with local and community development organisations. A national scoping study on climate change had already been completed in China. Consultations with national policy-makers indicated a need for additional scoping focused on the adaptation needs in specific ecological zones. Accordingly, this report reviews existing climate change assessments and provides case studies of two ecological zones that have been identified as being particularly vulnerable to climate change impacts: the Ningxia Hui Autonomous Region in the northwest of China and Guizhou province in the southwest.

The goal of this review is to identify ways to strengthen the links between scientific and technical knowledge with action on climate change adaptation. The study focuses on the impacts of climate change on agriculture and rural development, the two sectors thought to be most vulnerable. It draws on a literature review for context, but employs case study research as its main methodology. Data were collected through a review of official documents and relevant research publications, stakeholder consultations, and rural household interviews using structured questionnaires (Annex 1). The field data and findings were then mapped according to the climate change impacts analytical framework developed by the Intergovernmental Panel on Climate Change (IPCC, 2007) and the climate change adaptation framework developed by the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNDP-UNEP, 2010) to identify potential knowledge gaps as well as any actions needed to fill them.

The main findings are:

1. The effects of climate change have been observed and are well-documented across China, and further changes are expected. It is thought that some of the most important impacts will be felt in the areas of biodiversity, water resources, agriculture, rural livelihoods and food security, as well as on human settlements and infrastructure. The two case study sites are particularly vulnerable to climate change due to their respective geographical locations, natural climate, topographical features, soil structure and socio-economic profiles. Symptoms and impacts of climate change have been recognised in both regions, particularly by people in the agricultural sector and those whose livelihoods rely on climate-related conditions. These findings match those from previous academic research on climate change conducted in the regions.

2. At the national level, climate change policy development has gained momentum with the publication of the National Climate Change Assessment Report and the National Climate Change Programme. The Assessment Report includes an analysis of the potential impacts of climate change. The National Programme provides a framework to guide future climate change policy development at the national and provincial level, and is focused on agriculture, forests, natural ecosystems, water resources and coastal regions. Every year, the National Development and Reform Commission publishes a National Climate Action Report that evaluates progress towards the goals identified in the Programme.

3. Knowledge gaps exist at different levels. For instance, a significant amount of research has been conducted on the impacts of climate change in Ningxia. However, research findings have tended to be used for academic discussion, rather than supporting adaptation actions. Currently, there is no decision/policy system to convey research information and new knowledge in support of policy-making.

4. Since the 1990s, many actions have been initiated in Ningxia as part of the national programme in order to cope with environmental degradation and a changing climate. Most of these have focused on the benefits of combining ecological recovery with economic development.

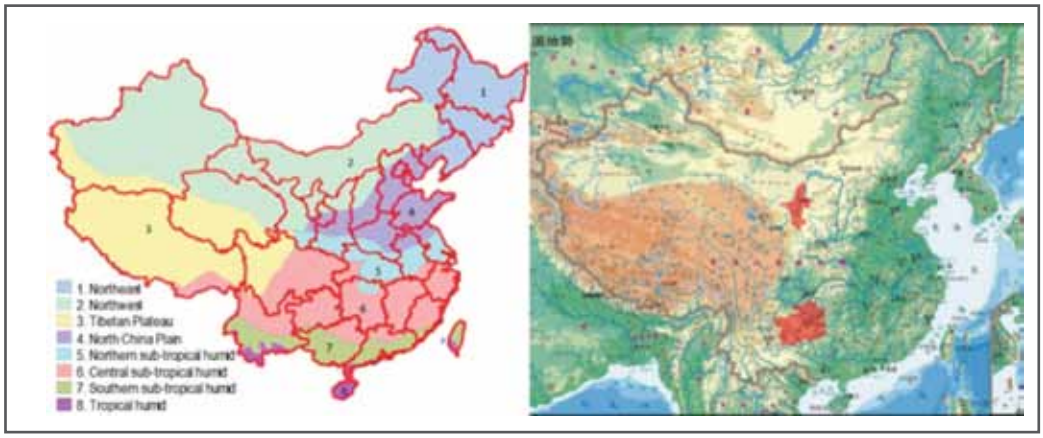
These findings suggest that there is a need for a knowledge support system to generate, communicate, and manage climate change knowledge and information in support of policy- and decision-making processes at all levels.

The report is organised into six main sections: 1) a summary of the context and the research methodology; 2) a summary of climate change impacts at the national level; 3) a review of institutional arrangements at the national level; 4) findings from field work conducted at the local level; 5) an analysis of the interaction between national and local adaptation planning; and 6) recommendations to inform the design and implementation of a Climate Change Adaptation Knowledge Platform in China.

Context AND METHODOLOGY

China spans 9.6 million square kilometres (km^2) and covers a wide range of geographic regions that differ considerably in terms of their exposure and vulnerability to the impacts of climate change (Zhang et al. 2008). Thus, in order to understand climate change and adaptation needs in China, it is imperative to consider the diversity and complexity of China's ecosystems. The Research Centre of Eco-environmental Sciences at the Chinese Academy of Sciences has classified China into eight major ecological function zones. Figure 1 shows these zones as well as the locations of the case studies in this report.

Figure 1: Ecological zones in China (left) and locations of the case studies (right) (Source: Institute of Geographic Sciences and Natural Resources)



The two provinces selected for case studies here were chosen as two very different examples of ecosystems that are particularly vulnerable to the impacts of climate change. Ningxia, in Zone 2 in northern China, is an arid and semi-arid region suffering from an increase in drought conditions and desertification. Guizhou, in Zone 6 in southwestern China, has a humid subtropical climate and a distinctive karst geology that presents a unique adaptation challenge. Both provinces are classified as ecologically fragile zones or "ecotones" (as defined by Van der Maarel 1990) under the Chinese Ministry of Environmental Protection's *Outline of National Plan for Protection of Ecologically Fragile Zones,* adopted in September 2008. The document explains the scientific term ecotone as referring to areas as an ecological transition zone, where the ecosystems are pulled or stretched by different natural forces interacting with one another, as well as by human forces that drive ecosystem change. The plan puts Ningxia, Guizhou and 20 other provinces (autonomous regions) under special environmental protection.

Research for this study included a review of official documents and relevant research publications, stakeholder consultations and rural household interviews using structured questionnaires (Annex 1). Six groups of stakeholders were consulted and/or interviewed:

- Departments of the regional governments, including planning, agriculture and animal husbandry, water resources, environment, forestry and meteorology. These departments plan the regional economy and lead and supervise the implementation of sector-based development plans at the regional level.
- County-level governments in these same fields. These departments plan the county-level economy and lead the implementation of sector-based development plans at that level.
- Research institutes which support decision-making at different levels.
- Non-governmental organisations (NGOs) involved in climate change adaptation activities and capacity-building at the community level.
- Community members who are directly affected by climate change and need to cope.
- Local companies (the private sector) that are directly affected by climate change and need to adapt.

The field data and findings were then mapped according to the climate change impacts analytical framework developed by the Intergovernmental Panel on Climate Change (IPCC, 2007) and the climate change adaptation framework developed by the United Nations Development Programme and the United Nations Environment Programme (UNDP-UNEP, 2008) to identify potential knowledge gaps as well as any actions needed to fill them. The findings and analysis are reported below.

It should be noted that a Second National Assessment Report was published by the Chinese government mid-way through the scoping process.[1] This report, which is not included in our analysis, can also provide guidance on understanding the adaptation priorities in China. It is likely that our findings overlap somewhat with the report's findings, but we also feel that our approach provides a deeper and locally grounded perspective on adaptation.

Impacts AND RESPONSES AT THE NATIONAL LEVEL

Impacts at the national level

Signs of climate change have been well documented in China. Based on official records, Ding et al. (2006) found that from 1905 to 2001, the country-averaged annual mean surface air temperature in China had increased by 0.5 to 0.8°C. Scenarios developed by Xiong et al. (2009) using a regional climate model show that recent warming in China will accelerate, with associated changes in precipitation and frequency of extreme events. Xiong et al. also find that recent climate models project modest, but consistent, increases in mean annual precipitation for China. However, regional models indicate significant variations, with large increases in the north and northeast of the country, and decreases in the central, eastern and southern provinces.

[1] For news coverage of the report, see Buckley, C. 2012, 'China report spells out "grim" climate change risks'. *Reuters,* 17 January. Beijing. http://www.reuters.com/article/2012/01/18/us-china-climate-idUSTRE80H06J20120118. The report, in Chinese, is available for purchase on Amazon's China website (http://www.amazon.cn).

Hongfeng Lake, the major fresh water source for the capital city of Guizhou, fell to its low level in summer when the province was experiencing a record-breaking severe drought
Photo Credit: Xu Jiayi

Two female interviewees in the village in Guizhou talking about the impact they felt from climate change
Photo Credit: Xu Jiayi

A comprehensive assessment of climate modelling was conducted at the national level, resulting in the National Assessment Report on Climate Change, published in February 2007. The summary here draws on an English-language synopsis produced by Lin et al. (2007). The assessment finds that, since the 1950s, sea levels along China's coastline have risen by 1.4 mm to 3.2 mm per year, and projects a cumulative increase in sea levels of 1 to 16 cm by 2030, and 60 to 74 cm by 2100. The report also notes that the extent of marine ice on the surface of the Bohai Sea and Yellow Sea has decreased, and that since the 1980s, the onset of spring has advanced by two to four days.

The assessment finds different climate impacts in different regions, with significant implications for forests, grasslands, wetlands, permafrost, lakes and coastal marine ecosystems. For instance, broadleaf trees are becoming the dominant species in the northeast, and forests at high altitudes are under threat. Grassland production in the Sichuan, Qinghai, and southern Gansu provinces have decreased. Since the 1960s, China's wetlands have also shrunk and their functionality has declined.

Climate change has also caused changes to the distribution of water resources across China. For instance, a decrease in runoff has been observed for China's six main rivers (the Haihe River, Huaihe River, Yellow River, Songhuajiang River, Yangtze River, and Pearl River) over the past 40 years. This is thought to be a direct consequence of reduced water resource availability in northern China, particularly the northwest, i.e. Zone 2. Desertification has been worsening across northern China since the 1960s, and in 2004 deserts covered 2.64 million km^2, accounting for 27.46 per cent of China's total territory.

In the agriculture and livestock sector, climate change is causing a reduction in the productivity of China's main food crops. China currently loses 30 million metric tonnes of food each year due to droughts alone. In the second half of the 21st century, China's annual production of wheat, rice and corn may decline by as much as 37 per cent due to the impact of climate change. Due to warmer winters, climate change is also increasing the threats posed by pests and weeds.

The living environment and house in the visited rural community in Guizhou
Photo Credit: Xu Jiayi

Since the 1990s, floods and droughts have wreaked severe damage across China, with floods causing economic losses of about 1.5% of China's GDP each year, and droughts causing annual losses of about 1% of China's GDP, according to the Ministry of Water Resources.[2] In 2007, for example, floods and 'waterlogging disasters' occurred all across the country, killing 1,230 people, destroying more than 1 million dwellings, and harming 12.6 million hectares of farmland – almost 6 million of which lost their full harvests. That same year, droughts affected 599 million hectares of farmland; 250 million hectares were 'seriously' affected, and 52.4 million had no harvest.[3] In early 2009, northern China was hit by its worst drought in nearly 50 years, which left four million people without drinking water.[4] In 2010, 2 million people were thrown back into poverty by southwest China's worst drought in 60 years.[5] Devastating floods and landslides, meanwhile, killed 3,185 people by 31 August; more than 15 million people had to be evacuated, and more than 350 billion yuan ($51.4 billion USD) in direct economic losses were tallied.[6]

The increase in the frequency and intensity of heat waves has led to a possible increase in the incidence and severity of cardiovascular diseases, strokes and other diseases. Malaria, dengue fever and other tropical epidemic diseases are also more likely to expand their range. Worsening floods have also led to more post-disaster infectious diseases such as diarrhoea, cholera, dysentery etc.

Table 1 summarises the projected impacts of climate change in China using the IPCC framework of the *Fourth Assessment Report* (IPCC, 2007).

Table 1: The likely impacts of climate change in China

Trends	Impacts on ecosystems	Impacts on water	Impacts on agriculture	Impacts on settlements
Warmer temperatures	Disease vector shifts; species range shifts	Dependence on snowmelt	Decreased yields in warm environments; increased yields in cold	More demand for energy to cool; less to warm; poorer air quality
More frequent heat waves	Wildfire risks	Increased water demand	Reduced yields in warm regions	Lower quality of life in warm areas; increased heat-related mortality
More frequent episodes of heavy rain	Landslides and soil erosion	Lower surface and groundwater quality	Damage to crops, soil erosion	Flood-related disruption and losses
More intense tropical cyclones	Altered community composition	Disruption of public water supplies	Damage to crops and trees	Damage and losses from wind and floods; insurance difficulties in vulnerable areas
Increased high sea level events	Coastal ecosystem shifts	Saltwater intrusion reducing freshwater availability	Salinisation of irrigation water	Costs of coastal protection or re-location
Areas affected by more drought	Species range shifts	Water stress	Land degradation; crop and livestock losses; more fires	Water shortages; less hydropower; migration responses

Source : Authors' summary based on IPCC (2007).

[2] Ministry of Water Resources 2012, 'Flood Control and Drought Relief in China'. http://www.mwr.gov.cn/english/fcdrc.html.

[3] Ministry of Water Resources 2008, *2007-2008 Annual Report. http://www.mwr.gov.cn/english /2007-2008.doc.*

[4] Xinhua 2008, 'Droughts put north China on red alert'. *China View,* 2 February. http://news.xinhuanet.com/english/2009-02/02content_10753141.htm.

[5] China Daily 2010, 'Lack of rain results in poverty for many'. 22 May. http://www.chinadaily.com.cn/china/2010-05/22/content_9880833.htm.

[6] Xinhua 2010, 'Floods, landslides leave 3,185 dead in China this year: MCA'. 31 August. http://news.xinhuanet.com/english2010/china/2010-08/31/c_13471818.htm.

Adaptation actions taken

The Chinese government has responded to climate change by adopting a series of programmes and establishing specialised institutions within government and in research organisations. Below we describe key actions in each realm.

Government

Institutional arrangements

At the national level, the National Development and Reform Commission (NDRC) has taken a coordination role and has assembled a multi-sectoral advisory National Leading Group on Climate Change, with representatives from ten ministries, covering science and technology, environment, energy, water resources, and agriculture, as well as the Chinese Academies of Science and of Agricultural Sciences. Every year, under the coordination of NDRC, the government releases a National Climate Action Report summarising the action taken in responding to climate change as well as any significant outcomes.

Following the leadership of NDRC, most provinces have also established their own Leading Groups to address climate change. Some have also set up a dedicated climate change department in their provincial Development and Reform Commission, in order to coordinate climate change-related work.

National strategy

In recent years, the government has moved to undertake comprehensive scientific and policy reviews and has developed a national strategic response to climate change. Both through the government's own initiatives, and in collaboration with bilateral donors and multilateral agencies, China has advanced its adaptation strategy farther than many of its neighbours.

The National Assessment Report on Climate Change, summarised above, warned that impacts would be felt across a range of sectors, "including energy, industry, transportation, agriculture, forests and water resources, in both coastal and other areas", and recommended an integrated approach to both mitigation and adaptation. Informed by the assessment, the NDRC then formulated specific guidance for adaptation strategies via the National Climate Change Programme, published in June 2007. These strategies deal with the impacts of climate change on agriculture, forests, ecosystems, water resources and coastal regions. The document provides overall guidance for local implementation of the adaptation strategies. Agriculture is a priority for adaptation, and the government at all levels is required to prioritise the improvement of agricultural infrastructure, crop varieties and distribution, adjusting cropping systems, strengthening research and development of new technologies, and bringing grassland desertification under control.

In 2010, the National Climate Action Report 2010 was released. The report emphasises that climate change adaptation should take place within the framework of sustainable development and encourages a long-term strategic perspective. It also stresses the importance of "mainstreaming" adaptation into social and economic development and identifies five key principles to be followed:

1. Take a "precautionary" approach in the face of uncertainty, establishing crisis management and disaster prevention systems and undertaking preventive measures to minimise climate risks while strengthening climate research and improving scientific forecasts;

2. Ensure that adaptation measures are appropriate, based on a comprehensive evaluation of local social and economic development, financial and technical conditions, the natural environment and the impact of climate change;

3. Coordinate adaptation with mitigation, considering the optimal combination of adaptation and mitigation measures, the strengthening of each approach, and potential synergies to promote adaptive behaviour;

4. Ensure the effective participation of a broad range of stakeholders in the process of policy formulation and evaluation of adaptation strategies; and,

5. Follow international principles of cooperation to improve adaptive capacity and help resolve cross-cutting and inter-regional problems.

Under the sustainable development framework, the national government has adopted a series of policies and/or programs to address climate adaptation in the most affected sectors, particularly agriculture, water resources, marine resources and public health.

In agriculture, the consolidation of farmland and water conservancy infrastructure is the priority. Research is invested in developing drought-resistant crops and robust species that are able to withstand water logging, high temperatures, diseases and pests.

To improve management of the country's limited water resources, the government has formulated the National Comprehensive Plan for Water Resources, the Seven Major River Basins Flood Control Plan, the National Mountain Torrent Disaster Prevention and Control Plan, the National Plan to Guarantee the Safe Supply of Drinking Water to Urban Dwellers, and the National Plan for the Eco-protection of Major Rivers and Lakes (Government of China, 2011). These documents are all formulated in the context of an intensification of climate change. In 2008, the Chinese government invested 11.7 billion yuan (US$1.9 billion) in major water resource projects, including initial parts of the South-North Water Diversion project. By the end of 2008, the supply capacity of water conservancy projects nationwide exceeded 700 billion cubic metres, which is enough to ensure water supply for urban and rural needs in a moderately dry year. China has also adopted *Administrative Measures for Water Use Licensing* to tighten the administration of water resources and encourage a culture of water-conservation.

With regards to marine resources, the national government has developed a Plan for Coastal Protection and Utilisation, the Working Plan for Investigating and Assessing the Impacts of Sea-Level Changes (2009), and a Proposal for Climate Change Monitoring (Observation) Capacity Building Projects in the Marine Sector. It also released an Annual Report on Addressing Climate Change in the Marine Area.

For public health, the government has adopted the National Health Emergency Response Plan against Natural Disasters (on a trial basis), the Emergency Response Plan against High-temperature heat-stroke (on a trial basis) and National Environment, and Health Action Plan (2007-2015).

Research

Institutions

In the two decades since the Rio Summit in 1992, a comprehensive and systematic research effort has developed within China, devoted to identifying the impacts of climate change and coping strategies and supporting policies and actions at the national level.

The China Meteorological Administration (CMA), the Chinese Academy of Sciences (CAS) and the Chinese Academy of Social Science (CASS) are among the major research institutions actively engaged in climate change adaptation research at the national level. These generate scientific knowledge and information to enhance the understanding of the decision-/policy-makers at all levels, as well as of the general public. CMA is directly affiliated with the State Council, and is responsible for climate prediction, drought and flood monitoring and other issues related to climate change. CASS focuses on social and economic aspects of climate change impacts, exploring an alternative or sustainable pathway of development. Such social and economic studies of climate change are also implemented by organisations including the Development Research Centre of the State Council and the Research Academy of Macro Economics of the NDRC.

In addition, research institutions have been set up within each administrative sector related to climate change. The CAAS and its research institutes distributed in different parts of China have become the main force behind research into the impact of climate change on agriculture, supported by the CMA. The Water Resources Information Centre under the Ministry of Water Resources, also plays an important role, and the Ministry of Science and Technology (MoST) and the Natural Science Foundation of China (NSFC) together help set priorities for state investment in scientific and technological innovation for mitigating and adapting to climate change, including capacity-building.

Most of the research conducted for the national climate change strategy involves collaborations between the different research institutions mentioned above. For example, the CAS collaborated with CMA in producing the National Climate Change Assessment Report. In addition, the CMA has released and implemented the Weather Research Plan (2009-2014), Climate Research Plan (2009-2014), and Applied Meteorology Research Plan (2009-2014). They also distributed a Comprehensive Meteorological Observation Research Plan (2009-2014), the Implementation Plan of the Climate Observation Systems in China, in an effort to promote the observation, pre-evaluation and evaluation of climate change. The CAS also collaborated with international partners to produce *Climate Adaptation in Asia: Knowledge Gaps and Research Issues in China* (Zhang et al. 2008), which took an ecosystems-based approach to climate change adaptation.

Research on adaptation options: Agriculture has been identified as the most challenging area for climate change adaptation. In the agricultural sector, research is focused on food security under different climate change scenarios.

Adaptation takes place on the ground, and its measures are ecologically constrained and thus site-specific. It is clear that the process of identifying adaptation options must draw from external, technology-based innovations and locally-developed solutions. Different processes are required to identify these different options. Stakeholders should be involved under each process. In fact, the participation of stakeholders is crucial. Most research issues have so far been framed in terms of scientific and technological issues around climate impacts and the agricultural, engineering or technical measures to address these. However, some have also emphasised the need for more action-oriented research and enabling of support for local, farmer-led, and context-specific adaptation approaches (see, for example, CAS et al. 2008).

An emphasis is being placed on the development of technical capacity to deal with the adaptation challenge. The institutions most actively involved in this process are MoST and the NSFC. A programme of agricultural technology promotion and extension has been in place for decades, based on the work of the country's Academy of Agricultural Science and budgeted for by the provincial agriculture departments. Many existing climate change adaptation measures, including water-saving agricultural techniques and changes to drought-resistant plant species, are largely a result of this system.

In addition, a number of major research projects have helped to identify adaptation options at the local level in China. One of the most comprehensive efforts to date was a study of vulnerability and adaptation in Western China (Yin, 2006) conducted as part of the Assessments of Impacts and Adaptations to Climate Change (AIACC) project sponsored by the Global Environment Facility. The AIACC project, implemented by the United Nations Environment Programme (UNEP), aimed to enhance capabilities in developing countries to respond to climate change by building scientific and technical capacity, advancing scientific knowledge, and linking scientific and policy communities.

International cooperation

China has received both financial and technical support for adaptation from international partners, although official development assistance has been phased out in China since 2006. Projects have included both research to assess climate change risks and adaptation options for agriculture, grazing lands, water resources, ecological systems, biodiversity, coastal settlements, food security, livelihoods and human health, such as a study of the Haihe River basin conducted during 2003-2006. More recently, the U.K. government has been engaged in collaborative research with Chinese counterparts in order to identify adaptation options in rural China and inform decisions on potential development assistance. Two other major international cooperations focus specifically on climate change adaptation in China:

Adapting to Climate Change in China (ACCC) – 2009-2012 is a major collaboration between China, the U.K. and Switzerland. The programme aims to support adaptation policies in a range of sectors, including agriculture, water resources, disaster risk reduction and human health. Three provinces have been selected as demonstration sites for research and to test proposed solutions, including Ningxia, the Inner Mongolia and Guangdong. Due to challenges in the identification of suitable methodologies, the programme in Ningxia has been delayed.

The Yangtze Forum[7] is a collaboration conceived by the China Council for International Cooperation on Environment and Development's (CCICED) Task Force on Integrated River Basin Management (IRBM) in 2004. It brings together government officials at the national, provincial and municipal level, key stakeholders in the region, and representatives from the World Wildlife Fund (WWF) and the Global Water Partnership.

[7] For more information on this project, see http://en.wwfchina.org/en/what_we_do/freshwater/. A summary of the *Yangtze Conservation and Development Report 2011* is available at http://wwf.panda.org/?uNewsID=203195.

Resillient agriculture
Photo Credit: Lailai Li

The first Yangtze Forum, held in 2005, called for a comprehensive and collective approach to tackle environmental and social issues in the Yangtze River basin, including climate change. Since then, as part of this effort, WWF, the CAS and other partners have published three assessments of ecosystems and developments in the Yangtze River basin, most recently in January 2012.

Impacts and responses on the ground – case studies

Climate change adaptation occurs primarily at the local level, so policies at the provincial or regional level are arguably more relevant to these actions than national policies. In addition, as mentioned, the diversity and complexity of China's ecosystems expose different regions to different climate change risks and impacts, demanding different programmes and actions. Ningxia and Guizhou (Figure 1) were selected as case study sites because of the vulnerability of their respective ecosystems. These case studies will identify and assess the needs for knowledge and capacity in climate change adaptation in the national context described in the earlier section.

Key social and economic indicators for Ningxia and Guizhou are displayed in Table 2. The data show several significant differences between the two provinces and the national average: both have significantly larger ethnic minority populations and significantly higher poverty rates; Guizhou is significantly less urbanised; and both provinces have lower per capita incomes for both urban and rural dwellers, especially Guizhou. Not shown in the data, but notable, is that 36 per cent of the population in Ningxia is from the Hui ethnic group, and are practising Muslims.

Table 2: Social economic indicators for Ningxia and Guizhou compared to the national average

	Territory (km^2)	Total population (million)	Population of minority ethnic group (%)	Rural population (%)*	Population in poverty (%)**	GDP per capita (CNY)	Income per capita (CNY)	
							Urban	Rural
Ningxia	66,400	6.3	36.8	54	17	21,777	14,025	4,048
Guizhou	176,0v00	37.7	37.8	70	13	10,309	12,863	3,005
National	9,600,000	1334.7	8.5	53	3	25,608	17,175	5,153

Source : National Bureau of Statistics of China (2010). Notes: * based on the residence registration; **poverty line: annual income of 1196CNY per person per year.

Both provinces are also included in the Ministry of Environmental Protection's Outline National Plan to Protect Ecotones due to their vulnerable ecosystems. Ningxia is surrounded by three large deserts: the Tenggeli (42,700 km^2) in the west, the Maowusu (42,200 km^2) in the east and the Wulanbuhe (15,000 km^2) in the north. The most critical factor constraining the livelihoods and well-being of local people is water scarcity. Ningxia has very low and unevenly distributed precipitation, around 167 to 600 mm annually, plus an extremely low reserve of underground water (0.3 per cent of the national total).[8] It is also accompanied by a high evaporation rate of up to 1,312 to 2,204 mm per year. As a result, the Ningxia has less than 200 m^3 of renewable water resources per capita per year, less than one-tenth of China's already low average.[9] Any reduction in water availability will intensify land degradation and desertification, which are already serious, leading to the displacement of people.

Situated on the Yunnan-Guizhou Plateau, Guizhou has a landscape defined by prominent karst features, including sharp limestone formations, caverns, subterranean streams and deep gorges. This karst geology is what makes Guizhou's ecosystems so vulnerable, as it encourages the rapid movement of rainwater through crevices into the ground (Ford and Williams, 2007). Consequently, very little surface water persists, and the development of topsoil and vegetation cover is extremely slow (Wang et al., 2004). In addition, soil erosion is common. All of these factors make the land extremely vulnerable to further degradation by human activities or extreme weather events such as floods or droughts. The result of such degradation is what is known as "rocky desertification" in Guizhou (Li et al., 2006b and Wang et al., 2004).

[8] *New Round of the National Underground Water Resource Auditing,* published by the Chinese Ministry of Land and Resources in 2003.

[9] China's per capita water supply in 2007 was 2,156m^3 per year, according to Xie, J., Liebenthal, A., Warford, J. J., Dixon, J. A., Wang, M., et al. (2008) *Addressing China's Water Scarcity: Recommendations for Selected Water Resource Management Issues.* Report No. 47111. The World Bank, Washington,D.C.http://documents.worldbank.org/curated/en/2009/01/10170878/addressing-chinas-water-scarcity-recommendations-selected- water-resource-management-issues.

Impacts of climate change

In both provinces, climate change is intensifying the vulnerability of ecosystems and livelihoods of people who directly depend on ecosystem services. Symptoms of climate change are well recognised by local people, and their impacts are documented in research. They are seen in four main areas: a) an increase in temperature, b) a change in precipitation, c) increased extreme weather events, and d) changes to hydrology and reduced water availability. Data collected via the literature review, stakeholder consultations and field interviews are summarised in Table 3.

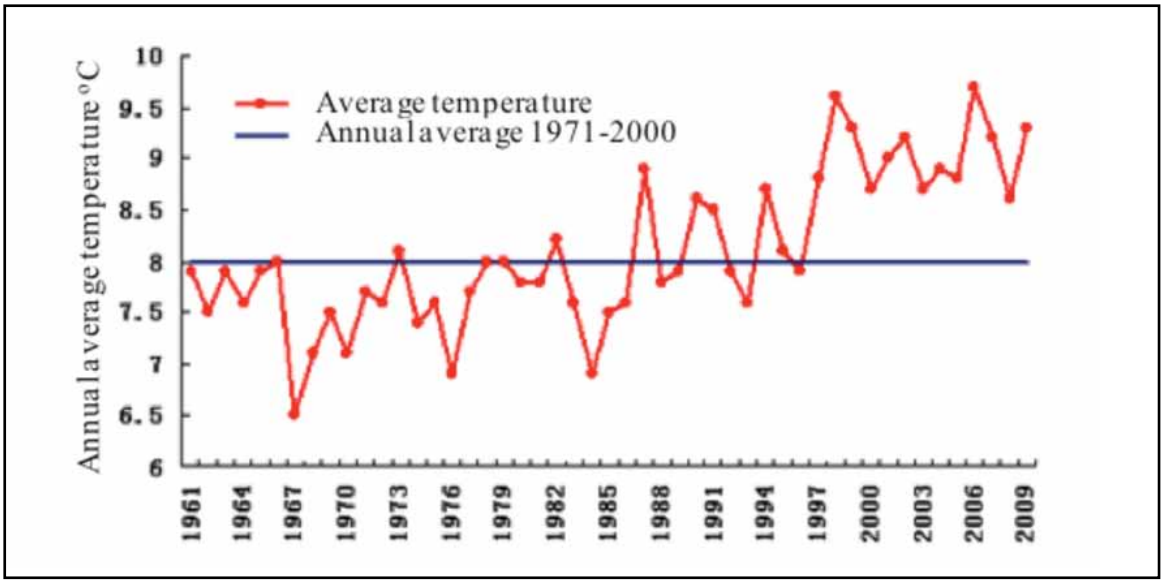
Table 3: Climate change symptoms recognised in Ningxia and Guizhou

	Ningxia	Guizhou
a. Temperature increases		
Average change over last 50 years	+1.5°C	+0.94°C
Number of warm winters over last 50 years	17	8
Projected increases	+4.4°C in summer, +3.7-3.9°C in winter by 2080	+1.6-2.0°C by 2030
b. Change of precipitation over last 50 years		
Change in volume	Reduced by 5.2 mm per year	Slightly reduced
Change in pattern	Significantly reduced or no rain in spring; increased in autumn	Increased in summer; reduced in spring and autumn
	Reduced in the central dry and southern mountain areas by 3.4 mm and increased in the irrigated plain by 3.27 mm	
c. Increased extreme weather events		
Floods	Rainstorms significantly increased in the southern mountain areas, causing damaging floods in autumn	Increased floods
Drought	Extreme drought of 5 years in a row during the 1990s	Increased droughts, including extreme drought in 1999-2011 Increased floods
d. Change in hydrology and water availability		
	Reduced amount of water allocated to Ningxia from Yellow River from 4 billion m^3 in 1999 to 3.3 billion m^3 in 2010.	Increased droughts, including extreme drought in 1999-2011 Increased floods
	Reduced total runoff of the Yellow River from 58 billion m^3 during 1950s-1980s to 53 billion m^3 in the early 21st century drought of 5 years in a row during the 1990s	

The increase in temperature in Ningxia is more in line with patterns of global climate change as identified by the IPCC's *Fourth Assessment Report* (IPCC, 2007) than that observed in Guizhou. However, both regions are seeing more extreme weather events, including an increased incidence and magnitude of floods and droughts (Wang et al. 2009, Yu and Zhou 2005). Droughts are associated with a change in the pattern of precipitation, in terms of timing and geographic location, rather than with the total volume of precipitation. Water resources are the most serious concern in Ningxia. However, corresponding information is not adequately documented in Guizhou.

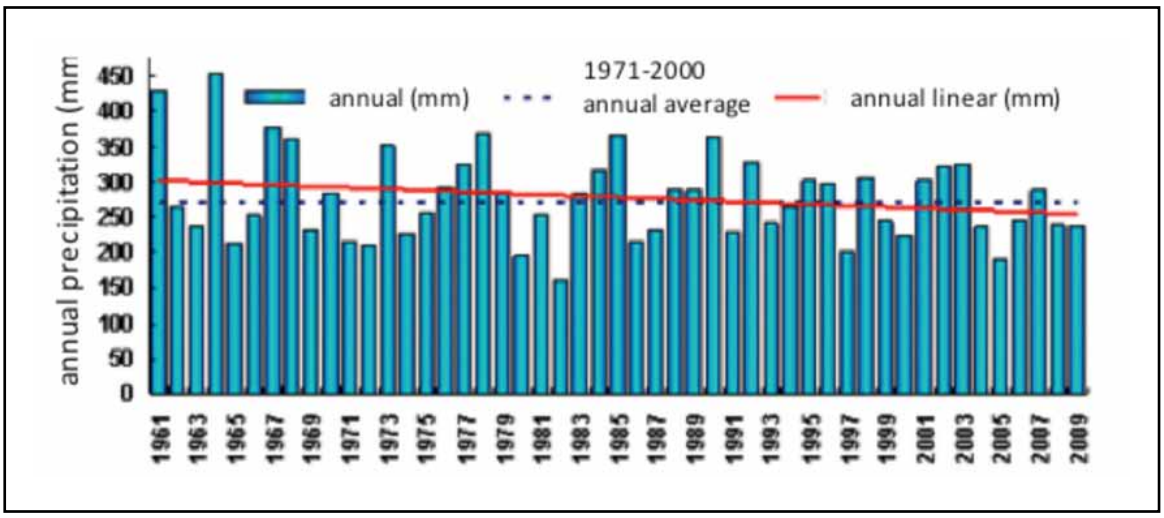
The research indicates that higher temperatures will further affect the distribution of precipitation in Ningxia. As a result, extreme weather events such as floods, droughts and hailstorms are projected to increase (Wang et al., 2009).

Figure 2: Change of average temperature, Ningxia (1961-2009)



Source: 'Climate in Ningxia', from China Weather Network Ningxia Node.

Figure 3: Change of precipitation in Ningxia (1961-2009)



Source: 'Climate in Ningxia', from China Weather Network Ningxia Node.

These climate change impacts are affecting the well-being of people in Ningxia and Guizhou. The data collected for this analysis were mapped based on five major areas in which the IPCC, the World Bank, the UNDP and the UNEP have identified high climate-related risks: 1) ecosystems, including natural resources, 2) buildings and infrastructure, 3) economic systems (including agriculture), 4) livelihoods, particularly the poor, and 5) public health. In all five categories, impacts in all these realms are visible in both provinces.

Ecosystems

Ningxia's and Guizhou's ecosystems are highly vulnerable to climate change. Frequent fluctuation between drought and flood conditions further exacerbate desertification in Ningxia. Although desertification has been largely brought under control, many areas still endure deteriorating conditions, especially those in the dry central area. Grasslands cover one third (2.5 million hectares) of Ningxia; over 90 per cent of this has been degraded by erosion due to wind and salinity changes caused by drought or floods.

In Guizhou, the vegetation defined by a karst geology is extremely vulnerable to floods and drought. Floods remove the thin topsoil, which takes a long time to form. Meanwhile, drought damages the slow-growing vegetation which holds the topsoil together. Along with intensification of water and soil erosion, rocky desertification has become a critical problem, further increasing the vulnerability of Guizhou's ecosystems.

Economic systems

Agriculture contributes to nearly 10 per cent of Ningxia's total economy and provides livelihoods for more than 3 million people living in rural areas. In Guizhou, it accounts for 14.2 per cent of the total economy. In Ningxia, 77 per cent of the farmland is without irrigation, so crops depend entirely upon rainwater. Meanwhile, as noted before, Guizhou's karst geology makes it very difficult to retain water and topsoil. In both regions, farmers and people living in rural communities are the most exposed to economic harm due to climate change impacts.

In Ningxia, drier springs have already caused a reduction in spring wheat production of 30 to 60 per cent (Ju et al., 2005, Wang et al., 2009), and they continue to cause problems with spring crops. In Guizhou, drought is the main threat to agriculture, even though there is much more precipitation than in Ningxia. The incidence and magnitude of droughts has been increasing, and when coupled with higher evaporation rates, threatens rice plantation. Three consecutive years of droughts, from 2009 to 2011, affected 3.4 million hectares of crops and resulted in agricultural losses estimated at of CNY35 billion (US$5 billion).

In both provinces, warmer winters and a warmer climate, in general, are encouraging the survival of plant diseases or insects. Simultaneously, they are also extending or reducing the growing period of different crops and thus altering the timing of their maturity (Wang et al., 2009). Systematic knowledge of the links between climate and agriculture is therefore needed in order to develop more adaptable forms of agriculture.

Buildings and infrastructure

Agricultural infrastructure, including roads and waterways for agriculture, industry and other business, are all damaged to different degrees by rainstorms, floods, frost, early thaws, or extreme dry weather. In Ningxia, increased rainstorms have seriously damaged water catchments in the valleys and cause devastating impacts on farmland, agricultural infrastructure, roads and local people's properties. In Guizhou, buildings, roads, and dams built on the karst geology are more susceptible to damage. For example, the economic losses in the flood of 2011 in Guizhou were twice those of the neighbouring Hunan province. The impacts of these disasters within the provinces are also distributed uneventy affecting the livelihoods of farmers and rural communities more severely.

Livelihoods

People's livelihoods are becoming more vulnerable to the impacts of climate change. This is well documented in the field data. Reduced water availability, increased floods and droughts, and land degradation, have all displaced people from their homes. This is particularly true in Ningxia.

The supply of drinking water has always been a problem in Ningxia. However, it has now become a problem in Guizhou. Overall, the problem has intensified over the last decade in both areas. Rainwater can no longer be relied upon as a source of drinking water. In addition, the water table is falling, forcing villagers to dig new wells as deep as 200 to 300 metres. Villagers have to buy drinking water from a well 20 km away, at a cost of 200 Yuan (US$32) per cubic metre.

Damage to agricultural production has reduced villagers' incomes, while the need to buy drinking water and build new underground water storage tanks has imposed additional costs. Many see migration as the only option.

Public health

The water supply problems are also leading to increases in water-related health problems and water-borne diseases. Extreme heat affects public health.

Table 4 summarises the climate change impacts and their effects in the five realms reviewed. The most serious problems recognised involve reductions in the availability of water due to changes in precipitation and hydrology. Most of the impacts of climate are negative, except for an increase in tourism due to higher temperatures in Guizhou.

Table 4: Summary of climate change impacts

Impacts of climate change	Damages to human well-being caused by climate change – system vulnerability				
	1) Ecosystems	2) Buildings and infrastructure	3) Economic systems	4) Public health	5) Communities and livelihoods
a) Changes in precipitation patterns	Land degradation, desertification and 'rock desertification', loss of vegetation cover		Reduced agricultural yields; crops disrupted; loss of arable land		Reduced income from farming; loss of productive land
b) Increased and intensified extreme weather events (e.g. floods and droughts)	Land degradation and soil erosion; desertification; underground water resource diminished	Infrastructure, roads, housing and other facilities damaged	Disruptions to rain-fed agriculture; damage to roads, water systems, etc.		Homes, farming facilities and other properties lost
d) Changes in hydrology and reduced water availability	Water table falling; vegetation lost	Irrigation systems less effective	Less water for irrigation, harming irrigated agriculture	Reduced water quality; increases in water-related health problems and diseases	Drinking water shortages; added costs from having to purchase water; reduced agricultural income
e) Higher temperature and unexpected temperature changes	Shift or change in distrib ution of habitats and species (forests and grasslands)		Increases in plant diseases and pests; high evaporation exacerbates water shortages; however, good for tourism	Health problems from strong heat	Cost of living increased due to increasing cost of drinking water and medical bills for health problems

Actions taken to respond to climate change

Both Ningxia and Guizhou have adopted a series of measures to cope with climate risks. However, the two provinces differ in their level of knowledge and in their capacity gaps and needs.

Role of the government

In both Ningxia and Guizhou, the provincial government plays the most important role in dealing with the impacts of climate change.

In 2010, the Ningxia government adopted the Programme of Climate Change Adaptation in Ningxia,[10] which prioritises agriculture as a key economic sector in urgent need of adaptation. It recommends several structural adjustments:

[10] From a presentation of "Impact assessment of climate change on agriculture and adapting measures in Ningxia" made by Ningxia Meteorology Research Institute at a stakeholder consultation in June 2011.

- The development of agricultural products that fit Ningxia's changing climate;
- Adapting to warmer winters by moving winter wheat production to the north and developing double-cropping systems in areas irrigated by the Yellow River;
- The partition of mountains and degraded grassland for ecological recovery, plus the launch of an ecological compensation system for the livestock sector;
- The development of high-value or value-added agriculture; and,
- The rezoning of agriculture production to incorporate three zones (the Yellow River irrigated plan, the dry central areas, and mountains in the south), as opposed to the traditional two zones (the irrigated plains and the southern mountains), developing more suitable forms of agriculture, livestock and forestry for each area.

In 2011, as a regional counterpart of the Climate Change Department of the NDRC, a Division of Climate Change was established under the Ningxia Development and Reform Commission (Ningxia DRC). The Ningxia DRC is now the top planner and program and financial coordinator for climate change adaptation within Ningxia. Of course, actions responding to the impacts of climate change were being taken by the government long before the launch of this division. However, these actions are now expected to be more coordinated and effective, as they are coordinated by a cross-sectoral department. Financially, these actions all have budgets to support and ensure the implementation of the adaptation program.

The Ningxia DRC is taking four main actions in response to climate change, all of which support one another: ecological migration (organised), the development of more resilient forms of agriculture, water resource conservation, and desertification control and ecological recovery. Each is supported financially by the government and involves an element of training.

Ecological migration started in Ningxia during the 1980s as a way to combat poverty. Over the 11th Five-Year Plan period (2006-2010), 206,800 people in about 46,800 households relocated from the dry central areas that are suffering from severe land degradation and desertification. The 12th Five-Year Plan intends to relocate 350,000 people to areas that have greater water resources. Migration is followed by the enclosure of the original villages. In the absence of human activities, land degradation stops and the process of ecological recovery begins (Box 1 and Table 5).

Box 1 : Targeted the first year income for each migrant household

This migration program is implemented by Ningxia DRC; 10,000 RMB (US$1,585) per household is budgeted. It is expected that this figure is matched by the farmers themselves in order to build a new house. Government support also includes the installation of electricity, running water and a biogas digester. In some areas, a greenhouse is provided to allow the family to survive their first year of relocation by growing fresh vegetables for sale in local markets. Farmers are also trained in the skills they would need to work in the cities. It is expected that each migrant household can make an income of RMB18,000 to 22,000 (US$2,854-$3,488) from diversified sources in the first year of resettlement (Table 5).

Table 5: Estimated income from various sources of employment

Source of income	Estimated Income (RMB)	
	Low	High
Farming	6,000	8,000
Vegetable / fruit production from greenhouses	4,000	5,000
Livestock rearing	4,000	4,000
Wage labour in cities	4,000	4,000
Estimated total	**4,000**	**4,000**
Estimated total in USD$*	**2,812**	**3,437**

* at an exchange rate of USD$1~RMB6.4

The resilient agriculture programme led by the Department of Agriculture aims to deal with the uncertainties caused by changes in precipitation patterns. Amongst the range of counter-measures proposed is the idea to replace water-intensive crops with drought-resistant species. Depending on location and natural conditions, agriculture could be replaced by livestock rearing.

Five hundred RMB (US$79) per person has been budgeted to provide farmers with training to cope with the uncertainties caused by climate change. Existing agricultural technology extension systems are being utilised to implement this. Infrastructure development is being considered, and flood catchments in mountains are being reinforced.

Water conservation is the responsibility of the Department of Water Resources. At the regional level, this involves the development of water-saving agricultural practices. Drip irrigation coupled with plastic films is promoted as a means to preserve soil moisture and water resources. In areas irrigated by the Yellow River, the government finances water-saving facilities. In 2009, a price for water used for irrigation was established as an incentive to conserve water. However, as the price is far below the true cost, which is approximately RMB10/m^3 (US$1.50/$m^3$), the water pricing policy has not been very effective.

Desertification control focuses on the ecological recovery of highly degraded areas and is part of the national ecological reconstruction programme, formally launched in 2000. Under this programme, an eco-compensation package was adopted, one of the largest payment for ecosystem services (PES) schemes in the world (Zhang et al. 2010). At the national level more than US$15 billion has been spent since 1999 on the conversion of cropland to forest and grasslands. In summary, the program pays farmers to retire from farming and re-plant grasses on their sloping and marginal land. In addition, almost US$2 billion has been invested in the forest ecosystems compensation fund, which pays households, communities, and local governments to protect key forests areas. The scheme now covers 44 million hectares and is found in every province in China. The enclosure of degraded mountains and grassland has also been introduced to allow for the recovery of vegetation. 70 per cent or 1.8 million hectares of grassland have been enclosed, which has improved the amount of vegetation by 20-30 per cent. Villages that have been abandoned in Ningxia have also been enclosed for the same reason.

The government of Guizhou established its provincial climate change group as part of the provincial Climate Change Programme, adopted in 2008. The province's governor heads the group, which also includes representatives from 21 government departments. This is the focal point for the National Climate Change Leading Group headed by the Premier. An expert group has also been established to provide policy and technical support and advice for the leading group.

The responsibilities of the Guizhou Climate Change Leading Group include:

- To conduct research to identify major climate change strategies, guidelines and actions.
- To coordinate the response to major climate-related issues.
- To supervise and evaluate the implementation of climate change objectives and related work.
- To coordinate work between various government departments and industry on climate change-related issues.

The key areas identified for climate change adaptation in the Climate Change Programme include the development of more resilient forms of agriculture, improved water resource management and conservation, improved forest management, and improved emergency and disaster management, including forecasts of extreme weather events.

The Guizhou Development and Reform Commission (DRC) is responsible for the strategic planning of climate change and related policies, following the guidance of the Guizhou Climate Change Leading Group. Currently, water resource development and conservation is one of the programmes led by the DRC.

The Chinese Meteorological Administration has made a significant investment in research and improving the national weather forecasting system, and in 2011, it set up five projects relating to forecasting disasters and building the capacity for disaster management. It has since established weather observation stations at the village level throughout Guizhou.

Role of communities

In Ningxia, government programmes are largely implemented at the community level by villagers, and led by the village development committee. It is common for communities to need time to understand the government programmes, so implementation can be slow. The most widespread adaptation programmes are to develop more resilient and water-saving forms of agriculture. With financial support from the government, villagers have built rainwater harvesting and storage systems and biogas digesters in their courtyards. They have also constructed water conservancy and drip irrigation systems. Villagers also attend training on new farming techniques. As their sources of income are shrinking, many farmers move to urban areas to find jobs or to start small businesses. In the beginning, ecological migration is rather difficult as few people are willing to leave their homes.

Unlike the situation in Ningxia, in Guizhou, although impacts of climate change have caused many problems, people haven't taken adequate actions to cope with the impacts of climate change. For example, droughts have reduced crop yields and threatened the supply of drinking water. Despite this, the communities studied did not indicate that they had thought about taking action to deal with these problems. However, Guizhou's communities do not have the skills or techniques to deal with the impacts of climate change and without government subsidies cannot afford any infrastructure development. In one village visited, located beside Hongfeng Lake, villagers could not afford to build a pumping system in order to irrigate their vegetable fields.

Research and development

Quite a few researchers have studied the impacts of climate change on Ningxia. They have focused on climate impacts under different scenarios, and on the impacts of climate change on agriculture, food production, water resources, vegetation and desertification. However, there is no institutional arrangement in place to share this knowledge to facilitate regional climate change adaptation. In stakeholder consultations and field interviews, almost no one spoke about the uncertainties surrounding long-term climate change impacts. Our literature reviews also found no comprehensive analyses and forecasts of climate change impacts in different climate scenarios.

The R&D system of the Chinese Academy of Agricultural Science is a long-standing national agriculture technology extension system established in the 1950s. It still plays a very important role in transferring new knowledge, technologies and techniques to villagers today and is funded by the Department of Agriculture at the national and or provincial levels.

Adaptation strategies such as shifting the seasons in which different crops are grown, introducing water-saving agricultural techniques, and planting drought-resistant species are promoted largely through the agricultural technology extension. In addition, local hydrology observation stations and weather observatories have been set up at the community level to provide much-needed information. Further expansion of the observation system has been urged by the local governments. However, there is a lack of cross-department/sector coordination to cope with climate change.

Scientific research on climate change impacts in Guizhou has focused on identifying different scenarios, on the impacts of climate change on agriculture, water resources, vegetation, and rocky desertification, and on the interaction of climate change with karst geological processes. However, as in Ningxia, there is no special institutional arrangement to ensure that this knowledge is used to support regional climate change adaptation. Guizhou does have an agricultural technology extension system, and local hydrology observation stations and weather observatories have been set up at the community level. The expansion of this network is ongoing, under the Bureau of Meteorology.

Role of private sector

In Ningxia, the private sector has invested in the development of water-saving agricultural practices. In the county of Tongxin, one of the driest areas in Ningxia, villages of 133,000 people have had to relocate. The vacated villages and the surrounding farmland were then enclosed to allow the environment to recover. In one such area, Shengfeng Jujube Plantation invested in the planting of jujube (fruit) trees or bought the trees from the villagers who relocated. Dry conditions, high levels of sunshine, and efficient plantation techniques have resulted in a quality fruit crop. The company now has a 156,000 hectare plantation and plans to expand. Another company is following this example, but produces value-added jujube products instead of fruit. The company plans to farm 100,000 hectares in Ningxia in total and 30,000 hectares in of Tongxin County alone.

The government supports private-sector involvement in climate change adaptation by providing permits for land use, water supply and the provision of seedlings. However, the private sector needs more direct support from the government, including finance.

There has been some policy debate around the issue of the transfer of water use rights from farmers to water conservancy project investors. Water distributed or allocated from the Yellow River to Ningxia is prioritised for agriculture, rather than for industry, in the form of water-use rights with a very low concession price (gravity irrigation 0.0305RMB/m^3; pumping irrigation 0.137RMB/m^3).[11] A policy of allowing the transfer of water use rights is meant to encourage industrial companies to invest in water-saving facilities and systems in exchange for the right to use the water saved. However, the Ningxia Department of Water Resources has concerns about the possibility that farmers might lose their water-use rights in the long run, and about the prices being too low for industry. The water price is heavily subsidised in order to support farmers and agriculture; the actual irrigation cost of using the Yellow River water is 10RMB/m^3 (US$1.50). This is of concern for both equity and economic reasons. Very little economic assessment of the water use rights and the transfer of such rights to encourage investment has been conducted.

There is little evidence of active participation of the private sector in climate change adaptation in Guizhou. One explanation is that adaptation is still a new policy area, and opportunities for the private sector are currently either underdeveloped or still being explored. Guizhou's private sector will need time to develop strategies to respond to the adaptation challenge. In contrast, mitigation is a familiar concept, and advanced market mechanisms are being established. In July 2010, the Guiyang Environment and Energy Exchange was established in Guizhou's capital, covering issues such as emissions trading, pollution permit trading, ecological compensation, technology trading for energy conservation, etc.

Non-governmental organisations

There are more than fifty NGOs in Guizhou, making it one of the most active civil societies in western China. Some work on climate-related issues, but the vast majority of this is focused on mitigation rather than adaptation. Our research suggests adaptation is still a quite new concept for many NGOs in Guizhou. However, it should be noted that much of the capacity-building and awareness-raising that these NGOs undertake also contributes significantly to adaptation efforts.

For instance, the Guizhou Association of Community Development and Rural Governance focuses on disaster management and the sharing of information with rural communities. In communities around Hongfeng Lake, which is an important freshwater resource for Guiyang, the organisation is promoting organic farming as a means to conserve water and soil in the dry season. In other parts of Guizhou, the organisation is conducting adaptive agriculture projects that shift paddy fields to dry farmland, and promote the use of early-maturing crop varieties. To assist in this adaptation to farming, the organisation is undertaking a project to plant local varieties of crops, which they have found consume less water and mature more quickly than the crops from popular seeds sold in the markets. To protect against intensive storm-induced flooding in summer, the organisation suggests that local communities shift from focusing just on agriculture, to combining agriculture and animal husbandry.

Both Guizhou Green Home and Guizhou Ren have climate change education projects with minority ethnic communities in southeastern Guizhou. These projects take into account social and cultural concerns. Given that ethnic groups reside in the areas most affected by climate change, cultural considerations play an important role in adaptation programmes. In particular, local ethnic groups have a unique relationship with the environment. Some of these cultures imbue elements of the environment, such as animals and trees, with a spiritual importance thus ensuring their protection. Therefore, NGOs have begun to differentiate in their approaches in adjusting adaptation measures to local culture.

Interviewing people in local community
Photo Credit: Xu Jiayi

In Guizhou, the work of NGOs in rural areas is highly regarded, and viewed as more important than that of the local government, particularly when villages are experiencing difficult periods. However, all the NGOs interviewed expressed their strong need for further capacity-building in climate -related issues, especially for adaptation information and technology.

There are not as many NGOs in Ningxia as there are in Guizhou. There are several engaged in rural community development and poverty reduction, which are very active. They provide poor rural communities with technical support for household biogas development, rainwater harvesting, and resilient agriculture. However, in Ningxia, government is taking the lead in adaptation, while NGOs play only a supporting role.

[11] The notice of water price adjustment of Yellow River Irrigation area in Ningxia, 2009.

Outline OF KNOWLEDGE GAPS

Climate change often affects the poor most severely, and socio-economic factors can limit people's capacity to adapt. This has led the UNDP-GEF (Global Environment Facility) adaptation programme to link its strategy to the Millennium Development Goals. Under this approach, pro-poor and pro-growth adaptation aims to encourage low-emission, climate-resilient development. The approach emphasises that development planning should take account of the anticipated impacts of climate change, i.e. mainstreaming climate change adaptation in development strategy (UNDP-UNEP, 2010).

Using this framework, our analysis identified knowledge needs and gaps in three categories:

1. Knowledge/information generation, access and interpretation to support development-oriented adaptation planning at all levels:
   - Assessment and communication on current climate trends and projected future climate change across Guizhou and Ningxia and their impacts on ecosystems, economic systems, built systems, public health and people/communities;
   - Vulnerabilities of regional/local natural systems and communities to current or projected climate related impacts, including hot spots;
   - Climate-related risks on specific sectors, agriculture and disaster management in particular for Guizhou and Ningxia;
   - Data generation, database, and computer-based information systems, information sharing platform and decision-making support systems, to support decision/policy-making at different levels;
   - Observation and forecast systems for extreme weather events with stations based in each community with the capacity to collect and distribute information; and,
   - Availability of data regarding existing water catchments, consolidation.

2. Methods for identifying and assessing potential adaptation strategies:
   - Building climate change and impact scenarios;
   - Assessment of the economic and social impacts of climate related disasters and climate change under different scenarios;
   - Applying a 'real options' approach wherever appropriate, in order to deal with climate risks;
   - Vulnerability assessments to identify hot spots of natural systems and human settlements;
   - Scenario-based development planning; and,
   - Downscaling methods, to collect community-specific evidence for local vulnerability and adaptability.

3. Human resource and policy context, including appropriately skilled people and institutional setups:
   - Interdisciplinary expertise for knowledge/information generation;
   - Climate change communication expertise;
   - Information and communication technology expertise to organise and distribute knowledge and information; and,
   - Capacity to track adverse climate-related health problems.

Table 6 examines these gaps against the known climate risks in the two provinces.

Drought of nine years in Ningxia
Photo Credit: Lailai Li

Table 6: Preliminary needs assessment

Identified needs and proposed actions	Focus of needed actions	Eco-system	Economic system	Buildings and infrastructure	Public health	Communities and livelihoods
Generate, access and interpret knowledge and information	Climate change impacts, trends and projected future	*	*	*	*	*
	Vulnerabilities of natural systems and communities	*			*	*
	Climate -related risks on specific sectors		*	*	*	*
	Weather observation at community leve					*
	Inventory of water catchments			*		
	Data, information sharing and decision-supporting system	*	*	*	*	*
Methods for identifying and assessing potential adaptation strategies	Scenario building	*	*	*	*	*
	Economic and social impacts assessment	*	*	*	*	*
	Downscaling to community-specific evidence					*
	Scenario based development planning		*			
	Vulnerability assess to identify hot spots	*				*
Human resource	Interdisciplinary expertise	*	*	*	*	*
	Climate change communicators	*	*		*	
	Capacity to track climate-related health problems				*	
	Information/communication technology expertise	*	*	*	*	*

Recommendations

Based on the analysis of needs and knowledge gaps, we offer several recommendations for the governments of Ningxia and Guizhou, which have a crucial role to play in enhancing the understanding and capacity of climate change adaptation in both regions.

A regional centre for climate change adaptation

Science-based advice for decision-makers is essential for adaptation planning. Establishing a new centre for climate change adaptation will provide governments, industry and the community with clear and reliable information in order to assess risks and develop adaptation strategies. The centre would need to have a strong focus on the needs of decision-makers at regional and local levels and would synthesise and communicate existing and emerging knowledge and information for adaptation. Its central role would be to strategically focus research efforts in areas of mutual benefit, link existing research organisations and coordinate multidisciplinary and cross-sectoral investigations.

The centre would have a key role in filling the current information and knowledge gaps. The centre would also synthesise knowledge, coordinate and commission research activities, broker research partnerships, and provide information for decision-makers in a form relevant to their sectoral or regional needs. The centre would have the following objectives:

a) Deliver knowledge and information to support climate change adaptation decision-making at the national, regional and/or local levels and via the coordination, integration, synthesis and communication of research;

b) Conduct integrated impact and vulnerability assessments of priority vulnerable sectors (ecosystems, economic systems, buildings and infrastructure, health, and livelihoods and communities);

c) Coordinate regional and national adaptation research resources to more effectively support climate change decision-making, including brokering research partnerships and providing a vehicle to commission new research;

d) Build the capacity of the provincial research communities to generate information relevant to decision-makers, and link these communities to research institutions at the national level;

e) Establish an interface between researchers and decision-makers;

f) Promote coordinated work programmes on impacts and adaptation across the provinces, working in collaboration with stakeholders and other researchers in national, regional and sectoral contexts, and;

g) Deliver capacity-building programs and incorporate climate change into existing training programmes.

Regional climate change and vulnerability information

Scientists have generated vast amounts of information about how the climate is changing in Ningxia and Guizhou and the broad impacts these changes may have. However, decision-makers require more detailed information concerning future projections of climate change, particularly of extreme events, social and economic trends that affect climate change vulnerability, and the social and economic impacts of climate change.

Thus, it would be valuable to establish an information system, which could be implemented by the new centre for climate change adaptation and linked to national information networks, in order to develop and widely communicate information and knowledge for regional assessment of vulnerability and climate change impacts and risks. This information system should include the following elements:

- An analysis of social and economic data and trends in order to assess factors likely to influence vulnerability to climate change. Socio-economic scenarios could also be developed to provide decision-makers with possible future scenarios to assist in the assessment of risk and developing adaptation strategies within appropriate planning timeframes;
- Research to identify the social and economic costs of climate change, including the cost of not taking adaptation action;
- Development of improved projections of regional climate and extreme events; and,
- Improvement of regional climate modelling and down-scaling techniques.

Communication, information and tools

Decision-makers need accessible and robust information, tools and guides. It is necessary to make existing knowledge widely available and meet the information needs of decision-makers. The understanding of potential climate change impacts can be facilitated by computer-based information and communication technologies. Regional information systems set up in Ningxia and Guizhou should therefore be interfaced with national systems. Information collection from different sources, tools for analysis and planning, and communication mechanisms should be considered in the system design. Suggested potential areas of action include:

- Develop and implement a comprehensive communications strategy to raise awareness of the impact of climate change and the advantages of early adaptation, including partnerships with key national professional and interest groups to develop best practice networks;
- Develop and promote tools for adaptation planning tailored to the user's requirements. These would include:
  - Decision-support tools such as methods for assessing the costs and benefits of adaptation strategies, and guides for risk management;
  - Methods for understanding social impacts;
  - A regional 'one stop shopping' website where decision-makers and their advisers can access information about climate projections, likely climate change impacts, tools, guides and approaches to adaptation planning,
- Conduct training for users and sources of information and knowledge. Trainees should include decision makers, practitioners and technical experts; and,
- Develop a regional (linked to the national) digital elevation model (DEM) for the whole of Ningxia, with vulnerable regions mapped using high-resolution images. This would involve spatial and temporal information of landscapes or land cover at a resolution relevant to decision-making.

International connections and partnerships

Ningxia has formed international partnerships on climate change. Among them is the Adaptation to Climate Change in China (ACCC) programme. There is no such programme in Guizhou. This international collaboration can provide an opportunity to launch detailed vulnerability and climate change impact assessments and has helped to enhance the regional capacity of climate change adaptation. Therefore, it is suggested that active participation in international collaborative initiatives or programmes on climate change will be beneficial to both provinces.

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Last to migrate
Photo Credit: Lailai Li

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Annex

Guide questions for in-depth interviews

The questionnaire is developed based on the "Generic in-depth interview guidelines for RKP", targeting two major players – government at provincial and local levels and practitioners including communities and development organizations, e.g. NGOs.

To government:

1. Perception of climate change and adaptation
2. Knowledge needs in actions (policies, institutions, programs, knowledge or information)
3. Technologies and South-South collaboration
4. Adaptation information and knowledge management (IKM)

To practitioners (including research institutes, communities and NGOs):

1. Perception and experiences of climate change impacts
2. Perception and experience of climate change adaptation
3. Role of your organisation in adaptation and actions taken
4. Knowledge needs and gaps in climate adaptation in your region/ area of work?
5. Capacity building needed the most?
6. Examples of successful practice of adaptation to climate change.
7. Please share any adaptation IKM activities of your organisation, if any.

Old home of migrant farmers
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