

Strengthening Disaster Preparedness of Agricultural Sector in China TCP/CPR 3105

Final Technical Report



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Major Abbreviations and Acronyms

ADPC	Asian Disaster Preparedness Center
BCC	Beijing Climate Center, National Meteorological Administration
CIAD	Center for Integrated Agricultural Development
CDRLC	County Disaster Reduction Leading Committee
CDRM	Community Disaster Risk Management
DRM	Disaster Risk Management
EWS	Early warning system
FAO	Food and Agriculture Organization, United Nations
FC	Farmers Cooperatives
FO	Farmers Organization
GDP	Gross Domestic Production
IDNDR	International Decade of National Disaster Reduction
LOA	Letter of Agreement
LTO	Leading Technical Officer, FAO
MOA	Ministry of Agriculture, China
NPD	National Project Director
PECP	Public Emergency Contingencies Plan
PMO	Project Management Office
PSC	Project Steering Committee
RADAR	Rapid Agricultural Disaster Assessment Routine
RMB	Renminbi Yuan
SDPAS	Strengthening Disaster Preparedness in Agricultural Sector
SDRC	State Disaster Reduction Commission
TCP	Technical Cooperation Project
TOR	Terms of Reference

1 ha=15 Chinese mu

1 USD=6.8 Chinese Yuan

Executive Summary

Agriculture is among China’s most vulnerable sectors to the impacts of natural and meteorological hazards. According to national statistics, the annual average economic loss caused by natural disasters in the country reached 176.2 billion Yuan/year, which is about 2.0-6.0% of the annual GDP; and 380million people/year on average are affected by disasters.

The Project “Strengthening Disaster Preparedness of Agricultural Sector in China (TCP/CPR 3105)” was implemented from August 2007 to December 2009 in Juye County Shandong Province. The Chinese government counterpart institutions included: (i) Ministry of Agriculture (MOA) as the lead national counterpart; (ii) the Shandong Provincial Department of Agriculture; (iii) the Juye County Government of Shandong Province. The project supported the implementation of China’s new policy framework and priorities set in the new government legislation on natural disaster prevention (2005). The overall project objective was to assist the MOA, on a pilot basis in Juye, in testing and operationalizing the shift from an emergency response oriented approach towards the new policy framework, which gives equal importance to disaster risk prevention and preparedness.

The agricultural sector at county level was used as entry point to lead the project’s pilot implementation process in collaboration with other sectors and partners. The county level government agencies who participated in the project were: Agricultural Bureau; Water Resource Bureau; Meteorological Bureau; Fishery Bureau; Land Administration Bureau; Bureau of Civil Affairs; County All China Women’s Federation; Livestock Bureau.

A variety of sector and sub-sector specific field activities were implemented and consolidated by the project into an integrated planning framework for enhanced disaster risk reduction and management in Juye County.

Disaster Risk management activities promoted by the project in Juye County

Components	Main activities
Agricultural Sector	<ul style="list-style-type: none"> ▪ Soil improvement measures <ul style="list-style-type: none"> ○ Soil specific fertilization strategies for soil rehabilitation ; ○ Field levelling; ○ Deep ploughing of alkaline soil; ▪ Agronomic measures <ul style="list-style-type: none"> ○ Homestead gardening for income generation and mitigating vulnerability to drought impacts ○ Demonstration and dissemination of more hazard tolerant crop varieties/cropping patterns; ○ Capacity building for extension officers to enhance their skills for DRM in the AG sector;
Water Sector	<ul style="list-style-type: none"> ▪ Culvert construction including drainage canals ▪ Installing water pumps for irrigation¹ (drought management) ▪ Village-level drainage cleaning
Fisheries/Aquaculture Sector	<ul style="list-style-type: none"> ▪ Demonstration of aquaculture ponds with elevated earth walls in flood prone areas; ▪ Monitoring system for aquaculture ponds;

¹ This activity was not conducted; the original budget was shifted to building the culvert according to the modification made during the visit of Dr. Stephan Baas in May 2008.

	<ul style="list-style-type: none"> ▪ Involvement of the fishers management bureau into the county level DRM planning framework;
Early Warning System (EWS)	<ul style="list-style-type: none"> ▪ Planning of enhanced EWS to match farmers' information needs ▪ Instalment/downscaling of weather information from the national level to the county and community level; ▪ Assessment of value added when using crop yield forecasting and damage assessment information tool; ▪ Improving access to basic market information provision of simple.
Farmers Cooperatives (FC) Development for DRM	<ul style="list-style-type: none"> ▪ FC management training ▪ Supporting FCs formal registration; ▪ Supporting FCs participation in village level planning for DRM ▪ Conducting project pilot activities for DRM through FCs
Gender Mainstreaming in DRM	<ul style="list-style-type: none"> ▪ Mainstreaming women's participation in DRM capacity building and mitigation process; ▪ Women's participation during disaster preparedness; ▪ Planning relief operations for women during emergency response; ▪ Involvement of women in the disaster rehabilitation planning;
DRM planning framework	<ul style="list-style-type: none"> ▪ Participatory land use planning to reduce vulnerabilities ▪ Establishing an integrated cross-sectoral DRM planning framework and DRM plans at county level; ▪ Capacity building for county level staff on the DRM approach and operationalization and institutionalization;

Project findings strongly confirm that proactive disaster risk management contributes to poverty alleviation and agricultural development. It needs to be actively promoted by policy makers and field practitioners at all levels and further up-scaled and mainstreamed at all levels. This is particularly important in the context that the observed increase in frequency of natural hazards and damage are considered first signs of the impacts of climate change. The exposure to losses from hazards is likely to worsen, if no effective interventions are set in place. It is therefore recommended that the outcomes and DRM models tested by the TCP project should be further applied and up scaled in other prefectures of the Shandong province and other Chinese provinces, and used to prepare project proposals for international cooperation in fighting climate change

Up-Scaling and Implementation of DRM in the County of Juye

- A draft DRM framework was developed for Juye with the participation of all relevant governmental line agencies at county level and involvement of township officials and village representatives. Before further practical replication it, however, will need further consolidation and buy-in by local and county level stakeholders;
- For implementation of any DRM strategy, multi-stakeholder participation and cooperation is a pre-condition. The Juye county government and the county governor must continue to take a pro-active coordination role to ensure implementation with wide stakeholder participation and good coordination.
- For the daily coordination of DRM implementation, each line agency should have a liaison officer;
- The technical tools tested by the project, such as the early warning and information dissemination mechanisms, FC development, land use planning, and gender

mainstreaming, should be adopted by the relevant line agencies. All management and technical staff involved in DRM implementation should get further training in order to enable them to apply the recommended methods and tools;

- A monitoring and evaluation (M&E) system and DRM implementation supervision mechanism should be developed and systematically operated to ensure that the DRM approach will be effectively implemented at all levels. A set of indicators, methods and tools for M&E and implementation supervision still needs to be developed.

Up-Scaling and Replication in the Shandong Province

- All the new concepts tested in this project can be scaled up and replicated in other areas of the Shandong Provinces, taking into account the differing local ecological and social economic conditions. The main concepts are the shift from disaster response and relief to resilience capacity building, migration and preparedness; community participation in DRM; gender mainstreaming in DRM; and integrated land use planning and water resource management.
- The new concept and management methods should be added into the existing County and Provincial Public Emergency Contingencies as annex or amendments documents.

Replication in other provinces of China

- The developed systematic DRM framework and tested concept and procedure guidelines could be replicated in all provinces of China;
- The technical guidelines and countermeasures for flood disaster management could be replicated in the Hui River catchment area in the provinces of central China, such Henan, Anhui, Jiangsu, Hubei. However, the local social economic conditions, micro-climatic conditions and geographical conditions of each specific area should be taken into account.
- Finally, the technical concept and methodological guidelines as described above could be incorporated into the national disaster management policies. These could be also incorporated into the relevant national laws and regulations.

1. INTRODUCTION

1.1 Background

Although the share of national agricultural GDP has declined to 12.5% (2006), agriculture is still playing a crucial role in China for the production of sufficient food for about 1.3 billion people. Agriculture employs about 250 million labourers in the whole country. China's diverse ecological and geographical conditions in combination with high population densities make agriculture one of the most vulnerable sectors affected by both hydro-meteorological and geophysical hazards. According to national statistics, the annual average economic loss caused by natural disasters in the country in recent years is 176.2 billion Yuan/year, which is about 2.0-6.0% of the annual GDP; and 380million people/year on average are affected by disasters. Despite of the quick economic development, natural disasters are becoming a major constraining factor for overall development and are a main reason for poverty in areas with face high frequencies of natural disasters.

Responding to the high levels of risk exposure and challenges, the Chinese government has formulated a new national policy and strategies for disaster reduction and management. The new National Policy identifies improved disaster preparedness and mitigation as a clear priority, complementing the disaster response activities, which in the past were pursued as the only way to cope with disasters. However, while the Government has set these new priorities it remains a challenge to thoroughly translate this policy shift into systematic action within programmes, projects and operational strategies, in particular at the grass root level. A strong, country-wide signal to implement the policy shift was already set by the government in the aftermath of the Sichuan Earthquake in 2008, by the request to establish throughout the country contingency plans for public emergencies at the county level. A crucial next step will be to include community based disaster risk management mechanisms into these county emergency contingency plans and strengthen local capacities to implement enhanced DRM approaches in close partnership with government. Government line agencies through their outreach into rural areas must take a proactive role in promoting the implementation of the policy shift, including within agriculture. It is important that these new processes of disaster risk management are planned for and undertaken within the context of addressing overall vulnerability.

At present, however, not much practical experience has been made yet how to operationalize this policy shift at local level; and local level technicians have very limited practical knowledge and skills yet about the new disaster risk management policy and its implementation in partnership with local actors. Therefore, it is very important that the MOA, in conjunction with other line agencies, increase their capacities which would enable them to implement the policy shift at county, township and village levels.

The Chinese Government has thus requested that the FAO's Technical Cooperation Project (TCP) assists the MOA in testing the operationalization of the shift from emergency relief towards a more preventive and mitigating natural risk management strategy for the agriculture sector on a pilot basis. Juye County in the Shandong province was selected a pilot area since this country it is recurrently affected by floods, strong winds and hailstorm, water stagnation, and droughts. The project should help increase the county's capacity to better cope with

natural hazard risks, by being more proactive, preventive and effective. The government committed to the replication of the project approach elsewhere, if successful, with its own resources.

1.2 Introduction of project area

Juye, the selected pilot county for the project, lies in the southwest of the Shandong province, P.R. China, and is located in the lower reaches of the Yellow River; The county occupies 1,308 sq km, of which, 76,455 hectares are arable land. Juye is a traditional agricultural county. Animal husbandry, cotton, vegetables, fast growing forests, and fruits are its main products. The county has 16 townships and an Economic Development Zone with a total population of 930,000 spread among 866 administrative villages. More than 90% of the rural people depend mainly on agriculture and migrant work for income.

Juye’s natural geographical location, however, is a disadvantage because it is a plain area lying in a topographical depression zone, being at the same time exposed to high annual and seasonal rainfall variability. Both factors together make the county highly vulnerable to natural disasters such as floods, droughts, strong winds and hailstorms. The timing of natural calamities has become more and more unpredictable and their intensities have increased often resulting in huge losses in the agricultural sector and increasing vulnerability to food insecurity. The last ten years were characterized by 6 droughts and 4 years of flooding. The weather is also very variable, especially during the growing period of major crops.

The following map indicates the administrative division of the county of Juye, its location in Shandong. The red points indicate the location of the TCP pilot villages.

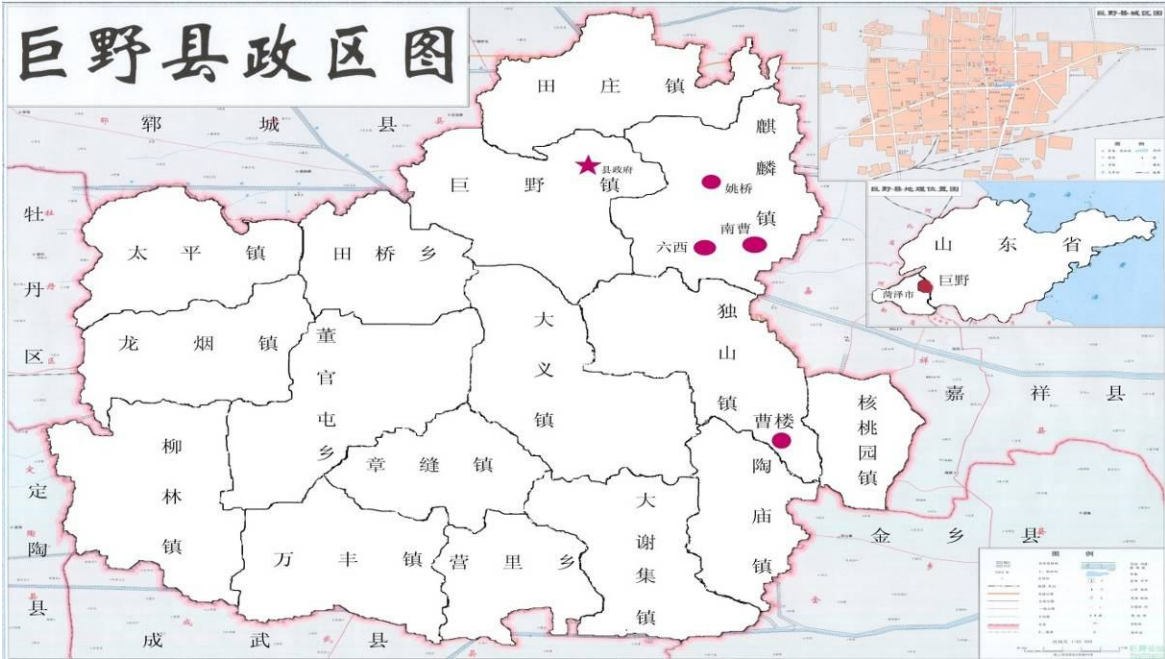


Diagram 1-1 Map of Juye and its location in the Shandong province

1.3 The Project

Within the framework of the National Policy and priorities of the Government's new legislation on natural disaster prevention (2005), the overall objective of the project Strengthening Disaster Preparedness of Agricultural Sector in China (TCP/CPR 3105) was to assist the MOA, on a pilot basis in the county of Juye, in testing and operationalizing within the agricultural sector the shift from an emergency response oriented approach towards the new policy framework, which gives equal importance to disaster risk prevention and preparedness. Determined by the hazard context of Juye the project focused mainly on two types of disasters: floods (combined with water logging) and drought

The project aimed at achieving three main outputs:

- Output 1: An improved early warning system for flood and drought disasters and a better agriculture and market information system (from provincial to village level);
- Output 2: The preparation of an enhanced operational disaster risk management plan at county level with a focus on natural disaster risk prevention and preparedness;
- Output 3: The establishment and empowerment of farmer organizations in order to enable them to contribute as local partners to the DRM planning; and implementation of good practice demonstrations for enhanced risk reduction at village level;

The intended long-term project outcomes were to contribute to the:

- Reduction in the economic losses of farmers due to the impacts of recurrent natural disasters, and building of their capacities and resilience so that they can mitigate future impacts from natural calamities;
- Reduction in environmental degradation (alkalization of soils) by enhancing the operational capacities and coordination mechanisms for risk prevention and management at county, prefecture and provincial levels;
- Improvement of farmer's livelihoods overall, which is the most important outcome.

The project design was built on the following basic principles: i) to work in a participatory, process oriented way; ii) to build on what already exists, such as local knowledge, available training materials, existing institutions and organizations, and successfully practiced risk adaptation techniques/methods in China or elsewhere; iii) to ensure complementarities of actions and links with all stakeholders in disaster risk management at local, county and provincial level.

If successful, the project was supposed to offer good practice examples and guidance for further replication in other high-risk flood and drought prone areas of China

2. PLANNING THE IMPLEMENTATION PROCESS

The TCP technical assistance project adopted bottom up and participatory working methods and approaches during the implementation of the whole project. The following steps outline the approach followed to achieve the project outputs:

- Step 1: Conducting an in-depth situation analysis to understand the agro-ecological and socioeconomic features of the project areas by using participatory baseline survey methodology;
- Step 2: Analysing the current DRM mechanism, early warning system and disaster emergency response system of Juye through institutional interviews and community surveys;
- Step 3: Multi-stakeholder involved DRM planning. The TCP intervention priorities and work plans have been formulated based on the findings of step 1 and step 2. The planning exercise was conducted using a participatory and interactive method. Multi-stakeholders, such as the leaders of Farmer's Cooperatives (FC); community representatives; township officials; and officials and technicians from agriculture, water, meteorological, and fishery sectors, participated in the planning stages.
- Step 4: Pilot the DRM related actions at the village level. The TCP activities included the building of culverts, cleaning of community drainage canals, and capacity building for technicians and farmers' cooperatives;
- Step 5: Development of village and county DRM plans with the participation of villages and different governmental line agencies at county level.

2.1 Situation and vulnerability assessment for DRM in Juye County

In September 2007 and June 2008, the Centre for Integrated Agricultural Development (CIAD) carried out a baseline survey about the socio-economic and agro-ecological context of the county, its local farming systems and practices, and peoples hazard and risk exposure. A farmer's livelihood analysis and an assessment of the functions and roles of farmer's cooperatives in community disaster management were also part of the study. Participatory survey methodologies were applied in these surveys.

2.1.1 Natural Framework Conditions for DRM in Juye

The climate in the county is characterized by rain during summer (June - August) and a dry winter. The annual average temperature is 13.3°C varying from 11 to 14°C. The average high temperature in the summer is 31.5°C, the recorded highest temperature is 42.3°C. The average low temperature in winter is 4.4°C, and on average, there are 213 frost free days in the year. The average annual precipitation is 655mm varying from 500mm to 1000mm. The following tables 2-2-2 and 2-2-3 show the annual rainfall and monthly rainfall in July and August in Juye for selected years. They indicate that

- From 1990 to 2000 the amount of annual rainfall had decreased regularly, after 2000 it increased suddenly and the average amount of rainfall for the years 2003 and 2005 was more than 1000 mm;
- On average more than 60% of the whole annual rainfall in Juye falls in July and August;

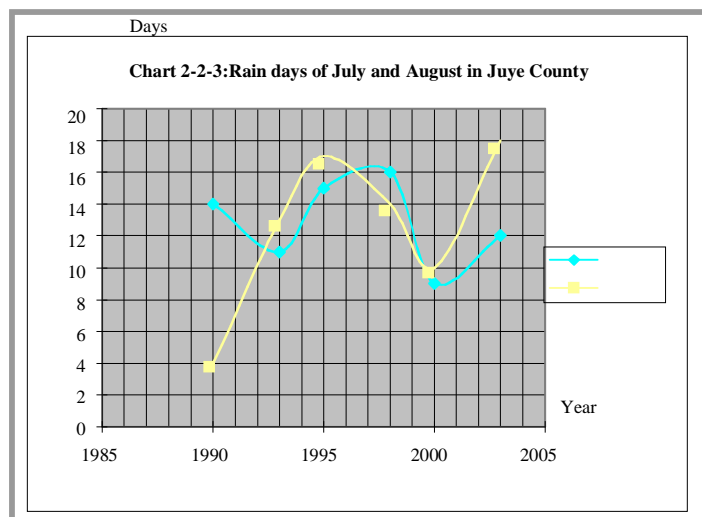
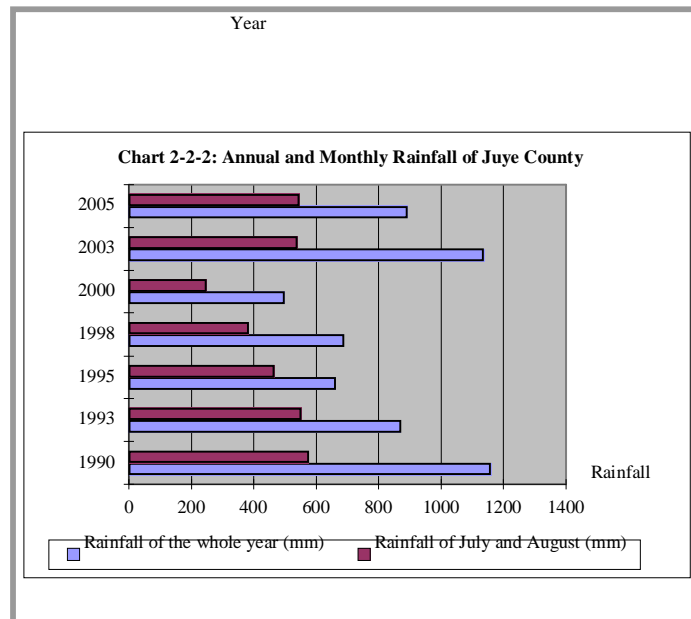


Chart 2.2.4 summarizes the average monthly rainfall in Heze (closest weather station to Juye with long term weather records available) for the years 2008 and 2009 when project field work was implemented. It shows the dry patterns in winter and spring as well as the high rainfall in July (which led in both years to local flooding and water logging in Juye). The spring season 2009 was a very dry season in all of Northern China, including in Juye. The drought prone spring season as well as the water logging which occurred after July rains made the year 2009 particularly relevant in terms of testing crop varieties with high tolerance to drought in spring (winter wheat) and water logging (cotton) in July /August.

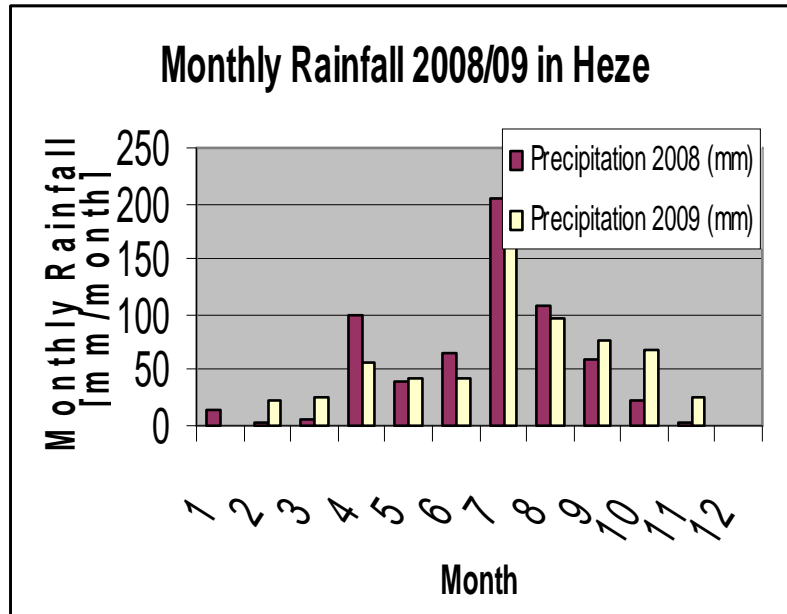


Chart 2-2-4.

Soil characteristics in the pilot sites: Due to the severe floods, low location, and the aged drainage system in the project area, the heavy, alluvial soils are characterized by salinization and alkalization, as well as a high concentration of calcium and magnesium, chloride ions, sulfate and carbonate. The salt compounds formulated by these positive and negative ions enhance the water salinity of the soil, and though this improves the activity of root cells it reduces the root's capacity to absorb soil nutrients.

2.2.2 Assessing the hazards context in Juye

Floods: Juye County is prone to both hydro-meteorological hazards such as floods, drought, extreme temperature, and strong winds, and geological hazard such as earthquakes. Floods are the most frequently faced disaster and also have the worst negative impacts on human livelihoods and agricultural production in the county.

- In 1990, 1993, 2003 and 2005, floods occurred in Juye. In these years the average annual rainfall exceeded 900 mm, and the total monthly rainfall of July and August was also over than 500 mm; These annual and seasonal rainfalls already exceed the drainage capacity of the current drainage infrastructure;
- In years with average precipitation, the average number of rainy days in July and August is about 25 days. This concentration of rainy days can easily result in the water logging in low lying villages as the drainage systems at village level do not function properly any more;

There are three major reasons for flooding:

- The low altitude: runoff water drains into the county and creates water logging and flooding in the low lying areas;
- The draining system is deteriorated and inadequate, and the poor maintenance of the drainage and irrigation channels have exacerbated the risk in low-lying areas especially the farmlands;

- Changes in land use have caused excess runoff from the surrounding regions.

Drought: Historically the counties and river plains of eastern China have been prone to periodic droughts. According to the villagers interviewed, the entire region faced severe drought in 1955 and consecutive droughts during 1987, 1988, 1989, 2001 and 2002. But in recent years there had been fewer drought events. However drought is still a problem when the rainfall is below normal and water in the river, drainage, and irrigation channels are very low. Drought still impacts wheat at the stage of its harvest, and the sowing of cotton and corn, especially in villages where the farmers rely on ground water in case of water shortages.

Wind: During the recent years, the county has experienced meso-scale strong winds and hail storms during July and August. In 2007 strong winds damaged more than 10 houses, green houses and poplar trees in the village of Liuxi.

Earthquake: According to the seismic hazard map of the Shandong province created by the China Earthquake Administration (CEA), the county of Juye lies in a seismic prone area. Based on the records and anecdotal information from the village elders, the villagers felt earthquakes in 1937, 1964 and 1970, with the 1937 earthquake causing damage. As per the seismic intensity map, the county of Juye can expect ground shaking of VIII-IX on the intensity scale. It should also be noted that most of the structures in the county are non-engineered masonry building which are highly vulnerable to earthquakes of moderate intensity.

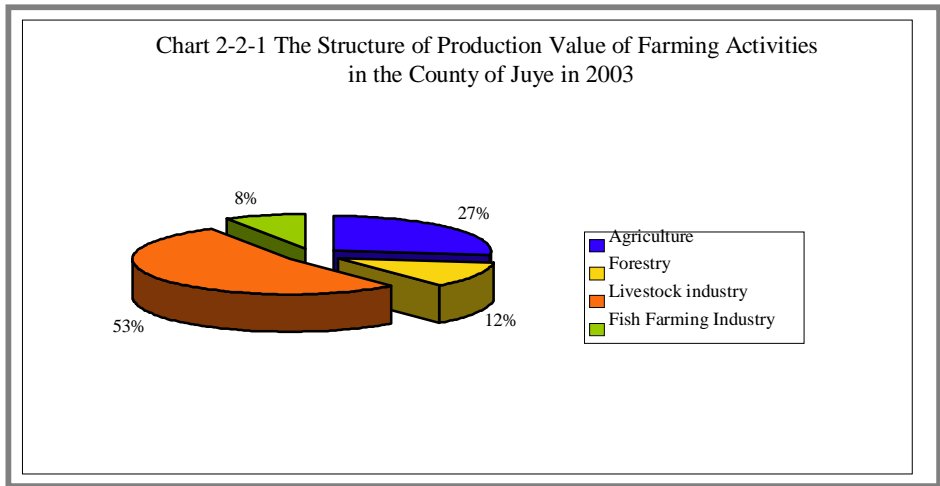
Pests and diseases: Pests normally occur from May to the end of August, during the growing season of the major crops harvested in the autumn. In the recent years pests have been a serious problem affecting cotton and poplar trees. Much of the cotton in the region is affected by cotton bollworm during September and October, and very recently poplar trees have started to be affected by the poplar bug which eats the young leaves of poplar trees during March and April and affects their growth. Epidemic diseases may also threaten animal production and fishery production throughout the year.

2.2.3 Hazard exposure of agriculture

Agriculture in Juye plays a key important role in farmers' household income. According to the county's statistic data, the agriculture sector contributes about 55-60% to the rural income with the remaining 40-45% coming from migrant work. The average share of gross production value of different farming activities in Juye by the end of 2004 is shown below in chart 2-2-1.

Livestock production generates, on average, more than 50% of farming households' incomes, crops production accounts for about 27%, and the other 20% is contributed by fishery and forestry. Thus climate variability and the high vulnerability of crops to floods and drought and lower crop market price are major reasons for livelihood insecurity in the county and the lower share of income from agriculture.

From 1970 to 1990, farmers in the villages cultivated rice for two seasons. From 1990, however, they shifted to the main crops being wheat, corn, and soya beans because of water shortages. In 2001, the county officials, via the township, recommended that the farmers plant poplar trees. As seen earlier on this was widely adopted by many farmers in all three villages.



The entire county is criss-crossed with rivers, natural drainage and man-made channels for irrigation. These drainage and irrigation systems are the backbone for agriculture in the region. The condition of the main backbone drainage canals in the whole county is efficient and well maintained. They function well in years with normal rainfalls, while the community based field drainage facilities in the whole county are very poor. Many villages, therefore, suffer even in years with average rainfall from floods either because of the complete lack of functioning drainage canals or the lack of connections from the community drainage canals to the main rivers or backbone canals.

As illustrated in table 2.3.1, cotton, corn, rice and poplar trees the commodities most exposed to flood and storm disasters (July / August) in Juye.

Table 2-3-1 Hazard Occurrence and Growing Calendar of the Main Crops in Juye

Items	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
A. Time of Hazards												
Floods							Red	Red				
Drought			Grey	Grey	Grey							
Pest					Yellow	Yellow	Yellow	Yellow				
Hail storms & wind							Red	Red				
Epidemic diseases	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
B. Crops and products affected												
Cotton				Green	Green	Green	Green	Green	Green	Green		
Wheat	Blue	Blue	Blue	Blue	Blue					Blue	Blue	Blue
Corn					Orange	Orange	Orange	Orange	Orange			
Soybean					Orange	Orange	Orange	Orange	Orange			
Rice				Green	Green	Green	Green	Green	Green	Green		
Poplar			Blue				Blue	Blue				
Fishery	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Livestock	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green

Wheat is the only crop that is not affected by floods as it grows in the spring, prior to the rainy season, however it can be affected by drought in the spring. The calendar shows not only the main cropping pattern but also the relationship between the seasonal rainfall threats and the farming seasons in the county.

Source of data: Household survey and workshops carried out in 2007 and 2008

Photo 2-3-1 Wheat field with water logging



Photo 2-3-2 Cotton field in Floods

Table 2.3.3 summarizes the perceived vulnerabilities of different crops and products in Juye (from scale 1 being low to scale 5 being high) .

Table 2-3-3 Assessed Hazard and Risk Vulnerabilities of Agro-products in Juye

Products	Floods	Drought	Hail and Wind	Pests	Epidemic Diseases	Market
Wheat	2	4	1	2	-	1
Cotton	5	1	3	4	-	3
Corn	5	1	3	3	-	1
Soybean	5	1	3	2	-	1
Vegetables	1	1	3	3	-	3
Poplar trees	2	2	4	4	-	2
Livestock	1	1	1	-	3	4
Fish	2	3	-	-	3	4

Source of data: The grading figures of vulnerability are estimated based on the findings from a baseline survey (CIAD) and DRM System Assessment (ADPC).

Further details on the structure and hazard exposure of agriculture and the vulnerability of selected communities to natural hazards are given within the short descriptions of the pilot villages in the next section.

2.2.4 Project Pilot Villages; Key Features of Agriculture and Hazard Exposure

(1) Nancao Village : The village of Nancao is located in the southeast of Qilin Township. The village has a total population of 945, of which 300 are labour force. Most of the young people of Nancao Village go outside and work in the cities, and the remaining women and elderly at home are responsible for the agricultural production. There is 1470 mu of arable land in Nancao, of which 1200 mu have been planted with fast-growing poplar trees (occurred since 2003) and 270 mu is used for growing cotton and winter wheat (inter-cropping). Farmers selected the poplar trees because they recognized that they are highly resistance to floods, need less labour input and have a relatively high market price.

The major income sources of Nancao include: forestry, animal husbandry and migrant work. The average annual income per capita by the end of 2006 was about 2200 yuan RMB. Floods disasters have a remarkable negative economic impact on farmer's livelihoods since they cause huge losses in agriculture production.

Since the 1980s, there has been a great change in the pattern of land use and the cropping system in Nancao. This has occurred due to a number of factors, the main one being the worsening effects of the floods disasters and migration. However, even so agriculture in Nancao is still important. Various of the main crops such as cotton, wheat, maize, and beans are sensitive to floods due to their growth period or the topography of the land.

A farmer's cooperative (FC) has been established and registered in Nancao with the support of the County Agricultural Bureau and TCP project. The Nancao FC has played a very active role in cleaning the village drainage canals, building mini drainage culverts and other community based irrigation and drainage infrastructures, and training farmers in livestock production.

(2) Liuxi Village: The village of Liuxi is located in the southwest of Qilin Township and has a total of 330 households. The total population is 1483, of which 783 are labour force and among these, 400 are males and 383 are females. In Liuxi 600 people work outside the village, which accounts for about 77% of the total labour force. There is 1,500 mu of arable land, with 800 mu for growing Poplar trees, 300 mu for cotton, 300 mu for wheat, and 150 mu for vegetables. By the end of 2006, the net income per capita was 2,500 Yuan, and this was mainly generated from agriculture, working outside, livestock raising etc.

In terms of the vulnerability of the farmland to floods and other natural disasters, the land in the village can be classified into three types:

- 93% is under severe threat of flood as it lacks adequate drainage infrastructures;
- Only 7% is located in higher areas with less threat of flood disasters;
- Farmers have also small courtyards that are used for cash crop production.

(3) Qianfengqiao Village: The village Qianfengqiao is located in the northwest of Qilin Township and has a population of 860. The village has about 400 labours, of which 200 go out of the village for work and the others engage in activities such as farming, livestock breeding and construction. The total area of arable land is 836 mu and the major crops are wheat and cotton. Among the crops, it is corn, cotton, and soy beans that suffer the most from natural disasters: after a flood there is almost no harvest for these three crops.

In Qianfengqiao about 400 mu of arable lands (57% of the total arable land) suffers from flood disasters. The 300 mu area of arable land without the threat of flood is higher than the villages of Nancao and Liuxi. In Qianfengqiao, the areas of farmers' courtyards were about 200 m²/household, the same as Nancao village, though almost all courtyards were hardened with cement. Therefore no crop or vegetable production occurred in the courtyards of Qianfengqiao.

(4) Caolou Village: Caolou Village has the population of 3000 and 740 households. The number of labours in Caolou is 1500, and more than 700 of them go outside the village to work. There are 3160 mu of arable land of which about 1000 mu is located in the southeast of Caolou and is affected by floods. In 2008, the per capita net income was 3000 yuan, 65%-70% of this is from migrant work and 30%-35% is from agriculture and farming. Just like the other three pilot villages of Qilin Township, the drainage and irrigation infrastructures were built in the 1970s during the collective economic period. Most of these infrastructures are now out of work, because systematic cleaning and improvements have never been carried out since the rural reform of 1982. This village has a long history and successful experience of aquaculture, and therefore could be a good demonstration for other villages. Although aquaculture is developing rapidly it does get animals escaping in the flood season.

(5) Yaoqiao Village²: The village Yaoqiao is located in the middle part of Qilin Township. The Zhu Shui River passes through the village. There are a total of 210 households and 743 people in this village. There are 1128 Mu of arable farmland with major crops of cotton, wheat, vegetable, beans and poplar trees. By the end of 2006, the average net income per capita in this village was 2,000 Yuan, with the major sources of the income including: agricultural, working outside, and livestock raising. The most serious natural disaster in Yaoqiao is flooding and it occurs here almost every year.

The details³ of agricultural production in 2007 for the five pilot villages are summarized in table 2.3.2.

Table 2-3-2 Production scale of crops⁴ and fishery in Pilot Villages (2007)

Products	Liuxi	Nancao	Qianfengqiao	Caolou ⁵	Yaoqiao ⁶
Wheat (mu)	500	270	600	1400	700
Cotton (mu)	500	270	200	700	700
Corn (mu)	-	200	500	300	-
Vegetable (mu)	200	50	-	-	128
Soybean (mu)	-	200	100	200	200

² Yaoqiao village has been selected as pilot village in 2007 and launched the greenhouse vegetable production activities in the first project year. But it was replaced by Qianfengqiao Village due to the change of the village election.

³ More details of the social economic features, and hazard exposure of these villages have been documented in the baseline survey reports and the reports on risk related land use planning.

⁴ In the farming practice, there are intercropping between wheat and cotton, wheat and corn, corn and soybean. The average cropping index in Juye is 1.5-1.7, since the cumulative annual temperature and frost free days are suitable for more than one crop harvests.

⁵ Caolou Village was selected as pilot village in 2008 for demonstrating the fishery production component.

⁶ Yaoqiao Village was replaced by Qianfengqiao Village as pilot in 2008 since the change of the village committee in Yaoqiao. Baseline survey was conducted in 2007, therefore, the data is presented in this summary table.

Poplar trees	800	1200	30	200	300
Fish pond (mu)	-	60	13	400	-
Total Land (mu)	1500	1470	850	3020	1128

Source of data: Collected through interviews with village leaders in 2007.

Local risk mitigation strategies

To reduce the livelihood risks caused by natural hazards, many households are engaged in small-scale economic activities, such as livestock raising (rabbit or birds), handicrafts, or the use of greenhouses to produce vegetables. At the moment farmers' cooperatives are still in the early stages of their formation and they need to be strengthened so that they can support livelihoods as well promote disaster risk reduction measures.

2.1.5 Vulnerabilities to natural hazards in agriculture

The hazard risk assessment for the agricultural sector highlighted the following vulnerabilities:

- Villages and households with a high proportion of cotton, corn and soybeans in their agricultural income are in general more vulnerable to flood hazards and water-logging especially during July and August. The lack of effective and functioning drainage systems at the village level was observed as the major reason for the floods and the water-logging. Changes in the sequencing of crop patterns could reduce loss due to floods or water logging;
- Wheat grows before the months of heavy rainfall in July and August and so it is less vulnerable to floods. It is, however more vulnerable to spring droughts. although economic losses due to drought are not as high due to floods, and so it is quite a stable food for farmer's self-consumption,. Supplementary irrigation in spring can reduce the loss caused by the droughts;
- Poplar trees are normally highly resistance to floods, however, they are vulnerable and sensitive to pests, and the extreme weather of hail storms and strong winds which often occurs in July and August. Pests and extreme weather are, however, lower risk than floods and because of this many villages transformed large proportions of their crop farmland into forested land;
- Normally livestock and fish are not vulnerable to floods and droughts however, they are vulnerable to epidemic diseases. With a good epidemic management system and cooperative action for marketing, livestock can make a big contribution to the household income. Livestock production practices tried in Qianfengqiao and Nancao village have shown good results;
- Products such as fish, livestock, cotton and vegetables with high added values or not suitable for long time storage, are not vulnerable to natural hazards, but are vulnerable to market risks unless organized marketing actions occur among the producers. This has been proven by the interviewed producers. The development of farmer's cooperatives within the villages is, therefore, a solution to reduce the producers' vulnerability to market risks for these high value agro-products. The village of Nancao has provided a good example of FC development and collective action.
- The major reasons for the high vulnerability of the villages to floods and water logging are that (i) the drainage and irrigation facilities within the villages were entirely out of work due to lack of maintenance mechanism after the rural land tenure reform and (ii)

government only invests in the construction of the backbone irrigation and drainage system and not at village level; also, since the reform no internal fundraising from individual villagers for public goods occurred yet (iii) the drainage canals running from the village fields to the backbone canals were not constructed, and thus water logging occurs with high rainfall; and (iv) there is still difficulties in organizing collective action to improving the village drainage infrastructures since rural land reform; and farmers associations within the villages did not play roles in the community disaster risk management, and so individual laborers were not mobilized to clean the drainage canals.

- As the majority of young people, both males and females from the villages have migrated to nearby towns and cities for non-agricultural incomes, the village is left with the old, women and children. There is a need to strengthen the institutional system at the village level by encouraging communities and local institutions, particularly the farmers association, the women's association, and youth groups, to participate in disaster risk reduction activities. This could be initiated through the Community Based Disaster Risk Management (CBDRM) framework.
- Currently villages play a very limited role in disaster management activities including those of the emergency response phase. There is a need to strengthen the village level system by encouraging communities to actively participate in disaster risk reduction activities.

2.2 Institutional assessment of the DRM and Emergency Response System in Juye

The assessment⁷ conducted by the project provided an in-depth understanding of the current disaster management mechanisms in place. It identified some constraints which must be overcome in order to ensure effective operation of the system. Findings from the in-depth survey also helped in the formulation of the DRM planning framework for Juye.

2.2.1. Policy Frameworks and Coordination of Disaster Risk Management

Until TCP project was launched in 2007, no operational mechanism for comprehensive disaster risk management framework existed in Juye county, although natural hazards, i.e. floods and droughts occurred recurrently, often causing major economic losses in the county.

Since 2008 the Disaster Reduction Leading Committees, have been initiated country wide and are responsible to coordinate disaster management. In Juye country the committee perceived its mandate as mainly related to floods and droughts. The committee is composed of 28 members, including the County Armed Force Department, County Meteorological Bureau, Financial Bureau, Agricultural Bureau, Water Resource Bureau, Civil Affairs Bureau, Health Bureau, Forest Bureau, Transportation Bureau, Broadcasting Bureau, and all the township governments. It is coordinated by the County Water Resources Bureau, with the vice county governor as the chairman. Discussions and interviews with officials at the county level revealed that coordination gaps exist with regard to DRM among the various bureaus in the

⁷ Conducted in the project context by the Asian Disaster Preparedness Centre (ADPC) and the Beijing Climate Centre (BCC).

current system. On the other hand, there were clear indications for good collaboration among different agencies during emergency response.

In 2008 the Juye County Public Emergency Contingencies Plan (PECP) was formulated by the county government, but not all of the line agencies mentioned above have participated in its formulation. The plan specifically addressed the major procedures of disaster response, the relevant line agencies and stakeholders needed for emergency relief, and post disaster recovery. However disaster mitigation and preparedness (DRM) have not been included in the County PECP.

Since July 1, 2007 “The National Law of Farmer’s Cooperatives of PRC” entered into force. This law provided an institutional framework for the development of farmer’s cooperatives (FC) in the county of Juye. The County Agricultural Bureau has the mandate to provide technical support and management advice to FC, and County Industry and Commerce Bureau is in charge of the registration of FCs. Founding and capacity building of FCs was also promoted by the government of Heze Prefecture. Based on a review of documents and discussions, it was concluded that the current disaster management system has a number of limitations to provide regular and proactive services for disaster risk management to farmers:

- the current institutional arrangement is only for floods and droughts, and the Water Resource Bureau has to rely on county leadership and the general office for many of their needs during any disaster events.
- at present very few agencies focus on pre-disaster activities, and preparedness is only limited to organisational response preparedness.
- due to the predominant top-down approach in disaster management the township, local institutions, and communities play a very limited role in disaster management, and there is no formal institutional arrangement for disaster management below county level.
- training and capacity building for disaster management (emergency response and relief) are organized at national and provincial levels only, and are limited to leaders of civil affairs and few other relevant departments. At the county level, there is a need to strengthen the existing institutional system to sensitize and train the county leaders and bureaus and its technical staff on the different aspects of Strategic Pre-disaster Management and Disaster Risk Reduction (DRR).
- township and local level institutional mechanisms need to be established in order to enable the locals to be better prepared for disasters. The township has limited, untrained and inexperienced staff and yet need to coordinate with 67 administrative villages during emergency response and relief distribution..
- With regard to agriculture specifically, it was noted that the agriculture bureau gives farmers no support on how to manage climate risk through the application of forecast information and pest management

There is a need for more effective multi-sectoral mechanisms with improved coordination, as well as to shift from the current emergency response approach to a proactive and multi-hazard disaster risk management approach with further strengthened early warning, mitigation and preparedness to reduce the losses and secure the livelihoods of the communities.

2.2.2 Early Warning System and services in Juye

The county meteorological bureau is responsible for providing weather and climate forecasts for the county. It has a network of 17 Automatic Weather Stations (AWS) located in 16 townships and one within the county meteorological bureau. The bureau receives hourly data from the AWS stations which it then transmits to the provincial meteorological bureau. Based on the forecasts of the province and prefecture meteorological bureau, and the observed data from the stations the county meteorological bureau provides the following forecasts: short term for 1 to 2 days, medium term for 3 to 10 days, and long term for 10 to 90 days. In general, the above forecasts are provided to help in the management of the risks of hydro-meteorological hazards. However in general they are only used as reference information when formulating the emergency response plan. The available forecasts have limited use at the community level as the information provided by the county authorities to the communities has the short lead time of only 1-3 days; thus the communities have very limited time only to get prepared for and respond to possible hazards.

The existing county “Early Warning System” is insufficient. In the future it has to play a more proactive role in providing forecast information to all its users including the farmers, so as to encourage users to undertake risk reduction and evolve response options through the application of forecast information. No formal institutional arrangement for disaster management below the county level exists and thus the establishment of an institutional system with adequate technical expertise at the township level needs to occur. This institution could act as a bridge between the county and the villages to support disaster risk management activities.

2.3. Conclusions from the Situation and Vulnerability Assessment

Based on these findings and conclusions, the following interconnected project, intervention areas have been prioritized in order to enhance and strengthen the DRM system and promote good practices for enhanced DRM in Juye:

- Promote the development and capacity building of farmers’ cooperatives (FCs) in the pilot villages and strengthen their roles and functions in community based natural disaster risk management;
- Support water engineering interventions to improve the water drainage system in the pilot villages. For example: building the culvert, improving the drainage infrastructures and cleaning the drainage canals;
- Improve the land productivity and increase farmer’s income from agricultural and crops production by adopting more hazard resistant crops, including relevant agronomy countermeasures and soil fertility improvement technologies;
- Further enhance the early warning system (EWS) in the county of Juye to forecast floods, drought and other natural hazards; and improve the information outreach to farmers;
- Study the possible role and function of fishery production for DRM, considering the creation of more resilient fish pond walls to over-flooding;

- Formulate the draft Disaster Risk Management Planning Framework at county and township levels, and concrete DRM plans at village levels, through the proactive participation of relevant governmental line agencies, communities, and FC representatives.

3. PROMOTING AN ENHANCED DRM SYSTEM IN JUYE

A variety of sector and sub-sector specific field activities and good practices to enhance know how and delivery capacities at various levels for DRM were implemented with the support from the project, and finally consolidated into an integrated planning framework for enhanced disaster risk reduction and management in Juye county.

Table 3.1 Integrated Disaster Risk Management activities promoted by the project

Components	Main activities
Agricultural Sector	<ul style="list-style-type: none"> ▪ Soil improvement measures <ul style="list-style-type: none"> ○ Soil specific fertilization strategies for soil rehabilitation ; ○ Field levelling; ○ Deep ploughing of alkaline soil; ▪ Agronomic measures <ul style="list-style-type: none"> ○ Homestead gardening for income generation and mitigating vulnerability to drought impacts ○ Demonstration and dissemination of more hazard tolerant crop varieties/cropping patterns; ○ Capacity building for extension officers to enhance their skills for DRM in the AG sector;
Water Sector	<ul style="list-style-type: none"> ▪ Culvert construction including drainage canals ▪ Installing water pumps for irrigation⁸ (drought management) ▪ Village-level drainage cleaning
Fisheries/Aquaculture Sector	<ul style="list-style-type: none"> ▪ Demonstration of aquaculture ponds with elevated earth walls in flood prone areas; ▪ Monitoring system for aquaculture ponds; ▪ Involvement of the fishers management bureau into the county level DRM planning framework;
Early Warning System (EWS)	<ul style="list-style-type: none"> ▪ Planning of enhanced EWS to match farmers' information needs ▪ Instalment/downscaling of weather information from the national level to the county and community level; ▪ Assessment of value added when using crop yield forecasting and damage assessment information tool; ▪ Improving access to basic market information provision of simple.
Farmers Cooperatives (FC) Development for DRM	<ul style="list-style-type: none"> ▪ FC management training ▪ Supporting FCs formal registration; ▪ Supporting FCs participation in village level planning for DRM ▪ Conducting project pilot activities for DRM through FCs

⁸ This activity was not conducted; the original budget was shifted to building the culvert according to the modification made during the visit of Dr. Stephan Baas in May 2008.

Gender Mainstreaming in DRM	<ul style="list-style-type: none"> ▪ Mainstreaming women’s participation in DRM capacity building and mitigation process; ▪ Women’s participation during disaster preparedness; ▪ Planning relief operations for women in emergency response; ▪ Involvement of women in the disaster rehabilitation planning;
DRM planning framework	<ul style="list-style-type: none"> ▪ Participatory land use planning ▪ Establishing an integrated cross-sectoral DRM planning framework and DRM plans at county level; ▪ Capacity building for county level staff on the DRM approach and operationalization and institutionalization;

The components and main activities supported by the project are summarized in table 3.1. The components guide the structure for the following sections of this report.

3.1 Soil Improvement and Rehabilitation Measures

The objective of a series of soil improvement activities was to enhance the resilience of saline or alkaline soils (to drought and flood in particular), to promote soil fertility, and so create a suitable soil environment.

The project assisted in the installation of a soil analysis laboratory for the county in Juye’s agricultural bureau. Thereafter a series of interrelated soil improvement activities have been conducted, such as infrastructure construction, levelling land, deep ploughing, improving saline soil, soil testing and formulated fertilization. These activities are discussed below:

3.1.1 Formulated fertilization strategy for water logged soils

The formulated fertilization strategy was designed and implemented to rehabilitate the water-logged soils while maintaining the productivity of crops. In order to compose the fertilizers specifically responding to local demands, 1500 soil samples were selected from different sites of the project villages and then classified into their soil type (saline and water logged soils) and according to the intended application by crops, such as cotton, maize and wheat. Soil samples were tested mainly for content of soil organic matter and salinity, pH value, available nitrogen, phosphorus, potassium, soil zinc, boron, iron and other trace elements. Agricultural experts were then invited to participate in a workshop where the soil characteristics were discussed in order to create suitable fertilizer formulas based on the results of the soil testing and the demands of local cropping patterns.

6 types of fertilizer, with different ratios of nitrogen, phosphorus and potassium, were produced by a fertilizer manufacture factory and used in the project. Before applying the new fertilization on farmer’s fields, two technical training sessions were organized, in April and July 2009, to introduce the concept and operationalization of formulated fertilization. 180 representatives from the pilot FCs and villages attended these sessions. 5000 copies of brochures were distributed to promote formulated fertilizers beyond the project pilot sites to ensure that every household got access to a suggestion card and brochure. An experts group was organized for field demonstrations. The group included the leader of the county Soil and

Fertilizer Station, the leader of the Agricultural Science Station, and other technicians from these two stations. They provided farmers with specific on-site technical training.

The following table summarises the types of fertilizers produced, with the support of this project, and their use.

Table 3-1-1 Adjusted fertilizers for improving the soil fertility in project area

Type	Crops	Soil type	Application Growing
F-I: 48% (16%N,16%P,16%K)	wheat and cotton (intercropping)	Water-logged soil	Base fertilizer
F-II: 40% (30-5-5)	Wheat, cotton, maize	Water-logged soil	Early growing period
F-III: 36% (31-0-5)	maize	Water-logged soil	Corn milking period
F-IV: 57% (19-19-19)	wheat and cotton	Water-logged soil	Base fertilizer
F-V: 48% (22-8-18)	Maize	Water-logged soil	Earing period
F-VI: organic fertilizer	All crops	Saline and water-logged soil	Base fertilizer

Source: Juye Agricultural Bureau, 2009

In order to institutionalize soil improvement measures as an aspect of the county level DRM plan, a technician group has been set up; at least one technician was present at each project site. The technicians used integrated field management techniques, regarding ploughing, plant patterns and varieties, the date of seeding, rational close planting, irrigating, control of disease and insect pests, plant growth regulators, and much more. Detailed monitoring and evaluation was required at the sites and the staff monitored data, conducted statistical analysis, selected formulated fertilizers, and found the optimal fertilizing amount. During the fertilizing time, on-spot meetings had to be organized regularly. FC members and farmers’ representatives were invited to the demonstration sites to learn more about the formulated fertilization.



Photo 3-1-1 Samples for soil analysis



Photo 3-1-2 Field experiment for formulated fertilization

The input costs for the formulated fertilization remained the same as they were under conventional fertilization patterns.

3.1.2 Field Levelling

The project area is low lying and uneven, and so the higher parts become saline while the lower parts are exposed to water logging. It is adverse very difficult to irrigate and drain such land, therefore, the levelling of fields is very necessary to improve irrigation efficiency, reduce irrigation costs, and to decrease losses caused by water logging in the lower areas. Soil was moved from higher lands to the lower lands with the help of heavy machinery and a farmer's labour force. Then the project area was made flat and convenient for irrigation. This activity was implemented in March to May, and September to October of 2008.

3.1.3 Deep Ploughing in Alkaline Soil

Due to the yearly shallow ploughing and hydrocele, the soil has hardened and plough pans become a serious problem. This hinders the growth of the crop's root system and reduces its coping capacities against the impacts of drought, flood and water logging; it is also an obstacle to the absorption of nutrients and moistures; and retards the growth and the productivity of crops. Meanwhile, because of the shallow active layer, the enrichment of alkaline compounds at the surface brings the pH of the surface layer to more than 7.5 which again has adverse impacts on the growth of the root system. In order to destroy the hard plough pan, and increase the active layer and prevent the enrichment of alkaline compounds at the earth's surface, the deep ploughing of alkaline soil is needed.

By deep ploughing the alkaline soil at the project sites in 2008 the height of the active layer increased to 25cm, the soil became looser, and the enrichment of alkaline compounds at the earth's surface was restrained. A more suitable soil environment for the growth of crops was re-created.

The advantages of the three soil improvement measures have been proved at the project sites, however, there is more work to be done in order to institutionalize and include all three measures into county level DRM plan. According to the County Agricultural Bureau if integrated soil improvement measures and formulated fertilization techniques are applied the crop yield could be increased county wide by 8-12% on average.

3.2 Agronomic Measures

Agronomic good practice measures for risk reduction were introduced into the existing farming systems of the pilot villages in order to reduce the vulnerability of selected key crops to floods, droughts and other natural hazards. Major countermeasures included: (a) introducing more hazard tolerant wheat and cotton varieties and (b) supporting the use of greenhouses for vegetable production. The Shandong Academy of Agricultural Sciences (SAAS) provided technical assistance to this component of the project. Technical training, information exchange, field shows and demonstrations were conducted to strengthen local practices and know how for disaster risk reduction.

3.2.1 Introduction of Hazard Tolerant Varieties with High Productivity

Crop yields in Juye regularly decrease greatly due to the impacts of natural hazards. One cause for that is that the low hazard-tolerance of the crop varieties currently planted. In order to enhance the hazard resilience of key crops, the project collaborated with farmers’ cooperatives and demonstrated on the fields of local farmers, at a technical high-standard, disaster tolerant cultivation technologies. Two wheat varieties (Jimai 21 and Jimai 22) and three cotton varieties (Lumianyan 28, Lumianyan 29 and Lumianyan 30) were selected. The wheat and cotton varieties selected combined characteristics such as high yield, drought tolerance or water-logging tolerance. In February 2009 a total of 1140mu of land, from 305 farmers in three project villages, namely Liuxi, Nancao and Qianfengqiao was used to test these, for Juye new, varieties technologies. 500 kg seeds of Lumianyan No.28, 500 kg of Lumianyan No.29, and 150 kg of Lumianyan No.30 were delivered to 305 farmers for planting before 20 March 2009.



Photo 3-2-1 Cotton Field Training for Women in One of the Project Villages



Photo 3-2-2 Trial of Intercropping of Cotton and Wheat in Juye

Results of the Experiments conducted in 2009:

The experts from the SAAS concluded that during the drought prone spring season in 2009 the trial varieties of wheat and cotton both enhanced hazard resilience and achieved significantly better yields and per *mu* net income compared to the control group of crops commonly used (applying long term average crop yield data of the locally common varieties). The following tables show the yields and economic results of the experiment with new varieties as compared to the long-term average control data for locally used varieties of the same crops in spring season.

Table 3-2-1 Yield comparison of wheat variety improvement experiment (2009)

Variety	Yield (kg/mu)	Increase against control (%)
Jimai 21	536.7	9.4
Jimai 22	543.6	10.8
Control	490.5	-

Table 3-2-2 Cost and benefit comparison of the wheat experiment in 2009

Variety	Input (RMB/mu)				Outcome (RMB/mu)	Net-income (RMB/mu)
	Seed	Water	Fertilizer etc.	Labour		
Jimai 21	50	60	160	180	1073.4	623.4
Jimai 22	50	60	160	180	1087.2	637.2
Control	44	45	150	170	981	572

Table 3-2-3 Cotton yields and 2009

Variety	Yield (kg/mu)	Increase against control (%)
Lumianyan 28	252.6	8.0
Lumianyan 29	251.3	7.5
Lumianyan 30	254.2	8.2
Control	232.2	-

Table 3-2-4 Cost and benefit comparison of the cotton experiment in 2009

Variety	Input (RMB/mu)				Outcome (RMB/mu)	Net income (RMB/mu)
	Seed	Water	Fertilizer etc.	Labour		
Lumianyan 28	40	20	160	590	1717.7	907.7
Lumianyan 29	40	20	160	590	1708.3	898.3
Lumianyan 30	60	20	160	580	1728.6	918.6
Control	32	20	140	530	1490.1	768.1

More details on the cropping demonstrations are provided in technical documents: “The characteristics and cropping conditions for the 5 induced disaster-resistant varieties”, “Cotton transplanting and its application in disaster prevention” and “High yield and high efficiency cultivation technology for coping disasters”. and in the good practice implementation guidelines provided for each of the technologies in Annex 1.

Besides the objective of introducing innovative technologies the project used the good practice demonstrations, to also promote institutional capacities for comprehensive and integrated extension services to farmers, including through technical training and in-door workshops, and technical guidance in farmers’ fields. Examples of training events include:

- A technical training in-door workshop for farmer cooperative representatives and field-level technicians held in Juye from 21 to 24 December 2008. Over 50 people, including two directors and 10 agronomists from Juye Agriculture Bureau, and over 40

field-level technicians and farmer representatives attended the training workshop. All the lectures focused on the practical knowledge and skills required for disaster prevention and reduction. Detailed knowledge and techniques were discussed during the informal discussion. Field-level technicians and farmers learned the characteristics and management skills of the main wheat and cotton cultivars, as well as a number of practical techniques for disaster prevention and reduction.

- Technical guidance in farmers' fields for 12 days provided by two wheat cultivation experts from SAAS during the critical growing stage of wheat. They also gave 3 days of technical guidance on drought resistant wheat management. This coincided with the strong drought which occurred in Northern China in the spring of 2009.
- Three cotton experts provided technical guidance in farmers' fields for 12 days during the following critical stages of cotton: planting, germination, seeding stage, squaring stage, boll-setting stage. The experts explained and demonstrated detail techniques on cotton transplanting and gave management tips on how to prevent drought and water-logging in wheat-cotton double cropping fields during the planting, germination and transplanting stage. During the seeding, squaring and boll-setting stage of cotton, they demonstrated some detailed cultivation and management technologies, such as cotton cultivation techniques, fertilization, pruning and topping. The field guidance also emphasized practical techniques for disaster prevention and loss reduction after water-logging.

3.2.2 Supporting Greenhouse Vegetable Production

The use of greenhouses for vegetable production was supported on high level land, which is not affected by floods and water logging. The main objectives of this intervention were to (a) enhance small farmers' income in order to reduce their overall financial vulnerability, which is presently high due to the remarkable economic losses caused by floods and other natural hazards and (b) to strengthen farmer's cooperation through a farmer's cooperative. This project subcomponent was implemented in Yaoqiao



Village where some households had already started to invest in greenhouses for vegetable production. 52 farmer's households received a financial subsidy from the project as contribution to purchase building materials. With the assistance of the county agricultural bureau, an informal Greenhouse Farmers' Association has been established. All 52 households (25% of all the village households) in Yaoqiao Village became members of the association.

3.3 Flood Drainage System and Water Engineering Infrastructures

As already analysed in chapter 2, poor drainage systems and out-of-work water engineering infrastructures are two major reasons for the high vulnerability to floods and drought hazards in Juye. According to the current governmental policy, public investment in the water sector is mainly used to build the backbone irrigation and drainage system. This is beyond the community level, and since the rural financial system reform in 2003 and 2004 the communities lack a collective fund accumulation mechanism to support maintenance and improvement of the local irrigation and drainage systems.

To reduce hazard exposure and future impacts of floods and droughts, which regularly hit Qilin Township, the project supported the improvement of the community flood drainage system and the enhancement of the water engineering infrastructures in the villages of Liuxi, Nancao and Qianfengqiao. However, due to the limitation of the project budget, catalytic project contributions to the needed investments had to be highly selective and focused on a two locally prioritized actions only, namely the construction of a culvert, and community drainage system cleaning.

3.3.1 Culvert Construction in the village of Liuxi

In order to prioritize the location of the culvert interviews were made with different stakeholder groups (local people, the engineers and consultants) about the following three considerations: i) the new culvert must fully match with and add value to the existing drainage and canal system; ii) its expected drainage effects; iii) the boundary conditions. Following these discussion the construction of a drainage culvert and other related activities were implemented in Liuxi village in the eastern Liuying Irrigation System. The wider activities needed to make the main culvert most efficient involved the planning and construction of 6 field canals with a length of 2350m, 6 small culvert bridges for field canals and 4 small culverts for field ways. Activities such as the reparation of cracks and leakages, and the reinforcement of drainage canals were also part of the project.

The main culvert was built in 2008 through the east dike of the Yunjuhe canal near the village of Liuxi. Constructions were finalized before the flooding season 2008. The FAO mainly invested in the construction of the bridge and the main culvert of the drainage canal, as well as the 6 small culvert bridges and 4 small culverts for field ways. Complementary constructions needed in the west field of Liuxi village were partly financed by the local township government.



Photo 3-3-1: Sluice gate of the Drainage Culvert in Liuxi (photo by Wang Yanguai)



Photo 3-3-2: Outflow of the Culvert (photo by Wang Yanguai)

Results of the intervention

The drainage capacity of the main culvert satisfies the drainage needs of the Yunjuhe Canal and so water-logging and flood disasters could be greatly reduced and hardly ever occur in the future. According to the Liuxi village leader and the Qinlin Township governor, Liuxi culvert now benefits about 6000mu of farmland for flood drainage, covering 6 villages, namely, Liuxi, Liubei, Liunan, Mengdian, Dongyoufang and Xiyoufang. The total benefiting population is about 5000 throughout the six villages. The positive impacts of the culvert were already felt during rainy periods in 2008 and 2009: In spite of comparatively heavy rainfalls during flooding seasons in both years, there was no more water logging. Local informants confirmed that in previous years heavy rainfalls such as observed in 2008 and 2009 would have led to at least 3 weeks heavy water logging in three villages located close to the culvert. The economic benefit of the culvert thus is significant: it has been estimated that it can save 200-300 Yuan/mu of economic loss each year; a total of 1.2-1.8 million Yuan could be therefore saved for 6000 mu.

3.3.2 Village-level Canal Drainage and Cleaning

The canal cleaning activities were carried out in a way that the dredging sediment was used to contribute to enhancing the overall levels the low-lying land. The following villages were involved: Qianfengqiao, Liuxi and Nancoa (or Rencaozhuang), where also the improvement and restoration of the irrigation and drainage canals was carried out. The volume of canal dredged in Qianfengqiao, Liuxi and Nancoa was 6050m³, 6800m³, and 6480m³ respectively, over a length of 2600 meters, 3500 meters and 3400 meters. The canal cleaning used machines, provided by the County Agricultural Bureau, and the farmer's labour, which was mobilized by the village farmer's cooperative in Nancoa and the village committees of Qianfengqiao and Liuxi.

According to the village leaders, in the three villages about 1460 mu of farmland has been benefited; the estimated economic benefit of the canal cleaning is about 430,000 Yuan, and the total benefited population is 4200 people.



Photo 3-3-3 The Cleaned Backbone Canal in Nancao (photo by Liu Yonggong)



Photo 3-3-4 A Cleaned Community Field Canal (photo by Wang Yangui)

3.4 Early Warning System Enhancement and Agriculture Information

Based on the study outcomes of the existing early warning system (EWS) and the disaster risk related information dissemination mechanisms conducted as part of the situation assessment, the project supported the following actions as contribution to the establishment of a more comprehensive, enhanced DRM approach for Juye County:

- (1) Conducted an assessment about hazard risk impacts on agriculture and identified the farmers' information needs for enhanced meteorological disaster prevention and mitigation;
- (2) Developed an information system to improve the information flow between the National Climate Center - Provincial Climate Center - County Weather Bureau/Agricultural Bureau and farmers. The objective was to catalyse better information flow to farmers to obtain regularly key weather information and advise bulletins about recommended seasonal crop selection and short term advice on production management steps related to weather conditions and hazard warnings; this included to improved the hardware of Juye County Meteorological Bureau.
- (3) Introduced methods for hazard impact assessment on agriculture
- (4) Capacity development for local EW and enhanced meteorological information management

3.4.1 Assessment of County Early Warning System & Farmers' Information Needs

Experts from Beijing Climate Center (BCC) and the FAO jointly conducted a field investigation on the existing hazards and risks, major disaster impacts, and farmer's information needs. This information assisted in the design of the comprehensive, cross sectoral disaster management plan for Juye. With focus on the agricultural sector, the assessment highlighted the followings:

- **Hazard exposure of main crops in Juye:** . In the villages with the lowest altitude, such as Nancao, Liuxi and Caolou, about 10-15% of the yield of the maize and cotton are affected by water logging in a normal year with average annual precipitation. In years with high annual precipitation and concentrated rainfall in late July and August, cotton yield per mu could be decreased by over 70%, and the yield for maize could be zero. Forests, which have been planted as an alternative for these crops can also be affected to some extent: roots of the poplar tree gradually rot if floods last. Forests are also affected by pests every year and they cause greater damage than that of the floods. Planted in September and mainly growing from March to June of the coming year, winter wheat is mainly affected by drought in spring from March to April. Without irrigation facilities, for supplementary irrigation during droughts, the wheat yield can be negatively affected. Normally, there are no droughts in Juye in June, July and August.

Pests mainly affect the summer crops, such as cotton, maize, soybeans and vegetables. The farmers currently use a pest management system, however although it can reduce economic losses it increases production costs and reduces the quality of the products.

- **Disaster and risk related information delivery mechanism for agriculture:** The county meteorological bureau did not provide flood, drought and other natural hazard related information, neither the relevant governmental line agencies nor to the farmers and villages;

The county governmental public emergency contingences system had no mechanism for local early warning to predict the natural disaster risk. Relevant data and information allowing the predication of disasters was mainly provided by the prefecture, provincial and national levels;

Information on marketing agro-products and relevant price changes were not provided to farmers.

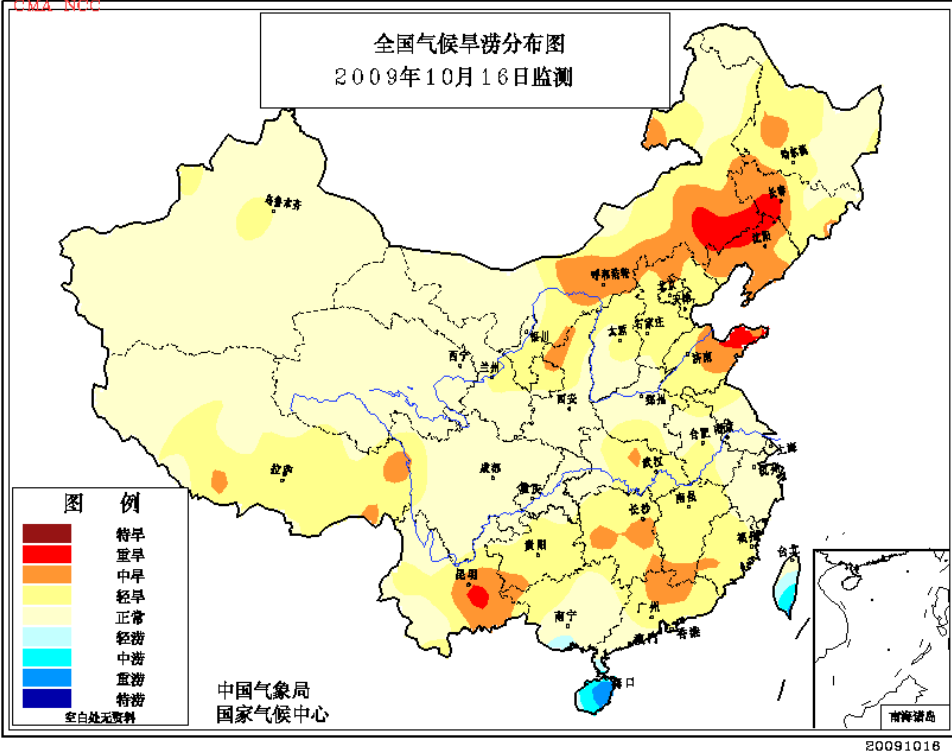
Based on the assessment findings, BCC experts recommended the improvement of the floods, drought and pest related early warning system for DRM, and implemented the following activities with the support of the TCP project.

3.4.2 Improved local EWS and Meteorological Information Delivery Mechanism including also market information

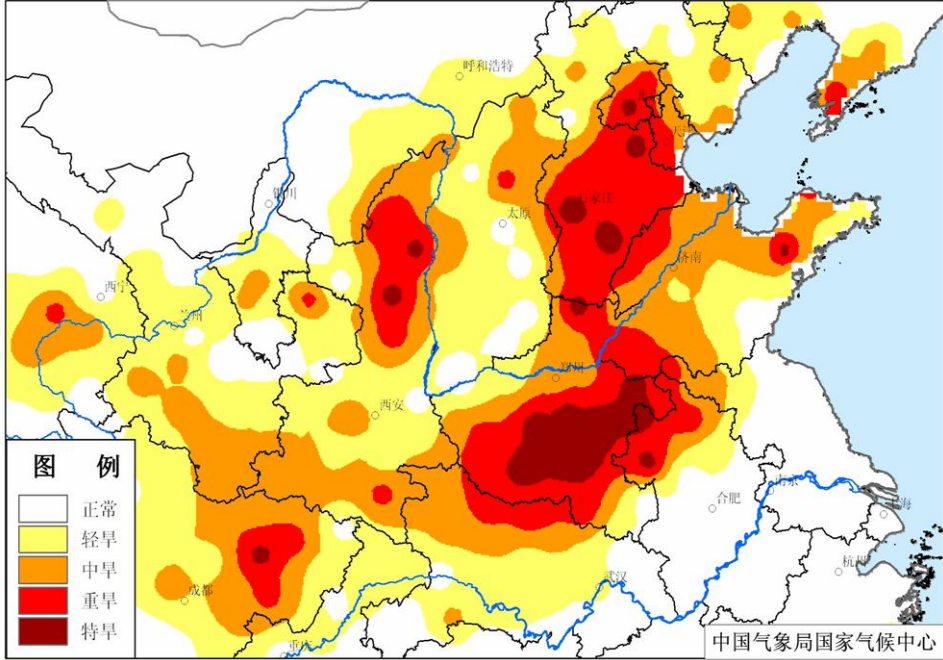
To improve the meteorological information delivery mechanism, the Beijing Climate Centre, affiliated to the Chinese Meteorological Administration, helped the Juye County Meteorological Bureau and Agricultural Bureau set up a new information delivery system being a component of the overall Juye County DRM approach. The new delivery system integrates climate monitoring and diagnosis, risk prediction, climate impact assessment, meteorological disaster monitoring, impact assessment and pre-assessment.

The BCC now provides, in forms of regular bulletins via the internet, all relevant county governmental line agencies, the Qilin Township and the pilot villages with meteorological information; prediction and analysis results; weather forecasting; and hazard early warnings,

focusing on droughts, rainstorms, floods, typhoon, low temperatures, freezing, high temperatures, dust, snowstorms, lightning and thunderstorms.



Drought Monitoring in Winter Wheat Region of North China
2009. 2. 7



The above charts are examples of (i) a drought broadcast for all of China for October 2009 and (ii) in more detail in the northern China provinces in February 2009. Broadcasts are delivered by the BCC in the northern China Provinces including Shandong.

In order to achieve efficient information flow to local levels effective and timely accessible early warning information is required. The objective of a local information dissemination strategy is to provide the relevant county governmental line agencies and villagers with the hazard and/or disaster related early warning information and preparedness instructions with good lead time and special advanced notice. In order to operate an localized early warning information system, the interplay of “top-down” and “bottom-up” information collection and dissemination mechanisms are important.

The project recommended the use of multi-channel information delivery. Meteorological services and early warning information can be effectively disseminated to various users via cell phone text messages, e-mail, facsimiles, radio broadcasts, the TV, LED screens in public places, and via newspapers. Simple information leaflets could also be used to deliver early warning information to villagers. The following actors/groups were identified as the major target receivers for early warning information: village leaders; directors of village farmer’s cooperatives; township governors in charge for agriculture; county level decision makers, such as the county governor in charge of agriculture; the county agricultural bureau; the water resource bureau; the civil affaires bureau; and other line agencies related to preparedness and emergency relief and post disaster rehabilitations.

During project implementation in 2008 to 2009, the Beijing Climate Center, together with the Shandong Climate Center, the Heze prefecture Meteorological Bureau and the Juye County Meteorological Bureau, provided enhanced climate service and meteorological early warning products (for more than 70 reporting periods to the county government, the Agricultural Bureau, the Qilin town government, and the Juye farmers (not including the daily weather forecast, and weather early warnings, mainly from the of Juye County Meteorological Bureau to county government and to the JUYE people). The main products included early warning messages related to five different meteorological hazards ten day, monthly, quarterly, yearly climate prediction products ;and the main agricultural market information as well as suggestions about crops

The EWS has been incorporated into the county level DRM plan, as an important component for preparedness. However, in order to institutionalize EWS in the implementation of DRM, both the county government and relevant line agencies need to further strengthen their coordination. Information collection, gathering and dissemination need to be designated to relevant line agencies, and this designation needs to be monitored and supervised.

In addition to the enhancement of meteorological services the project also supported better access to market information during 2008 and 2009. Market risks were also identified as a key threat to farmers in case price developments are not known. Changes in market prices can indeed create economic risks for all agro-products, especially for the high value low storage time products, such as vegetables and animal products. Monitoring the changes in market prices and to provide market tendency predictions is of high value added for individual farmers and FCs, as it allows them to create a crop and livestock production strategy and may help them to possibly sell their products at higher prices. The county agricultural bureau however is not providing any market information. The Beijing Climate Center provided during project implementation as supplementary service agricultural products market

information for more than 20 periods to the county government, the Agricultural Bureau, the Qilin town government, the leaders of the FC of the pilot villages in Juye. Market information about the main agriculture products (rice, wheat, maize, soybean, and pork) was provided from February to October 2009. The main agricultural products trends were monitored, their prices analysed, and the reason for the price fluctuation investigated. Information how to cope with market risk was also given to the farmers. A sustainable follow up mechanism to ensure continued market information access to farmers after project end could however not be established by the projects and is now in the hands of the Agricultural Bureau.

3.4.3 Introducing advanced methods for hazard impact assessment on agriculture

The project introduced the World Food Studies (WOFOST) assessment model, as a tool to monitor crop growth (main crop is winter wheat in Juye). It simulates the growth development and yield of a cultivar with different planting density, weather, soil water, and nitrogen. The model can be used for crop growth monitoring and potential yield forecasting on regional and national scales. The project supported the collection of the climate, soil, and planting density data required for the WOFOST model, and it supported the monitoring of winter wheat vulnerability using this model. The results of the assessment indicated that the growth status of winter wheat in Juye was pretty good in the recent years, and thus the climatic conditions for winter wheat must have been good in the past few years. Using this model the TCP experts could give suggestions on how to further improve winter wheat productivity and reduce the potential risks according to the climatic conditions and winter wheat growth phases.

Besides the application of WOFOST, the project experts also discussed with relevant counterpart institutions how to use RADAR in DRM as an effective tool for assessing the hazards and vulnerability of different crops and sectors in Juye. Data requirements and actors for implementing RADAR were also discussed in the Training Workshop in April 2008.

3.4.4 Capacity Development for localized Early Warning and meteorological information management

The project conducted a series of seminars and training workshops to train county staff on the prediction and assessment of agricultural hazard risks and disasters as well as on the design and setting up of a local early warning system. The major training contents included agriculture meteorological service pattern and content; an introduction to the agriculture meteorological service and agro-meteorological disaster early warning system in the Shandong province, Heze prefecture, and Juye county; and the requirements and bottlenecks for establishing an enhanced agro-meteorological disaster early warning systems for Juye; the country's meteorological disaster early warning transmissions; and crop growth models. Rapid Agricultural Disaster Assessment Route-RADAR, a FAO developed disaster assessment toolkit based on the local crop pattern, was also introduced in the training sessions.

Training courses were delivered by BCC experts and from FAO headquarters. The main training audience were relevant officials from the Shandong Provincial Meteorological Bureau, the Heze Prefecture Meteorological Bureau, the Juye County Meteorological Bureau,

the Agricultural Bureau, the Water Resource Bureau, Township officials and village representatives. Through these training courses relevant stakeholders recognized the importance of early warning systems for DRM. The knowledge and skills of the locals about the effective delivery of early warning information and the use of this information in the DRM planning was improved.

The operational capacities for meteorological services and localized disaster early warning in Juye, were further strengthened through the purchase for the Meteorological Bureau of 3 computers and 1 UPS (for uninterrupted Power Supply). This allows the bureau to improve information collection and their capacity to link local data to the prediction of floods, droughts, low temperatures, freezes, snowstorms, rainstorms, thunderstorms, and other meteorological hazards.

3.5 DRM Activities in the Fishery/Aquaculture Sector

Juye is located in the lower reaches of the Yellow River. The value of fishery production is a relatively large proportion of total agriculture production value, and relatively large areas of land become water logged during the raining season, the flood risk management of riverine fishery and aquaculture in Juye was identified as one of the most important components of the FAO supported project. Geographically located in a low plain and a water logging area, especially the townships in the south-eastern parts of Juye, have favourable water resources for fishery. Alongside the Wanfu River, Zhushui River and Zhuzhaoxin River, the total aquaculture area in Juye has reached 23,000 hectares with fish production of 9,000 tons per year. According to the county Fishery Bureau, the total production value of aquaculture and fishery reached 116 million Yuan in 2008. County data indicates there were 3800 part time labours and 900 full time labours engaging in fishery production in 2008, and that there were 30 large scale fishery farms in Juye.

On the other hand, the low lying topography and high annual and seasonal rainfall make the county highly vulnerable to natural disasters such as floods, droughts, strong winds and hailstorms. Both droughts and floods can result in economic losses for fisherman and fish farmers. For example fish can escape from aquaculture ponds when serious flooding occurs and fish can be threatened by inadequate water supply during droughts. In the past, there were no effective measures to secure the fish production during the occurrence of these natural hazards, the only help came in the form of subsidies from the government. The project has therefore included fishery and aquaculture as key sector for enhanced DRM in particular in view of the best possible use of lower lying and regularly water logged areas.



Photo 3-5-1 Concrete wall of fish pond in Caolou Village



Photo 3-5-2 Cultivation cage of fish pond in Caolou

From April 2008 to November 2009, the TCP project supported the following activities in order to identify and better understand potential measures for DRM in aquaculture and fisheries and assess their contributions to an overall DRM approach at county level.

3.5.1 In-depth Situation Analysis in selected Pilot Villages

The first activity conducted was a field survey to gain an in-depth understanding of the situation in two recommended pilot villages namely Liuxi in the township of Qilin, and Caolou in the township of Dushan. The field survey, brought two important findings:

- Caolou has a large scale fishery production. The production had been seriously affected by flood and drought in the past. There was a great interest in aquaculture due to large area of low-lying land which is saturated with water and therefore unproductive for crops such as cotton, maize and soybeans. Most of the farmers interviewed showed an interest for shifting the current vulnerable crop production to wards aquaculture. Aquaculture was seen as a viable alternative, which could lead to bring higher incomes and would be less affected by floods occurring due to modest rainfall. Some villagers had already been gradually replacing their arable land with aquaculture ponds with cement walls; and large scale aquaculture sites for soft-shelled turtle were also flourishing. A rudimentary fisheries association had also been formed, although the role it played was not clearly defined.
- Liuxi village also suffered from floods in the past,. Fishery production was never as well developed as in Caolou. The interviews revealed that there was no real interest for fishing.. Thus no Farmer's Cooperative for Fishery Production was established in Liuxi and the site was dropped as pilot site by the project.

The village of Caolou in the township of Dushan was selected as the pilot village where the fishery model as a DRM component would be tested.

3.5.2 Strategy for Testing the Flood Resilience of Fish Pond Walls in Caolou

Normally, the fishery sector has a lower vulnerability than the cropping sector against water logging and medium floods. However, there is a high vulnerability against serious floods (for

instance the 60 year floods) caused by very high and concentrated precipitation in the summer. Most fishery farmers were not aware of this risk. The project therefore recommended that the wall height and building materials for high flood resilient fish ponds must be determined by the results of the past 50-60 years of meteorological data. According to local people, the height of the cement wall was safe for the 10 year flood, but inadequate for a 60-year flood. The senior aged villagers in Caolou highlighted 2003 as the year of the biggest flood. Based on this information minimum requirement standard wall height should be 0.5 meter to resist heavy floods. In view of potentially even stronger floods in the future (climate change) and because the species cultivated in aquaculture were mainly high value fish, soft-shell turtle and crab, fish farmers were advised however to build their fish pond walls to reach at least the height of 0.8-1m to prevent the escape of these animals in case of floods.

Finally, the TCP experts recommended that a flood monitoring mechanism should be set up and implemented by the fishery bureau in cooperation with fish farmers to test whether the cement walls were high enough and had adequate resilience in the following flooding seasons.

3.5.3 Farmer's and Fish Technician's Capacity Building through Training

Based on a training needs assessment, the project provided various training courses and workshops to enhance the capacity and knowledge of fishery technicians and farmers. Two major training workshops were carried out (1) importance and context of fishery sector in disaster risk management; (2) aquaculture techniques.

- The first training workshop focused on 3 different topics: disaster prevention & reduction, disaster preparedness, and post-disaster countermeasures. Three points were emphasized: (1) developing fishery and aquaculture industries in low-lying land unsuitable for the growth of crops due to serious flood or drought threats; (2) risk assessment of biological invasion before introducing a non-indigenous species; (3) pollution control from aquaculture sites.. In addition, the integrated concept of water resource management (Smart Water Management Concept) for river and canal water, the use of logging water from floods and the transformation of lower level farmland into fish ponds were introduced .n.
- The second workshop focused on (1) feeding habits of common cultured fishes; (2) the ecological environment of aquaculture ponds; (3) aquaculture fertilizers; (4) aquaculture feeds; (5) stocking pattern, and proper stocking density and mixed culture. The second section of the training workshop was about aquaculture pond construction, introducing site condition assessments, water source and quality assessments, soil quality assessments, and layout design (shape, size, depth, pond bottom design, various culture facilities).

3.5.4 Improving the Capacity for Water Quality Tests in Fish Ponds:

The water quality and ecological conditions of the fish ponds are directly related to the ecological risk of fish diseases which are threatening the fishery production. The situation analysis found that the county Fishery Bureau was not able to provide water quality tests for ecological risks, such as diseases and water pollutions. TCP project therefore provided support to the Fishery Bureau enabling them to purchase laboratory equipment to measure water quality.

3.5.5 *Improving coordination and integrated planning for fisheries and DRM*

Due to the time limitations of the project not all technical recommendations, such as increasing the height of the fishponds, could be fully implemented and tested. However, this project sub-component prepared the following pathways for further institutionalization of DRM technologies in fisheries:

- The fishery and aquaculture sector was introduced into county DRM, not only as an alternative solution to be used where crops grow unproductively, but also as an important solution for increasing farmer's household income, and diversifying their livelihoods; The technical concept for increasing the resilience was developed in close cooperation with the Fishery Bureau, the Agricultural Bureau and the Water Resource Bureau
- Cooperation and coordination mechanisms between the different line agencies related to agriculture, fishery production and water resource management, have been strengthened through multi-stakeholder workshops and training courses. This provides a good institutional foundation for the realization of the county DRM plans after project completion;

3.6 Farmer Cooperatives as Partners for Community Based Disaster Risk Management

In 2007, when the project commenced, the National Law of Farmer's Cooperatives entered into force. This offered an excellent opportunity and legal framework to establish formal farmers' cooperatives and link their tasks to DRM as well. The promotion of Farmer's Cooperatives (FCs) and strengthening their capacities for community based disaster risk management (CBDRM) was a key strategy within the project design.

The baseline survey strongly confirmed the importance to reinforce local collaboration for several reasons. First, since the rural reform, farmers did not undertake any more collective actions for the preparation and response to natural disasters. Individual farmers did not pay much attention any more to collective actions for drainage and irrigation infrastructures, and in fact often changed the existing drainage system close to their farmland according to their own needs not thinking about the implications for the wider community. Second, since the community internal fund raising mechanisms were abolished in the reform of the rural taxation system in 2003, the communities are now lacking the funds needed to improve the community irrigation and drainage infrastructures. According to the current public investment policy, governmental investment in water infrastructures only covers the backbone water engineering projects beyond the community level. It is difficult for village leaders to mobilize contributions from individual households;

The Center for Integrated Agricultural Development (CIAD) China Agricultural University, was the commissioned consultant organization for this project subcomponent, and provided technical assistance for its implementation. The Project implemented the following actions for capacity development and enhancement of the roles of FCs in CBDRM.

3.6.1 Assessment of FC capacities and their potential functions in CBDRM

A baseline survey at the community level was conducted in August 2007; an in-depth assessment of FC functions in CBDRM was conducted in May 2008. The outputs of the survey were used as a reference to develop the FC capacity building training programme

Based on the findings of the surveys and consultations with relevant FC leaders and county counterpart line agencies, the project synthesized an approach to strengthen farmer cooperatives as local partners in DRM.

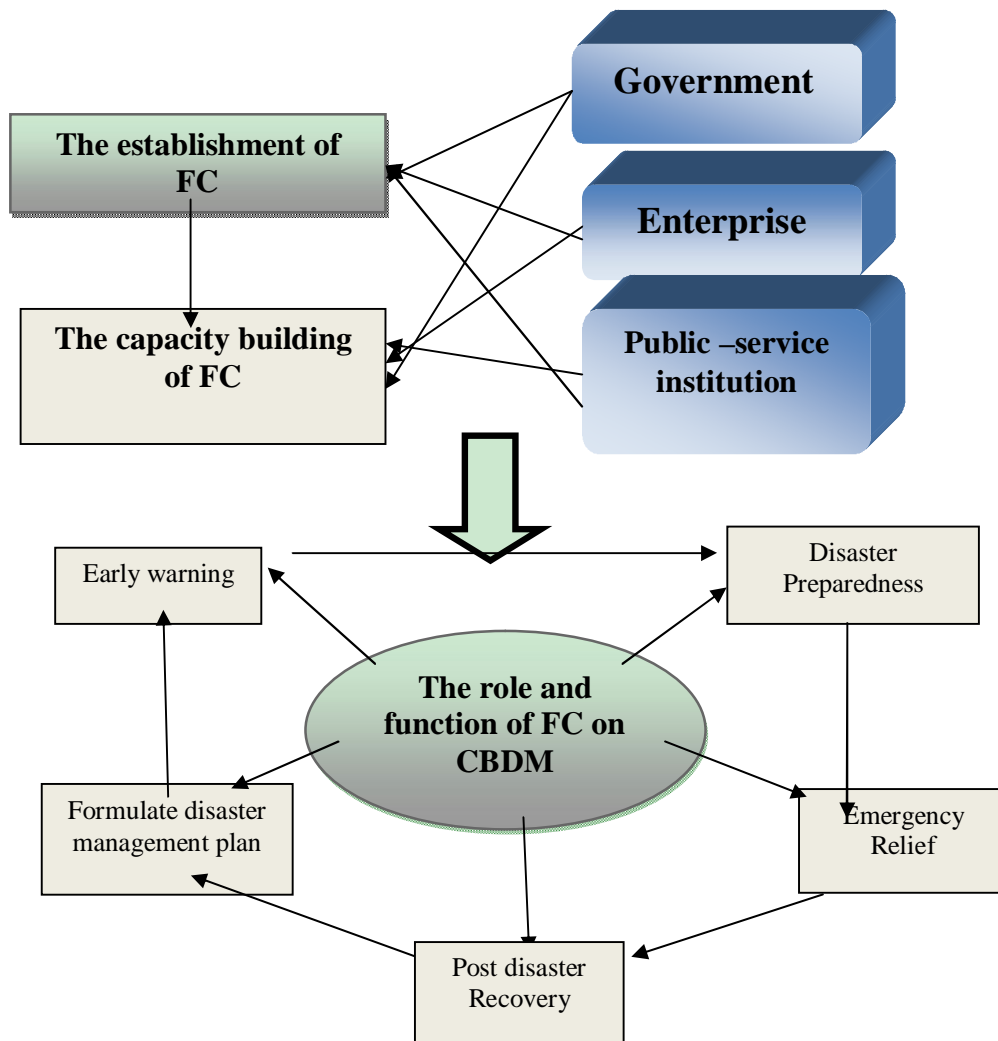


Diagram 3-6-1 FC capacity building and roles and functions in CBDRM

Diagram 3.6.1 illustrates the process of setting up FCs, how to capacitate them, including the recommended areas in which they shall take up collaborative functions as partners of governmental organizations.

More in detail the project recommended that FCs should be capacitated to take active roles in the whole CBDRM cycle. In the Juye project context it was thus decided that FCs interactively participated in:

- (i) County level DRM and Community Based DRM planning;
- (ii) Development and operation of the Early Warning System;
- (iii) Community disaster preparedness and community mitigation capacity building, including community drainage system cleaning; community irrigation infrastructure improvements and management, marketing the products for reducing the market risks, etc.;
- (iv) Emergency relief planning, especially at the level of helping village households and FC members;
- (v) Post disaster recovery. FCs play a key role in replanting alternative crops and organizing alternative income generation activities for farmers; FCs could also provide credit services for individual farmers who were greatly affected by the disaster and need cash sums for rehabilitation.

In addition, FCs should be accepted by relevant governmental line agencies as equal counterparts for the implementation of county DRM.

3.6.2 Capacity Development of Farmers' Cooperatives and Support for FC Registration

Although the National Law of Farmer's Cooperatives provided an institutional framework and guideline for the establishment of FCs at community level, the concept of modern, formally registered FCs was still very new to farmers. The creation of the new FCs benefited from the fact that informal farmers' production associations had already been in existence for a number of years in all pilot villages. Those interested were selected to be further promoted by the project to become new formally registered FCs. However their capacities were very weak, in particular in facilitating collective actions. There was a great need as well to raise awareness and train local community members, staff from the township and village committee on the development of new types of FCs. The project supported this training which focused on the basic principles of FCs, sustainable development of FCs, and the role and function of FCs in CBDRM.

The project also provided training on FC registration. In the training, an overview on the related regulatory and legal issues and requirements for registering a FC was provided. This was important as it enabled the key members of the FC to understand what preparation actions they should take in order to register their organization as an officially recognized cooperative. The main training topics included:

- The establishment and organizational development of FCs;
- The development of the functions of FCs and relevant capacity building;
- Case examples of successful FCs in China
- The definition of community-based disaster management;
- The roles, functions and participation of FCs in each part of the community-based disaster management cycle: such as early warning, preparedness, emergency relief and recovery/rehabilitation.

An FC Training Manual (in Chinese) and a Training Report were prepared by the TCP/CIAD consultant team to guide the follow-up FC capacity building activities.



Photo 3-6-1 FC leader presents the DRM plan during FC Training



Photo 3-6-2 FAO and Chinese experts deliver FC Training in the village of Qianfengqiao

3.6.3 Formulation of Village Disaster Management Action Plans

The formulation of the village Disaster Risk Management Action Plans was done in a participatory way with FC members. The planning was based on five basic aspects jointly selected and prioritized by FCs

- major steps for establishment and capacity development of the FC;
- agreed time frame for implementation of these steps;
- major preparatory activities for implementing the steps;
- responsible actors and implementers for agreed activities and steps;
- the strengthening of women's participation in the management and development of FCs.

Each village group discussed the points above and presented their results and DRM action plan to the other groups to obtain feedback from the other groups. The group discussions showed significant differences in the development of FCs in each village. The village of Nancao had already formed a very formal cooperative which was already functioning. However the other two villages had not yet effectively established an organizational structure nor service functions. (For detailed outputs please refer to the FC Training Report)

3.6.4 Pilot Activities for DRM

In the context of CBDRM, the major functions and roles taken by the FCs were to participate in the construction of the community drainage and hazard impact mitigating physical infrastructures, to reduce individual vulnerability to disasters, and help farmers establish an alternative farming pattern and livelihood strategies, which increase resilience to the natural disasters. The project provided subsidy funds for the implementation of selected core activities to village FCs in Nancao, Liuxi, Yaoqiao, Qianfengqiao and Caolou.as follows:

- In Liuxi, after the registration of their Aquacultural FC the project, supported: 1) the organization of bulk purchase of fish crab and lotus root seeds for farmers; 2) the invitation of technicians and experts to train and advise about insect and disease control,

and anti-flood production.; 3) the organization of the bulk purchase of animal fodder for FC members; 4) FCs with computers to facilitate members' search for market information on the internet;

- In Yaoqiao, the pilot activities, overseen by the FC, for the greenhouse vegetable production included: 1) the enrolment of all farmers into the FC and the organization of members for Spring vegetable production; 2) the construction of a vegetable wholesale market; 3) the design of integrated drainage networks, and the organization of members to contribute in its construction; 4) the analysis of the benefits of greenhouse vegetable production in the summary meeting.
- In Qian Fengqiao the following activities have improved disaster risk management capacities: 1) the adjustment of the agricultural structure; 2) the improvement of the water drainage systems; 3) technical training on raising of sheep and goats and training on disease prevention and control; 4) EWS for “summer harvesting and planting ” during June, which is the important wheat harvest period and planting period (June 6-20).
- In Nancao, after the registration of the FC, the FC organized a series of CBDRM activities 1) Adjustment of agricultural structure, 2) leveling of land, 3) constructing and rebuilding field canals. To meet farmers' need, the FC also 4) set up an agricultural technique service station, so as to conduct regular technical training sessions. Other activities included supplementing of seeds and fertilizer, planting and selling products collectively, and the control of pests and diseases.

3.7 Mainstreaming Gender in Disaster Risk Management

Due to the different roles women and men have economically, socially and politically, women have developed different skills from men and have different levels of vulnerability. Women in Juye are exposed to higher level to natural hazard risks than men because of the existing division of labour. Group interviews in the surveyed villages revealed that 90% of the production of cotton in the pilot sites is undertaken by women and is the women's major income source (Table 3.7.1). This means that women face higher flood disaster risks in cotton production than men. Women in Nancao village stressed that in normal years without floods, the cotton productivity is 500kg to 600kg per mu, however, in the last five years they harvested only about 100kgs due to the impacts of floods. Their income from cotton production greatly reduced, and they had to reduce their consumption, especially on items for themselves, such as clothes and food.

Table 3- 7-1 Labor division in crop production by gender (%)

Crops	Nancao Village		Liuxi Village		Qianfengqiao Village	
	<i>Men</i>	<i>Women</i>	<i>Men</i>	<i>Women</i>	<i>Men</i>	<i>Women</i>
Wheat	10	90	15	85	25	75
Corn					25	75
Cotton	5	95	10	90	10	90

Data source: field survey in 2008 June.



Photo 3-7-1 Women participating in a disaster analysis exercise



Photo 376-2 Women are the major labours for agriculture and horticulture work

In addition to the existing division of labor, more recent structural changes have massively influenced the role and the vulnerability of women, youth and the elderly. Since the majority of working age people, in particular men, migrate outside their villages to find work and cash income most of remaining laborers in the project villages are women, and the elderly. The project proposed a number of activities to strengthen gender equity, and women’s benefits and participation through its approach to community based disaster risk management.

Persons Permanently Working Outside the Villages (%)

Nancao Village		Liuxi Village		Qianfengqiao Village	
Male	Female	Male	Female	Male	Female
80	50	60	20	40	15

3.7.1 Gender Sensitive Early Warning

The) early warning system must provide timely and effective information, to allow individuals who are exposed to hazards to avoid or reduce their risk and prepare for effective response. Currently the villagers receive weather forecast information and flood warnings through the province and county TV channels, and emergency information from their village leaders who are informed by township authorities through the public address system. The villagers usually give the emergency information to the men, instead of the women, even though it is the women who are mostly responsible for the crops. The project induced that in the future, the early warning messages will be disseminated in a more gender sensitive way TV channels will provide forecast information during the hours when women are free from fieldwork and from cooking. The village leaders are committed to first pass emergency information to women.

3.7.2 Enhanced Participation of Women in Preparedness, Prevention and Mitigation

Before the project the women and men in the villages had already undertaken a few measures for preparedness, prevention and mitigation in the project area. They had diversified their

crops by planting poplar trees; they had cleaned the small ditch going through the village; and they had diversified their livelihoods by increasing the number of animals they raised, and by introducing vegetable greenhouses. However, nobody had paid attention to the drainage system, which did not work well due to lack of collective actions. The project formulated several additional strategies to strengthen preparedness, prevention and mitigation capacities, such as the improvement of the drainage system, land use planning, establishment of farmer cooperative, introduction of new varieties and techniques, which were all gender sensitive. Land use planning was formulated with great participation of women.

The farmer cooperatives were encouraged to have women leaders, and a large number of women members. Women leaders have more advantages than their male colleagues, as they can talk to women individually in their homes and convince women of their potential and the contribution that they can make in creating a community that is prepared for disasters. Mainstreaming the capacity building of women will equip them to take more active roles in DRM. Both technical and management training courses related to crops production, animal breeding, handy craft, awareness building, etc., must ensure the participation of women who are directly involved in the production. It must be assured as well that women will be the major trainees of horticulture and greenhouse vegetable production, poultry and animal production and breeding, as they are the major labor force in this routine production. Ideally special separate women's training sessions should be held.

3.7.3 Strengthened Response Capacity of Women

The county government has paid more attention to relief and recovery, than to the other aspects of disaster risk management. The township and village committee, however, only take coordinating roles in the activities. Township governments have carried out natural disaster damage assessment, but, there is no systematic assessment methodology. Assessments and relief were only mobilized in case of large-scale disasters. Women, as the major labours in the project area, lack the knowledge and techniques required to recover from flood disasters and obtain outside support and aid. Women know about the possible loss of cotton caused by floods, however, they do not have effective ways to recover or adapt. Mostly they just plant cotton again hoping for a good next year without floods. The only alternative way women currently have to recover is to plant soybeans as a post disaster alternative crop which however has a much lower economic return. The project assisted in capacitating women and men to be able to proactively respond to disasters, and in raising the gender awareness of county, township and village leaders.

3.7.4 Gender mainstreaming

Two key recommendations for mainstreaming gender in government Disaster Risk Management (DRM) were made: 1) women, who are the major labor force in agriculture must be involved in all stages of the DRM cycle, from early warning, to preparedness, emergency responses and post disaster recovery and with focus on preparedness. 2) The County Disaster Risk Management Plan must include specific actions to ensure women's participation. In order to further encourage women's participation and monitor this participation a draft gender mainstreaming framework was proposed (Table 3.7 3). This framework needs to be further applied in future projects and training activities.

Table 3.7.3 Framework for Gender Mainstreaming in Disaster Risk Management

Stage	Activities Coping with Disasters	Methods to Increase Women's Participation	Indicators to Measure Women's Participation	Affirmative Action
<i>Early Warning</i>	Predict disaster	Inform women, and men	% of women being informed	100% women informed
<i>Preventio, Mitigation Preparedness</i>	Improve drainage system	Women participate in the design of the system.	% of women member in the design team	More than 30% of the design team members are women
	Change farming system: <ul style="list-style-type: none"> ▪ Expand livestock production; ▪ Expand vegetable production; 	<ul style="list-style-type: none"> ▪ Provide technical and marketing training to women ▪ Provide micro-credit to women 	% of women being trained % of women who have the opportunity of getting credit	More than 50% of trainees are women
	Build capacity of farmer cooperatives (FCs)	<ul style="list-style-type: none"> ▪ Women participate in the FC management committee; ▪ Women are members of the FC; 	% of women members in the FC committee % of women members of the FC	More than 30% of FC committee members are women
	Introduce new technologies: <ul style="list-style-type: none"> ▪ Introduce new crop varieties resistance to water and alkalinity; ▪ Improve the soil alkalinity; 	Inform and train women on new technologies	% of women being informed % of women being trained	100% women are informed about new technologies; 90% of trainees are women
<i>Post-Disaster Relief</i>	Deliver relief	Equal delivery to women		
<i>Recovery from the Disaster</i>	Introduce new techniques to decrease the losses of cotton in a disaster: <ul style="list-style-type: none"> ▪ Use more fertilizer; ▪ New kinds of pesticide; 	Inform women of the new technologies Provide technical training to women	% of women being informed % of women being trained	100% women are informed about the new technologies; 90% of trainees are women

3.8 Integrated DRM Planning Framework at the County Level

3.8.1 Participatory Land Use Planning (PLUP) to Reduce Vulnerability

The concept for Participatory Land Use Planning (PLUP) was introduced by the project to assist communities and the agricultural bureau to better assess and understand current land use patterns in view of vulnerability and exposure of the current farming system to the natural disasters and to identify solutions to improve the existing land use pattern in order to increase the disaster resilience;



Photo 3-8-1 Village Land Transect Walk with focus on disaster vulnerability



Photo 3-8-2 Land Mapping with a focus on flood disasters

The project made the following main recommendations, for land use planning, which were partly considered already during project implementation:

- Intensive greenhouse vegetable production, using courtyards and farmland located in higher elevation areas, should be further promoted since vegetables can give higher economic profits and are less affected by the floods;
- Flood resistant cultivation techniques and high flood resistant varieties of cotton, maize and soybeans should be introduced even and overall drainage infrastructures improved. Special fertilization techniques to increase and rehabilitate the soil fertility should be applied.
- The frequently flooded lower land should be used more intensively for fish ponds. The height of the fish ponds walls needs to be greater than currently present to avoid the loss of fish in heavy flooding;
- The population of Liuxi and Nacao have good opportunities to diversify their income through quick growing tree species, whereas the village of Qinfengqiao has good conditions to further promote livestock production;
- Implementing the above recommendations for land use is beyond the capacities and functions of any individual line agency. Therefore there needs to be an interactive and close cooperation and coordination among the key members of the County Natural Disaster Emergency Contingencies Committee, such as the CAB, the Animal Husbandry

Bureau, the CLRA, the County Meteorological Bureau, and the County Fishery Bureau. A representative from each of these line agencies should be mandated to establish a cross-sectoral DRM committee designated with the task of integrated Planning for DRM.

3.8.2 Integrated Cross-Sectoral DRM Planning Framework

The County Disaster Risk Management Action Plan is a yearly plan of the county government designed to build a Comprehensive Disaster Risk Management System and also reduce the underlying vulnerabilities and risk in the county. The Plan was an intended key output of the project to consolidate the learning from all project subcomponents, embedding them into the existing county level DRM approach and plans, and to provide the guidance needed for project follow up and the institutionalization of an enhanced DRM system in Juye County. In order to formulate the plan experts from the Asian Disaster Prevention Centre (ADPC), who were responsible for developing the DRM plan, carried out the following series of activities between 2007 and 2009?

- (1) A disaster risk analysis at the village and county levels to understand the current disaster risk management system, the major risks threatening the community and household livelihoods, and the institutional set up; and to assess the institutional capacity for planning and implementation of the DRM plan. The output of the analysis provided a basis for designing the DRM planning framework.
- (2) Training for farmers on community based disaster risk management (CBDRM) and help for community stakeholders in formulating their CBDRM plans, based on the identified flood and drought risks and community risk management capacity.
- (3) Interviews, with relevant governmental line agencies, to design the county DRM framework based on the DRM cycle.
- (4) Integration of cross-sectoral DRM activities at county level. Two multi-stakeholder DRM workshops were held at the county level to develop the county DRM plan.

During the formulation process, community representatives and county governmental officials from different line agencies always played a pro-active role. Participatory and consultative methods and tools were applied during the whole process. It was therefore also a process of capacity building for all the different governmental line agencies. In order to create synergies between activities in the action plan they were grouped into key areas of DRM, namely Prevention and Mitigation, Preparedness, Response, Recovery and Rehabilitation. The Action Plan then identified key activities, in each of the main areas of Disaster Risk Management for the County Government Bureau to carry out in follow up to the project. In spite of some problems during the project to obtain the full support and buy in from some government line agencies to the formulation process of the plan and its follow up, the main structure and elements of the plan were widely discussed and shared within the county and within the province.

Table 3.8.1 shows the integrated cross-sectoral DRM planning framework. Table 3.8.2 shows the detailed Action Plan jointly prepared with key stakeholders. Short before project end it was handed over to the Juye County Government for final fine-tuning in terms of setting specific targets, locations and time frames for certain activities. It was suggested that the responsibility for the implementation of the action plan and its activities will be within the

County Government Bureaus and the respective Township and Village Committees. Funding for its implementation shall be mobilised through the county bureaus or additional funds be requested from the county/district /prefecture governments or from other developmental projects.

Table 3.8.1 The Integrated Cross-Sectoral DRM Planning Framework

Line Bureaus	Prevention and Reduction	Preparedness	Post-disaster
<i>Agricultural Bureau</i>	<ul style="list-style-type: none"> ▪ Prevention-oriented forecast. 	<ul style="list-style-type: none"> ▪ Storage of seeds, fertilizers and other materials for post disaster recovery. 	<ul style="list-style-type: none"> ▪ Formulate remedial measures, such as the postponement of re-sowing, formulation fertilizer techniques, insect control and pest prevention, and long-term management; ▪ Provide rescue materials, such as seeds, chemical and fertilizer; ▪ Provide market information for agro-products to reduce the market risks;
<i>Meteorological Bureau</i>	<ul style="list-style-type: none"> ▪ Set up and operate an effective EWS to guide the DRM; ▪ Deliver weather and climate information to governmental line agencies and communities. 	<ul style="list-style-type: none"> ▪ Make recommendations for the formulation of the preparedness plan according to the disaster assessment results. 	<ul style="list-style-type: none"> ▪ Provide information on secondary disasters induced by the initial disaster.
<i>Agricultural Comprehensive Development Office</i>	<ul style="list-style-type: none"> ▪ Level land and construct irrigation systems; ▪ Deliver disaster forecasts to people in vulnerable areas. 	<ul style="list-style-type: none"> ▪ Organize and facilitate people in townships and villages to conduct self-rescue. 	<ul style="list-style-type: none"> ▪ Provide support for rehabilitation in the form of small projects; ▪ Support the improvement of the drainage systems through agricultural development projects.
<i>Animal Husbandry Bureau</i>	<ul style="list-style-type: none"> ▪ Build a disease prevention team, provide technical guidance and quarantine monitoring to livestock breeding households. 	<ul style="list-style-type: none"> ▪ Storage of rescue materials, such as emergency vaccines and disinfectant; ▪ Build an epidemic prevention team, isolate infected area, disinfect and harmless processing. 	<ul style="list-style-type: none"> ▪ Post disaster restocking in case of serious animal loss; ▪ Post disaster animal epidemic control.
<i>Forestry Bureau</i>	<ul style="list-style-type: none"> ▪ Training on poplar tree disease control and insects prevention; ▪ Plan and build a farmland shelter forest. 	<ul style="list-style-type: none"> ▪ Insect forecast; ▪ Make feasible prevention measures. 	<ul style="list-style-type: none"> ▪ Replanting forests.
<i>Bureau of Aquatic Products</i>	<ul style="list-style-type: none"> ▪ Technique training on aquaculture and fish disease prevention; ▪ Monitoring water quality 	<ul style="list-style-type: none"> ▪ Strengthen fish ponds and add escape-proof instruments; ▪ Creation of an aquaculture-related disaster 	<ul style="list-style-type: none"> ▪ Post flood disaster water quality monitoring.

Line Bureaus	Prevention and Reduction	Preparedness	Post-disaster
	and water level.	prevention brochure.	
<i>Water Bureau</i>	<ul style="list-style-type: none"> ▪ Drainage system construction; ▪ Apply for funds. 	<ul style="list-style-type: none"> ▪ Monitor the irrigation systems regularly. 	<ul style="list-style-type: none"> ▪ Rebuild the damaged drainage system.
<i>Land and Resource Bureau</i>	<ul style="list-style-type: none"> ▪ Carry out Participatory Land Use Planning (PLUP) to reduce the vulnerability of the current land use pattern. 		<ul style="list-style-type: none"> ▪ Investigate damaged land and re-plan. ▪ Recover the damaged arable land.
<i>Health Bureau</i>	<ul style="list-style-type: none"> ▪ Formulate the medical emergency rescue plan as part of DRM. 	<ul style="list-style-type: none"> ▪ Create a storage plan for medical materials; ▪ Build up a rescue team. 	<ul style="list-style-type: none"> ▪ Conduct disinfection and epidemic prevention in disaster areas; ▪ Collaborate with the Red Cross and other committees, and deliver rescue materials such as medicine, plasma and funds; ▪ Establish temporary rescue stations and medical teams.
<i>Qilin Township</i>	<ul style="list-style-type: none"> ▪ Irrigation system construction. 	<ul style="list-style-type: none"> ▪ Build up an emergency team at the village level; ▪ Facilitate project-related activities. 	<ul style="list-style-type: none"> ▪ Mobilize party members, cadres and the masses; ▪ Ask for rescue support; ▪ Jointly with the civil department, provide rescue equipment and guide rescue activities.

Table 3.8.2 The DRM action Plan

Phase	Actions	Specific Activities	Responsible Actors		Time frame	Support Demand
			Lead Agency	Supporting Agency		
Prevention and Mitigation (Structural/ Non-structural)	Improvement and maintenance of irrigation and drainage systems.	<ul style="list-style-type: none"> ♦ Dredge and de-silt the drainage canals from the villages to the backbone drainage facilities; ♦ Construct small scale reservoirs in the low lying and flood prone areas; ♦ Build drainage / culverts and sluices; ♦ Maintain the irrigation and drainage system in the flood prone areas with the participation of village committees and Farmers Cooperatives. 	<ul style="list-style-type: none"> - County Governor; - County Water Resource Bureau; - Township Government. 	<ul style="list-style-type: none"> - Finance Bureau; - Agricultural Bureau; - Village Committees; - Farmers Cooperatives. 	There is no time frame for this activity as it depends on resource availability.	Financial budget
	Land use planning	<ul style="list-style-type: none"> ♦ Conduct Participatory Land Use Planning (PLUP) in the communities frequently affected by flood disasters at the county level; ♦ Develop hazard zone maps to guide further land use planning and infrastructure construction; ♦ Improve the land use pattern to increase its resilience to disasters: <ul style="list-style-type: none"> • Levelling of land in villages as required; • High land: keep the original structure, and plant economic crops and greenhouse vegetables; • Low land: return it to wetland, plant rice or lotus, fishery, forestland; ♦ Update the Land Use Plan every five years. 	<ul style="list-style-type: none"> - Agricultural Bureau; - Land Administration; - Township Governments. 	<ul style="list-style-type: none"> - Water Resources Bureau; - Village Committees; - Farmers Cooperatives. 	2009	Funds
	Introduce anti-disaster crop varieties and cultivation technologies to improve crop productivity.	<ul style="list-style-type: none"> ♦ Introduce anti-flood crops varieties (especially for cotton, maize and wheat), and farming practices; ♦ Introduce anti-drought crops varieties (esp. for cotton, maize and wheat), and farming practices; ♦ Introduce anti-pest/insects crop varieties (esp. for cotton, maize and wheat); ♦ Vegetable production technical service and training and greenhouse management training; ♦ Organise technical training on crop production; ♦ Organise technical training of plant pest, 	<ul style="list-style-type: none"> - Agriculture Bureau - Animal Husbandry Bureau 	<ul style="list-style-type: none"> - Shandong Agricultural Academy-SAAS; - Township Governments; - Village Committee; - Farmers Cooperatives; - Innovative farmers. 	<ul style="list-style-type: none"> - Pilot villages: 2009; - Non pilot villages: based on the outcomes of 2009 in the pilot villages. 	<ul style="list-style-type: none"> - Funds - Technical support

Phase	Actions	Specific Activities	Responsible Actors		Time frame	Support Demand
			Lead Agency	Supporting Agency		
		disease control and fertilization techniques; ♦ Develop and apply livestock animal breeding and feeding techniques to improve the productivity, livestock hygiene, and vaccination of the animals.				
	Introduce aquaculture into low lying and frequent flooding areas	♦ Promote and develop large-scale aquaculture by digging fish pond in low lying lands; ♦ Strengthen existing reservoirs and fishery ponds; ♦ Introduce special aquatic species; ♦ Establish a surveillance system for epidemic disease prevention and control by purchasing the necessary laboratory equipment; ♦ Support the development of Fishery Cooperatives to reduce market risk and provide technical services; ♦ Provide technical training on aquaculture production; ♦ Introduce cooperative river water management mechanisms between water resource bureau and fishery bureau ♦ Set up an integrated mechanism to sustain the ecological function of river water for aquatic production.	- Fisheries Bureau	- Water Resources Bureau; - Shandong University; - Agricultural Bureau; - Township Governments; - Village Committee; - Farmers Cooperatives.	- Pilot village: 2009 - Non pilot village: based on the study after 2009.	- Funds - Technical support
	Soil rehabilitation and improvement	♦ Conduct soil testing; ♦ Prepare a map of soil type to guide formulated fertilization; ♦ Introduce formulated fertilization in water logged sites; ♦ Promote deep ploughing for the leaching of salts in saline areas affected by water logging.	- Agricultural Bureau; - Township Governments.	- Shandong Agricultural Academy-SAAS; - Village Committee; - Farmers Cooperatives.	- Pilot villages- 2009; - Non pilot village by 2011.	
	Strengthen Multi-hazard Early Warning System	♦ Establish early warning system for floods, drought, epidemics and pests; ♦ Improve the delivery of early warning information (horizontally and vertically); ♦ Strengthen coordination among the Meteorological, Agricultural, Water Resource	- Meteorological Bureau; - Water Resource Bureau.	- Governor's Office; - Agriculture Bureau; - Civil Affairs; - Other key line agencies; - Beijing Climate		

Phase	Actions	Specific Activities	Responsible Actors		Time frame	Support Demand
			Lead Agency	Supporting Agency		
		Bureau and other related line agencies; ♦ Build the capacity of local institutions for the formulation of response options based on the early warning information.		Center.		
Procedures	Set up and operate a disaster information and damage assessment system	♦ Establish a pre-disaster impact assessment system (RADAR); ♦ Operationalize RADAR for formulation of the disaster emergency contingency plan; ♦ Assess the vulnerability of different communities and households.	- Agricultural Bureau; - Meteorological Bureau; - Civil Affairs Bureau.	- Beijing Climate Center; - Water Resource Bureau.	Pilot & Operationalizing the RADAR system in 2009.	
	Promote hazard resistant construction and safe construction practices	♦ Strengthen the implementation of building quality standards and regulations; ♦ Strengthen / retrofit critical infrastructures, e.g.: schools, elder homes and clinics; ♦ Strengthen supervision on construction.	- Governor's Office; - Civil Affairs Bureau; - Construction Bureau.	- Other key line agencies; - Local Media; - Township governments; - Village committee.	No time frame suggested.	
	Awareness raising	♦ Raise awareness on natural hazards at the community level, especially focus on vulnerable groups (children, schools); ♦ Organize natural disaster prevention demonstration days, and media campaign on the occasion of National Disaster Prevention and Reduction Day (12th May); ♦ Distribute brochures and leaflet and posters for disaster prevention at community level;	- Governor's Office - TV and Broadcast Bureau - Civil Affairs Bureau - Red Cross - All China Women's Federation;	- Other key line agencies - Local Media	Every year	
	Set up a risk insurance mechanism	♦ Set up insurance portfolios (life, property, agricultural) ♦ Invite farmers to participate in the insurance schemes	- Government at county level and above; - Insurance Companies; - Sharing of Beneficiaries.	- Village Committees; - Farmers Cooperatives.	Ongoing	Governmental initiative fund
Preparedness	Strengthen Disaster Risk	♦ Designation of clear and specific tasks and functions to the different agencies;	- Responsible County	- Relevant line agencies.		

Phase	Actions	Specific Activities	Responsible Actors		Time frame	Support Demand
			Lead Agency	Supporting Agency		
	Management mechanisms	<ul style="list-style-type: none"> ♦ Design and publicize the disaster management organizational structure at county and township levels; ♦ Organize regular meetings to deal with disasters, with participation of the relevant agencies of the county and township; ♦ Strengthen the capacity of county disaster management committees to enable them to be proactive in their approach to disaster risk reduction; ♦ Formulate and implement preparedness action plan with short / medium and long term recommendations at village level 	Governor; - County Risk Management Coordination Committee.			
	Capacity building of local communities and Farmers' Cooperatives for Community-Based Disaster Risk Management	<ul style="list-style-type: none"> ♦ Establish Village Disaster Management Committees (VDMC) with participation of Farmers' Cooperatives, Women's Federations and Youth Associations; ♦ Training of village committees, and Farmers' Cooperative and Women's Federation Association leaders on Community-Based Disaster Risk Management and Early Warning; ♦ Provide training on life saving and first aid techniques to the community. 	- Civil Affairs Bureau; - Governor's Office; - Commerce and Industry Bureau; - County All China Women's Federation; - Red Cross.	- Township governments; - Village committees; - Farmers Cooperatives.		
	Design evacuation routes and build safe shelters	<ul style="list-style-type: none"> ♦ Identification of evacuation routes in vulnerable villages with the participation of local stakeholders; ♦ Select location for building safe shelters; ♦ Organise evacuation simulation exercises; 	- County Governor - Public Security Bureau; - Army; - Fire Service; - Health; - Civil Affairs Bureau; - Transportation Bureau; - Township Governments;	- Other key line agencies; - Village Committees; - County All China Women's Federation; - Farmers Cooperatives.		
Response	Response	Emergency mobilization and coordination	- Responsible	- Relevant agencies		

Phase	Actions	Specific Activities	Responsible Actors		Time frame	Support Demand
			Lead Agency	Supporting Agency		
stage	coordination	–vertically and horizontally	County Governor; - County Emergency Management Committee (CEMC).			
	Emergency Response	<ul style="list-style-type: none"> ♦ Evacuation ♦ Rescue of the affected people ♦ Deliver Emergency Relief i.e. food, water, medical service and other materials; 	<ul style="list-style-type: none"> - Public Security; - Militia; - Fire Prevention and Rescue Teams; - Civil Affairs Bureau; - Transportation Bureau; - Finance Bureau; - Health Bureau; - Trade Bureau; - Hospitals. 	<ul style="list-style-type: none"> - Township Governments; - Village Committees; - Farmers Cooperatives. 		
	Reporting system	♦ Timely reporting to the upper levels of the government and relevant line agencies;	<ul style="list-style-type: none"> - CEMC; - TV and Broadcasting Bureau. 	<ul style="list-style-type: none"> - Township Governments; - Village Committees; - Farmers Cooperatives. 	Ongoing	
	Declare the emergency	<ul style="list-style-type: none"> ♦ Assess the grade of disaster; ♦ Initiate an emergency response according the disaster grade (I-IV); 	- CEMC			
Recover and rehabilitation stage	Damage and post-disaster needs assessment	<ul style="list-style-type: none"> ♦ Establish a systematic procedure for a damage and needs assessment system (to check the level of damages) ♦ Report to the upper level about the losses and damage, and required relief; 	<ul style="list-style-type: none"> - Agricultural Bureau; - Civil Affairs; - Water Resource Bureau. 	<ul style="list-style-type: none"> - Township Government; - Village Committees; - Farmers Cooperatives. 		
	Cleaning of ruins or mud	♦ Villagers volunteer groups set up and external rescue team organised;	<ul style="list-style-type: none"> - Farmers Cooperatives; - Village committees; 			

Phase	Actions	Specific Activities	Responsible Actors		Time frame	Support Demand
			Lead Agency	Supporting Agency		
			- Rescue teams.			
	Psychosocial care in case of severe disaster	<ul style="list-style-type: none"> ♦ Establish teams comprising of health officials and leaders for counselling after heavy floods or severe earthquakes; ♦ Psychosocial care through TV, broadcasting, variety shows and radios. 	<ul style="list-style-type: none"> - Bureau of Radio and TV; - Public Health Bureau; - Social volunteers. 	<ul style="list-style-type: none"> - Farmers Cooperatives. 		
	Crop Contingencies	<ul style="list-style-type: none"> ♦ Organize post-disaster harvest ♦ Plant alternative crops ♦ Organise a supply of seeds and replant the same crops based on the growth stage 	<ul style="list-style-type: none"> - Agricultural Bureau; - Township Governments. 	<ul style="list-style-type: none"> - Village Committees; - Farmers Cooperatives. 		
	Protect crops and forests	<ul style="list-style-type: none"> ♦ Initiate emergency water drainage-ASAP; ♦ Timely publicise disaster-related information; ♦ Provide fertilizer and strengthen the maintenance of affected crops; ♦ Management of post-disaster pests and diseases. 	<ul style="list-style-type: none"> - Water Resource Bureau; - County forestry bureau; - Village committees; - Farmers Cooperatives. 			
	Post disaster soil improvement	<ul style="list-style-type: none"> ♦ Test the loss of soil nutrition by floods; ♦ Rational fertilization for rehabilitating the soil productivity; 	<ul style="list-style-type: none"> - Agricultural Bureau; - Township governments. 	<ul style="list-style-type: none"> - Farmers Cooperatives. 		
	Reconstruction materials	<ul style="list-style-type: none"> ♦ Deliver the required materials for reconstruction of damaged houses and infrastructures ♦ Organize reconstruction 	<ul style="list-style-type: none"> - Construction Bureau; - Civil Affairs Bureau. 	<ul style="list-style-type: none"> - Township Governments; - Village Committees; - Farmers Cooperatives; - County All China Women's Federation. 		
	Pay insurance to the affected households and people	<ul style="list-style-type: none"> ♦ Assess the losses for insurance payments; ♦ Claim crop/livestock insurance ♦ Distribute the insurance payments to the affected stakeholders; ♦ Supervise the payment procedure; 	<ul style="list-style-type: none"> - County government; - Insurance Company. 	<ul style="list-style-type: none"> - Township Governments; - Village Committees; - Farmers Cooperatives. 		

4. LESSONS LEARNT AND RECOMMENDATIONS

4.1 Lessons learnt

The project could identify and successfully test a package of value added good practice options and processes which altogether are suitable to enhance future resilience of farming households in Juye County against the impacts of natural hazards and disasters. The implementation of the draft Plan of Action for DRM in Juye will be instrumental in this regard.

The developed and successfully tested technical packages for enhanced disaster risk reduction in agriculture and fisheries, such as the creation of culverts, the cleaning of water drainage canals, soil improvement and fertilization, agronomy interventions and productivity improvement, fishery and integrated water resource management, etc., are all site and location specific.

The individual good practices tested by the project have the potential to be further replicated and institutionalized as part also of different, diversified packages suitable to the needs of other agro-ecological settings. The replication of any individual good practice alone, however will not be sufficient to create sustainable outcomes. Packages of good practice options have been designed by applying an ecosystems approach which reflects the specific geographic as well as socio economic patterns of a region or area.

Individual and community awareness, perceptions of disaster risks, and participation willingness are determined by the social economic features of the related communities; the livelihoods features and income sources of farmer's households; the contribution of crops, livestock, cash crops and grain crops; and the labour migration to urban areas and cities must be taken into account when identifying mitigation countermeasures for a particular area or regions.

Village governance, development and capacity of community organizations (CBO), such as Farmers' Cooperatives and Farmer's Production Associations are important factors affecting the community collective actions for DRM. Capacity and awareness building of the village-based organizations for participation in DRM is a definite pre-condition for

Women are a key important stakeholder group for DRM in Juye county. As they are the labourers for the agricultural and farming activities they are key for disaster management planning and implementation at the village level.

County government coordination, and the cooperation of different line agencies in disaster risk management planning and implementation will directly affect the

effectiveness of DRM implementation. The current mechanisms for a multi-sector DRM implementation process need to be further strengthened. The overall performance and efficiency of DRM implementation will depend on the systematic integration of the countermeasures for mitigation, early warning, preparedness, relief and rehabilitation across sectors at the county, prefecture, township and village levels.

FC development and capacity building, gender mainstreaming, women's participation, and land use planning for disaster management are systemic instruments that can be replicated in other areas and regions for the management of disasters caused by climate change. These instruments can also be adopted for forest resource management, water resource management, watershed management and environmental management projects.

4.2 Recommendations for follow up

Project findings strongly confirm that proactive disaster risk management contributes to poverty alleviation and agricultural development. It needs to be actively promoted by policy makers and field practitioners at all levels and further up-scaled and mainstreamed at all levels. This is particularly important in the context that the observed increase in frequency of natural hazards and damage are considered first signs of the impacts of climate change. The exposure to losses from hazards is likely to worsen, if no effective interventions are set in place. It is therefore recommended that the outcomes and DRM models tested by the TCP project should be further applied and up scaled in other prefectures of the Shandong province and other Chinese provinces, and used to prepare project proposals for international cooperation in fighting climate change

Up-Scaling and Implementation of DRM in the County of Juye

- A draft DRM framework was developed for Juye with the participation of all relevant governmental line agencies at county level and involvement of township officials and village representatives. Before further practical replication it, however, will need further consolidation and buy-in by local and county level stakeholders;
- For implementation of any DRM strategy, multi-stakeholder participation and cooperation is a pre-condition. The Juye county government and the county governor must continue to take a pro-active coordination role to ensure implementation with wide stakeholder participation and good coordination.
- For the daily coordination of DRM implementation, each line agency should have a liaison officer;
- The technical tools tested by the project, such as the early warning and information dissemination mechanisms, FC development, land use planning, and gender mainstreaming, should be adopted by the relevant line agencies. All

management and technical staff involved in DRM implementation should get further training in order to enable them to apply the recommended methods and tools;

- A monitoring and evaluation (M&E) system and DRM implementation supervision mechanism should be developed and systematically operated to ensure that the DRM approach will be effectively implemented at all levels. A set of indicators, methods and tools for M&E and implementation supervision still needs to be developed.

Up-Scaling and Replication in the Shandong Province

- All the new concepts tested in this project can be scaled up and replicated in other areas of the Shandong Provinces, taking into account the differing local ecological and social economic conditions. The main concepts are the shift from disaster response and relief to resilience capacity building, migration and preparedness; community participation in DRM; gender mainstreaming in DRM; and integrated land use planning and water resource management.
- The new concept and management methods should be added into the existing County and Provincial Public Emergency Contingencies as annex or amendments documents.

Replication in other provinces of China

- The developed systematic DRM framework and tested concept and procedure guidelines could be replicated in all provinces of China;
- The technical guidelines and countermeasures for flood disaster management could be replicated in the Hui River catchment area in the provinces of central China, such Henan, Anhui, Jiangsu, Hubei. However, the local social economic conditions, micro-climatic conditions and geographical conditions of each specific area should be taken into account.
- Finally, the technical concept and methodological guidelines as described above could be incorporated into the national disaster management policies. These could be also incorporated into the relevant national laws and regulations.

5. Annexes

5.1. Good Practice Implementation Guidance Sheets

(1) Enhanced resilience of water drainage and irrigation system for Disaster Risk Management in Shandong, China

<i>Hazard</i>	Flood/Drought
<i>Hazard Impact</i>	Water logging in the flood season and drought in the other seasons. Drops in the crop production and the farmers' livelihood
<i>Strategy</i>	Control of waterlog and drought and restoration of water conservancy projects in Qilin Township; the dredging and reconstructing plan of the canal system; introductions of the irrigation management and canal system maintenance.
<i>Agrovoc Terms</i>	flood; drought; drainage; water logging; drainage system; irrigation; land reform; drainage canals; dredging
<i>Categories</i>	Climate Change Adaptation and Disaster Risk Reduction
<i>Global Farming System</i>	Wetland Rice Based

Synopsis

The Juye County is located in the southwest of the Shandong Province, and the Qilin Township situates in the eastern part of the County, with a population of 65,000. The villages under its administration are located in the alluvial plain, southern part of the Yellow River. Frequent water logging and droughts happen between July and August. The lack of maintenance and rehabilitation of the built drainage and irrigation infrastructure added to the current land tenure forms, as well as the human activities have caused severe damages in the community drainage infrastructures. As a consequence, the resilience of the drainage system against water loggings and floods is low, with floods and water loggings causing high economic losses for farmers living in the low lying villages of the Qilin Township.

Detailed description of the Technology

Introduction

The community-based irrigation and drainage infrastructures in the Qilin Township were built in the period known as “collective”, between 1956 and 1982. In 1982, the reform of rural land tenure changed from a collective production management system to a family responsibility. However, the existing infrastructures were not properly maintained or renovated, leaving field drainage canals, local bridges, culverts and gates, useless. Most branch canals and main field canals were not able to distribute water or draining out the logging and flooding waters during the rainy season. In addition, blocked drainage canal systems caused by sediment deposition reduced the overall drainage capacity.

Damaged facilities and infrastructure in the irrigation systems have not been repaired in time due to insufficient funds, either from local governments or communities. Natural disasters such as water logging and drought often occur in the township, constraining the development of agriculture and causing economic losses when flood disasters happen, thus threatening farmer's livelihoods. To

improve this situation, major interventions as part of the DRM plan for the township were undertaken, including the construction of a drainage culvert for improving the water logging situation in Liuxi and its neighbouring villages, and the dredging of irrigation and drainage canals in pilot villages.

Objective

The objective was to increase the community's resilience to floods, water logging and droughts by improving the community water drainage and irrigation infrastructures, as well as cleaning the canals. This improvement at the community level will reduce the economic losses of crop production, therefore contributing to sustainable livelihoods of farmers who engage in agriculture.

Implementation of the Technology

(1) Construction of the drainage culvert and rehabilitation of drainage infrastructures

As an important component of Community-Based Disaster Risk Management-CBDRM, the Qilin township built a major drainage culvert of 1.5m diameter and 100m of length, and cleaned 6 field drainage canals with a total length of 2350 meters, repairing 6 culverts and building 4 new culverts within the area. These activities were undertaken between May and July 2008. According to villagers, the improved water drainage system was effectively functioning in draining out rain water from fields in August 2008. There were no water loggings and floods during the raining seasons of 2008 and 2009. The Qilin Township Government and County Agricultural Bureau and County Water Resource Bureau provided support to construction and rehabilitation activities.

(2) The Dredging of the irrigation and drainage canal in pilot villages

The village drainage canals mainly built in the collective period were not well maintained due to lack of collective fund since the rural land tenure reform in 1982. A baseline survey showed that most of village field canals were silted up with mud and grasses, dramatically reducing their water drainage capacity. In addition, individual farmers built check dams into field canals for transporting crops and straws from their field, completely blocking the canals. To change this situation, villages dredged their field canals by hiring engineering machines and mobilizing the labours in farmer's cooperatives. The total length of the dredged irrigation and drainage canals in villages was about 9500 m with the total soil volume of 18530 m³. The field canal dredging in Qianfengqiao, Liuxi and Nancao were completed in 2008. The increased drainage capacity of cleaned field canals significantly reduced the water logging time in the rainy seasons of 2008 and 2009. Village Committees and Farmer's Cooperatives (FC) in the villages played important roles in mobilizing labour inputs and individual contributions to clean the canals and repair the damaged field culverts and bridges.

Technical details

(1) Field Baseline Survey

A water engineering specialist carried out field investigations on the existing irrigation system and drainage canals, identifying problems related to flood disasters and their causes. During the baseline survey, data and basic hydrologic information were gathered, which constituted the baseline data for designing and planning the activities in the field.

(2) Designing and planning the drainage infrastructure construction projects

Based on findings during the survey on the irrigation and drainage infrastructures and lower resilience to the floods and water loggings, selected interventions were identified and prioritized through consultation with village leaders and villagers. The construction of the drainage culvert in the Liuying irrigation system and improvement of drainage canals were identified as a top priority and

implemented, followed by the technical designing concept. The culvert drainage had a 1.5m diameter, and the culvert length through dike was of 50m with reinforced concrete, the culvert length in flooding plain of the Yunju River was of 50m with strengthened concrete. The dredging parameters of the irrigation and drainage canal in the demonstration villages were designed according to the layout of the field canals and their sedimentation.

(3) Construction and implementation of selected activities

The construction of the major drainage culvert was conducted by a selected construction team. Based on the design of the related water management projects, the team began the construction, and its quality was monitored and inspected by the water engineering specialist and the township water engineer.

(4) Project management and maintenance

After the construction of the water infrastructure projects, all the irrigation and drainage facilities and infrastructures needed proper maintenance and management during the operating process. The appropriate operation and management of the drainage and irrigation canal system were the precondition for sustaining the drainage and irrigation functions. For the constructed drainage and irrigation system and dredged canals systematic and regular maintenance and management mechanism and systematic operation will ensure long term contribution to reducing the losses of floods and water loggings

Impacts and Results

According to the Liuxi village leader and the Qinlin Township governor, the culvert benefited about 6000 mu of farmland for flood drainage, covering 6 villages (Liuxi, Liubei, Liunan, Mengdian, Dongyoufang and Xiyoufang), with a total population of 5000. The economic benefit of the culvert is significant, estimating 250 Yuan/mu (35 US\$ for every mu⁹) of economic loss each year, for a total of 1.2-1.8 million Yuan for 6000 mu.

Monitoring of the Demonstration

The constructed water drainage projects and field canal cleaning projects were monitored and supervised by the water engineering specialist. Monitoring the long term impacts and benefit of these projects will be carried out by the county agricultural bureau and county water resource bureau.

Source of testing adaptation option

This adaptation practice has been successfully tested in Juye in the context of the Strengthening Disaster Preparedness in the Agricultural Sector (TCP/CPR/3105).

Reference

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⁹ 1 mu is equal to 1/15th of a hectare.

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- Irrigation and Drainage Engineering, <http://www.irrigation.cn/course/>
- Plan and layout of the irrigation and drainage canal system. <http://www.baisi.net/thread>.
- Technical guideline on Reparation and reconstruction of the irrigation and drainage projects in the flooding and water-logging area. <http://www.chinawater.net.cn/floodcontrol/gpxf>

Picture 1: Sluice gate of Drainage Culvert in Liuxi (photo by Wang Yangui)



Picture 2: Outflow of Culvert (by Wang Yangui)



Picture 3 Cleaned Backbone Canal in Nancao (photo by Liu Yonggong)



Picture 4 Cleaned community field canal (photo by Wang Yangui)



(2) Promotion of Farmers' Cooperative (FC) Development for Community-Based Disaster Risk Management (CBDRM) in China

<i>Hazard</i>	Drought/Flood
<i>Hazard Impact</i>	Increasing vulnerability of the Farming systems and Farmers' livelihoods
<i>Strategy</i>	Establishing FCs as local partners for CBDRM
<i>Agrovoc Terms</i>	drought; wheats; cotton; double-cropping; cultivars; training
<i>Categories</i>	Climate Change Adaptation and Disaster Risk Reduction
<i>Global Farming System</i>	Wetland Rice Based

Synopsis

Community Based Disaster Risk Management is a participatory process empowering communities to properly plan for and act on disaster risk management DRM. In this context, Farmer Cooperatives¹⁰ (FCs) can play in key role as local partners.

FC development for CBDRM was promoted between 2007 and 2009 in 4 project pilot areas in Juye County which is regularly prone to flood and drought hazards. The concepts of CBDRM were introduced to FCs; their specific roles in a district wide DRM system were defined and tested, leading to the formulation and implementation thereafter of community action plans for DRM. The FCs proved successful in organizing villagers to participate in the construction, repairing and cleaning of drainage canals, implementing improved disaster-related land use patterns, and in contributing to the district level disaster risk management planning process; The FCs also supported the field testing and learning about new, more hazard resilient cultivation systems (wheat and cotton), in collaboration with a regional research institute; awareness was raised among villagers about the importance of self driven and continued DRM activities throughout the year.

Detailed description of the Technology

Introduction

Local associations or farmers groups, if appropriately trained and empowered, can play a key role in disaster risk management. In 2007, the National Law of Farmer's Cooperatives was adopted in China providing a sound institutional framework for establishment of FC at community level. However, the knowledge about the new law and its related concepts of self managed FCs are still very limited among farmers in Juye. A possible link between the functions of FCs and CBDRM was not anticipated in the law.

Objective

The objective of this practice was to include the concept of CBDRM in the overall context of FC development; thus establishing local capacities for DRM on a basis of self managed, broad based and legally recognized institutions interacting as partners with County level actors in the fight against increasing drought and flood risks in the region

Technical details

¹⁰ An important component of the FAO/Ministry of Agriculture (MOA) supported TCP "Strengthening the Disaster Preparedness in Agricultural Sector in China" (TCP/PRC/3105)

Establishment of Farmer Cooperatives in the context of CBDRM

The promotion of FC as partners in DRM was a 2 years process built around the following key pillars.

1. Baseline survey

In order to analyze the situation of farmer associations, a baseline survey was conducted to assess institutional and technical capacities within existing FCs; it also looked at the scope for and interest of FC members to introduce CBDRM as additional concept and objectives into the service portfolio of FCs. The baseline survey confirmed that informal farmer production associations had existed for years in all pilot villages but with very weak functions and outreach for facilitating collective actions. A new understanding of what FCs can be and what they can do had to be established.

2. Capacity building

Tailor-made training plans were developed for capacity building of FC leaders and members over the period of 2 years, with active facilitation from outside experts and local government. A series of community-level training activities were conducted thereafter with the local population, focusing on issues regarding farmer cooperatives establishment and management, services and tasks. Participation of women in the FC training was specifically addressed throughout the planning and development process. Training contents included detailed introduction of the National Law of Farmers' Cooperatives and practical guidelines for the establishment of an FC. The understanding of specific rules of service functions and economic gains of FCs was essential to gain members confidence on operating as a new type of FC. The understanding of potential roles of FCs in CBDRM included the following topics:

- Standard, registration procedure and criteria of FCs;
- Roles, functions, regulations, administrative management and financial management of FCs;
- Membership development of FCs;
- Responsibility and legal rights of FC leaders and members;
- Technology service system and mechanism of FCs;
- FC-based whole sale marketing and inputs purchase and further income earning activities; and other important issues, such as women's participation.
- The potential actions and services as well as responsibilities as partner for CBDRM, vis á vis their members and the county authorities.

Participatory methods proved useful tools to illustrate training subjects related to potential DRM functions of the FC; including the review of secondary data, historical profile and resource mapping, drafting of problem trees and interviews, seasonal calendars and Venn diagrams, among others.

Trainees, including village leaders and farmers, were encouraged to hold FC promotion and follow-up meetings to further encourage other farmers to join the FC in future development. Functions of FCs in CBDRM take a long process to be developed and institutionalized. It is important to encourage women to participate, not only in the capacity building training, but also in other organizational activities.

Linked to the training, the performance of effective, visible demonstrations of practical interventions for DRM, conducted through the FCs at the community level was key to enhance acceptance and support among FC members, and to gain reputation among the local authorities and village committees.

3. Formulation and implementation of FC Action Plans for CBDRM.

In the second year of the capacity building process FC Action plans for DRM were drafted together with FC members, leaders and women in particular. Key points of the Action Plan were visualized in a four-column matrix on pin boards, including the agreed schedule, major activities, current constraints, as well as responsible actors and stakeholders. Activities for FC involvement in CBDRM were given priority, such as rebuilding of the drainage system, land levelling, cleaning the canals and consolidation of small dams, among others.

The institutional support from the county or township government and village committee for the implementation of the plans is essential. They must be brought on board the planning process, either through participation at training and/or through regular information meetings. They are key actors for the monitoring of the plan's implementation and ensuring follow up. Implementation of selected priorities identified from the action plans initiated during the capacity building process in the second year.

Impacts and Results

All FCs initiated under the project have been formally registered as new Farmer's Cooperatives. The FC have played important roles in cleaning the village drainage canals, and soil rehabilitation. In one village the FC assisted in transforming lower land into fodder production fields for cattle breeding and for establishing partnership with a beef cattle development enterprise in Shanghai. The Capacity building process has also contributed to the enhancement of farmers' awareness regarding disaster risk management, especially prevention and mitigation.

Source of tested option

This practice has been successfully tested in the context of the FAO funded project Strengthening Disaster Preparedness of Agricultural Sector in China. The project was jointly implemented by the Agricultural Bureaus of Shandong Province and Juye County, FAO and the Centre for Integrated Agricultural Development (CIAD) of China Agricultural. The County Agricultural Bureau and CIAD led the capacity building training and field research process.

References and Further Reading

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- China's Action for Disaster Prevention and Reduction (full text of the white paper) http://www.china.org.cn/government/whitepaper/node_7066921.htm
- *Law of the People's Republic of China on Specialized Farmers Cooperatives* <http://www.hksti.gov.cn/2009/English/>

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Sources

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- Project "Strengthening Disaster Preparedness of Agricultural Sector in China" TCP/PRC/3501, Report of Baseline Survey and Training Needs Assessment.

Picture 1: Meeting with village committee



(3) Soils Rehabilitation in areas exposed to recurrent floods and water-logging, Shandong Province, China

<i>Hazard</i>	Floods
<i>Hazard Impact</i>	Salinization/Alkalization of Soil
<i>Strategy</i>	Integrated measures for Soil Improvement Including Tailor-made Fertilization
<i>Agrovoc Terms</i>	Flooding; water-logging; alkaline soils; saline soils; fertilizer formulations; soil ph; wheat; cotton; soil sampling
<i>Categories</i>	Climate Change Adaptation and Disaster Risk Reduction
<i>Global Farming System</i>	Wetland Rice Based

Synopsis

One severe impact of recurrent flooding in Juye County in the Shandong Province is the salinization and alkalization of soils. The soil in Juye is rich in Calcium, Magnesium, ions of Chloride, sulphate and carbonate. Salt compounds, created by positive or negative ions, enhance water salinity in the soil, reducing the roots' absorptive capacity of soil nutrients. The average annual rainfall in Juye is 500 mm, which is concentrated (more 60% of the annual precipitation) in the months of July and August.

The good practice strategy for soil rehabilitation consists of a series of interrelated measures including: drainage improvements; land levelling; deep ploughing; and most importantly, based on detailed soil testing, the application of formulated fertilization which is key to the rehabilitation of local soil conditions. Soil testing focused on nutrition values and salinity. Suitable fertilizer compositions were developed in response to the specific soil conditions and predominant local cropping patterns. Local fertilizer production enterprises were hired to produce the formulated fertilization with the dual objectives of rehabilitating the soils while providing sound fertilization for the main crops used the region, mainly wheat, cotton and maize.

Detailed description of the Technology

Introduction

The cropping areas in Juye are low lying and uneven in general. The higher lying parts of land are prone to salinization, and the lower lying segments are prone to water-logging. The uneven surface structure has adverse impacts on both irrigation and drainage. By levelling the land the irrigation efficiency can be improved and the irrigation costs can be reduced.

Deep ploughing is another important way to improve the soil in the area. For a long period of time farmers have practiced shallow ploughing and this has caused the lower soil layers to harden, thus constraining the growth of crop roots. In addition it has caused the pH of the surface layer to increase above 7.5, as alkaline soil components remain in the upper layers, and this thus further affects the growth of the root systems. Therefore, deep ploughing is applied to smash the plough pan, increasing the active soil layer and reversing the alkalinisation process.

In addition the degraded soils should be regularly sluiced. During the dry season, in order to reduce soil evaporation and thus salt encroachment towards the surface, the amount of irrigation water should be increased and the application of mulching and other agronomic measures should occur. During rainy season, water with low salt content or rainwater should be used to flush the soil salinity, generally 1-2 times per season.

The above measures are a precondition for further soil improvement, which must then be based on the results of soil testing. The ultimate goal is to increase soil quality and fertility through the application of tailor made, formulated fertilization which should be applied according to the local plant patterns and targeted yields. The capacities and skills of available fertilizer factories need to be taken into account. Technical training and field days are needed for demonstration and to promote replication.

Implementation details of the tested Technology

The practice was tested in the Nancao, Liuxi, Qian Fengqiao and Caolou villages in Qilin Township of Juye County from 2007 to 2009..

1. Soil Analysis

- a) *Sampling quantity and method:* 1500 soil samples were taken from different degraded soils, using the S shape method. Every soil sample takes 15 spots and each spot is a 0-20 centimetre depth of topsoil. The sample quartering is kept after the intensive mixing.
- b) *Soil sample pre-treatment:* natural withering, smashing and bottling pre-treatment was carried out on all gathered soil samples, establishing soil sample files.
- c) *Soil sample testing:* The soil sample testing was performed in accord with common technical standards. The testing included: soil organic matter content; soil pH value; soil available nitrogen, phosphorus, potassium, zinc, boron, iron; soil salinity; as well as other tests.
- d) *Data processing and analyses:* Data processing and analyses was delivered by the laboratory, as well as the fertilization plan, including a scientific, environmentally sound and economically affordable fertilizer formula for soil rehabilitation and fertilization of the main crops on the demonstration plots.

2. Application of the Formulated Fertilizer

- a) *Production of soil formulated fertilizer:* A local fertilizer production enterprise was selected and contracted to produce soil formulated fertilizer according to formulas provided by the laboratory and checked by the soil experts of the agricultural bureau.

Table 1: Formulated Fertilizers identified for Juye

Fertilizer Types	Crop system	Soil type	Growing period
Type I: 48% 16-N-16P-16K	wheat-cotton	Water-logged soil	Base fertilizer
Type II: 40% 30 N-5 P-5K	wheat cotton maize	Water-logged soil	Early Growing Period
Type III: 36% 31N-5Ka	maize	Water-logged soil	Corn milking period
Type IV: 57% 19N-19P-19K	wheat cotton	Water-logged soil	Base fertilizer
Type V: 48% 22 N-8P-18K	maize	Water-logged soil	Corn milking period
Type VI: Organic fertilizer	All crops	Saline and water-logged soil	Base fertilizer

- b) *Field demonstration*: Field demonstrations on demonstration plots, with a control plot, were set up and were accompanied by technical training and on-the-spot meetings. An organic-based fertilizer with a reasonable collocation of nitrogen, phosphorus, and potassium, was used as the starting point for the fertilization strategy and was then complemented with extended fertilization plans in the demonstration area.

Examples of specific fertilization applications tailored to the study areas:

- a) *Fertilization for wheat production in the area with salty water-logged soil*: for each mu wheat, 2-3 cube meter organic fertilizer (Type VI) together with 30 kg/mu of Type I as base fertilizer. At early growing period, use 20-25 kg/mu of high-nitrogen compound fertilizer (Type II). At late period, foliage top dressing, spray urea and potassium dehydrogenate phosphate (KDP).
- b) *Fertilization for cotton production in salty water-logged soil*: Adhere to the principle of "adequate base fertilizer, little sprout fertilizer, stable cotton ball fertilizer, much flower fertilizer, fill the top cover fertilizer", in accordance with the rule of cotton fertilization, increasing the organic fertilizer and potash, balance the proportion of organic fertilizer, NPK fertilizer, microelement fertilizer. Let the fertilizer play a full role for increasing yield effectively. Through the growth period, a total amount of 50-60 kg/mu formula fertilizer will be used.
- c) *Fertilization for maize production in salty water-logged soil*: The "three-period fertilization approach" is applied:
- i. "Early growing period fertilizer" (Type II) when corn leaf age index is 30% (6-leaf seedling stage), with a total fertilizer amount about 30% of the total fertilization amount;
 - ii. "core ear bearing period fertilizer"(Type V) when the corn leaf index is 60%, (12-leaf seedling stage), fertilizer in total amount of 50% of total fertilization;
 - iii. "corn milking fertilizer" (Type III) in the corn tasseling stage after the topdressing, in amount of 20% of total fertilization.

During the entire growth period, a total amount of 40-60 kg of nitrogen formulation fertilizer is used.

3. Supportive Measures

- a) *Workshops* at city and county level to discuss soil characteristics and the suitable soil fertilizer formula based on the data processing results of soil nutrient testing.
- b) *Technical training*: Two-term technical training specifically for the association personnel in the project area, so as to enhance the understanding of soil testing and formulated fertilization. Training are should be ideally held during the spring and the autumn periods.
- c) *Technical information*: After data processing and expert workshops, publication and distribution of the soil formulated fertilizer suggestion materials, to make sure that every household gets a soil formulated fertilizer suggestion card and a leaflet.

Impacts and performance of formulated fertilization

According to the County Agricultural Bureau, in average, the average yields of wheat, maize and cotton have increased by 8-12% through applying formulated fertilization techniques. While the input costs for formulated fertilization remained the same as conventional fertilization pattern.

Source of testing adaptation option

This adaptation practice has been successfully tested during 2007 -2009 in the context of Strengthening Disaster Preparedness of Agricultural Sector in China. In this project FAO and the Institute of Agricultural Technique in the county of Juye were working in promoting and conducting the soil improvement activities at the county and community level. This was done in collaboration with the county/township line agencies and local farmers. The county agricultural bureau and Shandong Agricultural Academy of Science proceeded with specific technical processing and the demonstration of formulated fertilization. Pilot testing was closely monitored and results were included into a wider option menu of potentially viable adaptation practices to drought/flood conditions, which may become more frequent and severe in the context of future climate change.

Further Reading

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Source where practice was tested

- Project “Strengthening Disaster Preparedness of Agricultural Sector in China” TCP/PRC/3501, Report of Soil Improvement by Research Institute of Agricultural Technique in Juye County.

Photo: Air-dried soil sample pre-treatment	Photo: Soil Sampling preparation (bottling)	
		

(4) Improve drought and water-logging resistance of cotton cultivations in Shandong Province, China

<i>Hazard</i>	Drought/Water logging/Flood
<i>Hazard Impact</i>	Reduction of yield or crop loss
<i>Strategy</i>	New varieties of cotton with enhanced characteristics against drought and water logging
<i>Agrovoc Terms</i>	cotton; flooding; drought; double-cropping
<i>Categories</i>	Climate Change Adaptation and Disaster Risk Reduction
<i>Global Farming System</i>	Wetland Rice Based

Synopsis

The losses caused by seasonal floods in the agricultural sector in the county of Juye, in the southwest of the Shandong Province have increased during the last decade. Juye is the lowest lying area of a topographical depression zone. Rain water from the 6 nearby counties flows into Juye during heavy rainfall. Juye, while having an average of 500 mm of annual rainfall only, is exposed to high annual and seasonal rainfall variability. It is very important to increase agricultural resilience to natural disasters and floods, in particular by introducing practical and advanced agricultural technologies.

This practice introduces new, more water-logging resistant cotton varieties and includes a new transplanting technique. In contrast to traditional transplanting, this technique is not only labour-saving, but significantly improves root development, rendering cotton plants more resistant to water-logging and drought.

Detailed description of the Technology

Introduction

In the context of current climate change and natural hazards such as water-logging and drought spells, the introduction of new cotton varieties, namely *Lumianyan* No.28 and No.29 constitutes an efficient way to enhance the resilience of local farming systems, which rely on cotton as a key cash crop.

Luminayan 28 is an insect pest-resistant and drought-tolerant Bt transgenic cotton variety. Its characteristics include strong roots, tough stems, middle-size leaves and large bolls. This cotton variety matures early but not with a premature senescence, it is an incompact plant type with good aeration, appropriate fruiting site, strong boll-setting ability, high resistance to insect pests and to *Fusarium* wilt and good tolerance to *Verticillium* wilt. Overall, this cultivar has a high field potential, wide adaptability and yield stability. This variety was examined and approved in China in 2006.

Lumianyan 29 is insect/pest-resistant transgenic and water-logging-resistant cotton. Its main characteristics are short growth and development periods (around 125 days), early maturity, high fruiting site, high resistance to insect pests and to *Fusarium* and *Verticillium* wilts. Overall, this cultivar has high field potential and good yield stability, easily adapting to the region. The variety was examined and approved in China in 2006.

Lumianyan 30 is an insect pest-resistant transgenic and water-logging resistant hybrid cotton variety of SAAS¹¹. Its main features include short growth and development period (about 121-130 days), this

¹¹ Sichuan Academy for Agricultural Sciences

cultivar can reach a 101-110 cm height, and has early maturation and high level fruiting. In general, Luminayan 30 has good aeration, a strong boll-setting ability, a large boll size, high yield and resistance to Fusarium wilt and a high tolerance to Verticillium wilt. The variety was examined and approved in China in November 2007.

In order to introduce the new varieties, training of farmers on high yield efficiency cultivation, with a focus on techniques for planting, fertilization, plant density and harvesting, as well as cultivation technologies is necessary.

Objective

To mitigate the impacts of water-logging and drought spells on cotton crops through the introduction of more hazard resilient varieties and innovative cultivation technologies.

Implementation of the Technology

For the implementation of the cultivation system, dry ridge water cultivation techniques were applied. This system includes water-saving agricultural production technologies, the use of new varieties with anti-flood and insect-resistant features, and soil improvement through the application and extension of 3-D cultivation technologies.

1. Cultivation technologies

Cropping pattern

1.1 Wheat-cotton double cropping:

Three lines of wheat were planted in a 1.5m width area in early October with an in-row spacing of 20 cm. The following year, two other lines of cotton were planted in late April or transplanted in mid-May alongside the wheat with an in-row spacing of 50 cm. The row spacing between the wheat and cotton was 30 cm.

Before planting, a 10cm high ridge was built up. Wheat was planted at the bottom of the ridge, and cotton on the ridge. Wheat could therefore easily be watered and make full use of rainwater. It could improve the germination of cotton and alleviate the controversy between wheat and cotton. During the rainy season in the summer, the rainwater can be drained out in time. This method can increase the movement of air in the cotton field and prevent boll rotting, as well as considerably reducing the damage caused by water-logging.

1.2 Garlic-cotton double cropping:

Six lines of garlic were planted in a 1.5m width area in mid-October, with an in-row spacing of 16 cm. The following year, two lines of cotton were planted in late April or transplanted in mid-May alongside the wheat with an in-row spacing of 50 cm. The row spacing between wheat and cotton was 10 cm.

Seeds

It is important to select seeds that have been through acid-delinted treatment, a chemical process that removes all linters from cotton seeds, increasing nutrient density and flowability of the product.

Imidacloprid seed treatment is a pest control treatment that improves resistance to insect and seedling diseases.

Risk reduction measures

- **Drainage:** The water level of the ditches of cotton fields was lowered by digging out and clearing the ditches. Water should be pumped out of the field if it is lying below the surrounding rivers.
- **Loosen the soil early:** Soil ventilation is bad after floods. Loosening the soil is very important to

improve soil aeration and increase soil temperature, speeding the restoration and growth of cotton.

- **Fertilization:** Cotton should be fertilized in time; otherwise nutrients drain away during the floods. 5 to 8 kg per mu¹² of pure nitrogen, such as urea, and some organic and potassic fertilizer are necessary to fertilize after wilting disappears. Fertilizer should be used during irrigation at flowering stage, preventing pests and diseases in time.
- **Delay topping:** The topping stage of cotton should be delayed by 7 days to increase fruiting branches and bolls because cotton grows very slowly after suffering from water-logging.
- **Proper pruning:** Many shoots come out and consume nutrients after water-logging. Therefore, shoots should be cut off immediately to improve the output of cotton.

2. Technical training

Technical training for farmers is a pre-requisite for introducing new varieties. The series of technical trainings conducted in this project included an in-door workshop, technical guidance in farmers' fields and field demonstrations.

2.1 In-door workshop: Before planting, farmers and field-level technicians were invited to an indoor technical training workshop on practical knowledge and skills for disaster prevention and reduction, given by experts on cotton from universities and research institutes. Detailed knowledge and techniques were discussed during an informal discussion, and the field-level technicians and farmers learned the characteristics and management skills of the main cotton cultivars. They were also taught about a number of practical techniques for disaster prevention and reduction.

2.2 On-spot technical guidance: Cotton experts were invited to Juye to provide technical guidance on site during the critical growing stages of cotton, such as the planting, germination, seeding, squaring, and boll-setting stage. Detailed techniques about cotton transplanting, and management skills on how to prevent drought and water-logging in double cropping during the planting, germination and transplanting stage were explained and demonstrated. During the seeding, squaring and boll-setting stages of cotton, experts demonstrated some details about management techniques, fertilization, pruning and topping etc., putting emphasis on practical techniques for disaster prevention and reduction after water-logging.

2.3 Field demonstrations: High-standard demonstration fields were created using disaster prevention and reduction cultivation technologies in the project area. Farmers attended these field demonstrations to learn about the technologies.

Results and Impacts

The training sessions provided farmers with understanding of the characteristics of the new cotton varieties, and cultivation technologies. Their ability to adopt these new technologies was greatly improved through the technical trainings, by means of in-door workshops, on-spot technical guidance and field demonstrations. Compared to the previous year, the yield of cotton increased by 15%.

Pre-tests showed that the lint yield of Lumianyan 28 averaged 96.2 kg per mu (15.6% greater than the control) in regional trials during 2002-2003. In 2004, this cultivar averaged 95.7 kg per mu (20.1% greater than the control) and averaged 95.91 kg per mu in the Shandong Province (23.03% greater). The following year, the lint yield of Lumianyan 28 averaged 103.4 kg per mu (17.9% greater) in the same province. The average yield of Lumianyan 28 in the area is 252.6 kg per mu.

¹² The mu is a traditional unit of land area in China equivalent to 667m². It is often reckoned to be 1/15 hectare

In the case of Lumianyan 29, the lint yield in 2003-4 averaged 94.32 kg per mu (23.15% more than 33B). In the Huanghe growth area, the lint yield of Lumianyan 29 averaged 91.5 kg per mu (9.6% more than Zhongmiansuo 41) in 2004. The following year, the yield averaged 93 kg per mu (10.7% more) than Zhongmiansuo 41 in the same area. Average yield of Lumianyan 29 in the project area is 251.3 kg per mu.

For the Lumianyan 30 lint yield, the average was 97.17 kg per mu (12.4% more than Zhongmiansuo 29) in the Shandong regional trials during 2003-2004. In the Huanghe the following year, the lint yield averaged 96 kg per mu (14.7% more than Zhongmiansuo 41). In the Huanghe growth area in 2006, Lumianyan 30 averaged 99.2 kg per mu (7.7% more than Lumianyan 15). Overall, the average yield of Lumianyan 29 in the project area is 254.2 kg per mu. Seeds of Lumianyan 30 were the most expensive among the three induced cotton varieties because it is hybrid cotton; however, the yield of Lumianyan 30 was the highest.

In 2009 the cotton crops, which are planted in Juye in late April or transplanted in mid-May were not affected by the early spring droughts. But cotton was affected by water-logging, due to the high rainfall season in the summer, especially in the months of July and August.

Table 1: Cotton yield in 2008 and 2009

Yield (kg/mu) in 2008	Yield (kg/mu) in 2009			
	Lumianyan 28	Lumianyan 29	Lumianyan 30	control
223.2	252.6	251.3	254.2	219.2

The induced cotton varieties distinctly increased the local farmers' income (about 140 RMB/mu) when compared to the previous cotton varieties.

A cost-benefit analysis demonstrates that although more investment is needed for these new cultivars, yields are greater. About 140 RMB/mu more were obtained with the Lumianyan varieties, and Lumianyan 30 was the variety with the highest yield.

Table 2. Cost and benefit analysis of cotton planting in 2009. Cotton price was 6.8 RMB/kg¹³.

Variety	Input (RMB/mu)				Outcome (RMB/mu)	Net income (RMB/mu) (Outcome - Input)
	Seed	Water	Fertilizer	Labour		
Lumianyan 28	40	20	160	590	1717.7	907.7
Lumianyan 29	40	20	160	590	1708.3	898.3
Lumianyan 30	60	20	160	580	1728.6	918.6
Control	32	20	140	530	1490.1	768.1

Monitoring of the Demonstration

Based on the results above, optimum management procedures were established for sowing time, seeding rate, irrigation, fertilization, and pest and disease control. The optimum planting time was mid to late April for Lumianyan 28 and 29. Regarding seeding rate: Lumianyan 28's optimum seeding rate

¹³ China's currency, Yuan Renminbi (1 CNY = 0,146 USD)

was 2500 for low fertility areas, 3000 for middle areas and 3500 for high fertility areas; Luminayan 29's optimum seeding rate was 3000 plant per mu.

The highest yielding Luminayan 30 had an optimum planting time of about mid-April and transplanting time of about mid-May. The seeding rate was 2200-2800 plant per mu in the Shandong province and 1600-2000 plant per mu in the lower reaches of the Changjiang River.

The cultivars continue to be monitored to further analyze their response to droughts and water-logging and further compare their yields to control variety.

Source of testing adaptation option

This adaptation practice has been successfully tested in the county of Juye, in southwest of Shandong province in China, from October 2008 to November 2009 in the context of the Strengthening Disaster Preparedness in the Agricultural Sector (TCP/CPR/3105). Farmers who attended technical training skilfully apply the techniques in production practices.

Reference

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Further Reading

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Photo: 5-1 Boll of Luminayan cotton



Photo 5-2 Intercropping of cotton with Chinese Onion



(5) Improve the drought resistance of wheat cultivations in the Shandong Province, China

<i>Hazard</i>	Drought
<i>Hazard Impact</i>	Reduction of yield or crop loss
<i>Strategy</i>	New varieties of wheat with drought resilience and anti- drought cultivation techniques
<i>Agrovoc Terms</i>	drought; wheat; cotton; double cropping; cultivars; training
<i>Categories</i>	Climate Change Adaptation and Disaster Risk Reduction
<i>Global Farming System</i>	Wetland Rice Based

Synopsis

The county of Juye is an area located in a depression zone which receives an average of 500mm of annual rainfall. During the past few decades, the unpredictability of a changing climate has exposed this area to serious drought, almost every year for the past few years, especially in the winter and spring. China is the largest wheat producer in the world, thus it is very important to increase the agricultural resilience to drought by introducing practical and advanced agricultural technologies.

These new technologies consist of new, more drought resistant, wheat cultivars to promote water-saving agricultural production technology, and the introduction of soil improvement practices with the application and extension of 3-D cultivation technologies.

Introduction

The introduction of new drought resistant wheat cultivars, and new soil improvement practices constitutes an efficient way to enhance the resilience of local farming systems to drought events. Wheat experts were invited to provide technical guidance for field demonstrations to explain, among other things, disaster prevention and reduction cultivation techniques, such as delayed planting and N fertilization, and reduced seeding rate. It is important to complement the introduction of new cultivars with training to provide farmers with management skills on soil improvement.

Objective

To mitigate the impacts of drought spells on wheat crops through the introduction of more hazard resilient varieties and cultivation technologies.

Detailed description of the Technologie

Introduce disaster-resilient crop varieties

The two wheat varieties, namely Jimai 21 and Jimai 22 (the latter created by SAAS, the Shandong Academy for Agricultural Sciences and approved in China in 2007) are noted for their vigorous roots and resistance to drought and disease. They have strong tillering ability, and many ears with strong stems. In general, these cultivars have high ratios of productive tillers and optimum ratio of yield components, as well as good resistance to powdery mildew and strip rust. (See Table 1)

Table 1: Comparison of Jimai 21 and 22 values

Characteristic	Values for Jimai 21	Values for Jimai 22
Maturity rate of leaves	0,65 million ears per mu ¹⁴	0.4-0.45 million ears per mu
	35 seeds per ear	36 seeds per ear
1000 seed weight	38-48g	43.6 g
Test weight	778-783g/l	807 g/l
Protein content	15.15% and 15.04%	12.2%
Wet gluten content	almost 33%	31.4%
Sedimentation value	30.7-32.5 ml	--
Water absorption	58.1-60.3%	57.8%
Developing time	3.6-4.4 min	3 min
Stability time	3.8-5.4 min	--
Extorsograph area	32-42 cm ²	--
Maximum Resistency	226 EU	--

Cropping pattern

Wheat-cotton double cropping:

Three lines of wheat were planted in a 1.5m width area in early October with an in-row spacing of 20 cm. The following year, another two lines of cotton were planted in late April or transplanted in mid-May alongside the wheat with an in-row spacing of 50 cm. The row spacing between the wheat and cotton was 30 cm.

Before planting, a 10cm high ridge was built up. Wheat was planted at the bottom of the ridge, and cotton on the ridge. Wheat can be easily watered and make full use of rainwater. It can improve the germination of cotton and alleviate the controversy between wheat and cotton. During rainy season in summer, rainwater can be drained out in time.

The optimum management procedures have been established based on the field trials for sowing time, seeding rate, irrigating, fertilizing, controlling of pests and diseases. The optimum planting temperature was 16-18C and the optimum seeding rate was 80,000-120,000 seeds per mu.

Disaster-relief measures

- **Irrigation:** Wheat should be fully irrigated during the turn-green stage and in winter. If it is not watered in winter, lower soil moisture prevents the growth of the lateral roots. If the wheat does not grow well irrigation of 75-150 kg urea per hectare is necessary. If the wheat has been watered well in winter, then the soil should be loose retain moisture in the early spring.

3. Technical training

A series of technical training sessions were conducted in this project including: in-door workshops, technical guidance in farmers' fields and field demonstrations. Knowledge about the characteristics and the cultivation technologies of the newly introduced cotton varieties benefits farmers considerably.

¹⁴ The mu is a traditional unit of land area in China equivalent to 667m². It is often reckoned to be 1/15 hectare

3.1 *In-door workshop*: Before planting, farmers and field-level technicians were invited to a technical training in-door workshop on disaster prevention and reduction given by experts on cotton from universities and research institutes. The techniques of the local bureaus were shared with agronomists, field-level technicians and farmer representatives, who also attended the training workshop. The workshop was based on lectures and informal discussions.

3.2 *On-spot technical guidance*: Cotton experts were invited to Juye to provide technical guidance on site during the critical growing stages of cotton, such as the planting, germination, seeding, squaring, and boll-setting stage. Experts also went to the field to give farmers assistance and guidelines in case of disasters.

3.3 *Field demonstrations*: High-standard demonstration fields were built using disaster prevention and reduction cultivation technologies in the project area. Farmers attended these field demonstrations to learn about the technologies. Farmers who attended technical training could skilfully apply the techniques in production practices.

Impact and results

In pre-tests of the new varieties, the yield of the Jimai 21 cultivar was 19% greater than that of Lumai 14, in the advanced yield trials in 1999 and 2000. In 2000-2001, the yield of Jimai 21 was 5.2% greater than that of Lumai 14 (also as control crop for 2009), averaging 538.1kg per mu. In the following season, the yield of Jimai 21 averaged 494.47kg per mu, 6.1% greater than control in regional trials.

The yield of Jimai 22 averaged 530.94 kg per mu, the equivalent to 8.98% more than that of the Lumai 14 in regional trials during 2004. The following year, the yield averaged 542.68 kg per mu, 12.59% greater than the control in regional trials. In the Huanghuai growth area, the yield of Jimai 22 averaged 517.06 kg per mu, 5.03% greater than Shi 4185 in regional trials in 2005. The same year, the yield of Jimai 22 averaged 542.68 kg per mu, equal to 4.05% greater than control in Shandong province. The highest yield of Jimai 22 was 727.43 kg per mu.

In 2009, a year with serious drought spells in the early spring, the yield of wheat increased in the studied area when compared to the yield in 2008 (see table 2).

Table 2: Wheat yields in 2008 and 2009 for Jimai 21, Jimai 22 and Control

Yield (kg/mu) in 2008	Yield (kg/mu) in 2009		
497.5	Jimai 21	Jimai 22	Control
		536.7	543.6

In a cost-benefit analysis carried out to evaluate the new cultivars, the results demonstrated that although more money (about 31 RMB¹⁵/mu) is required to plant Jimai 21 and Jimai 22 than the control variety, earnings equalled 51.4 RMB/mu in the case of Jimai 21 and 65.4 RMB/mu for Jimai 22.

¹⁵ China's currency, Yuan Renminbi (1 CNY = 0,146 USD)

Table 3: Cost and benefit analysis of wheat planting in 2009¹⁶.

Variety	Input (RMB/mu)				Outcome (RMB/mu)	Net income (RMB/mu) (Outcome - Input)
	Seed	Water	Fertilizer	Labour		
Jimai 21	50	60	160	180	1073.4	623.4
Jimai 22	50	60	160	180	1087.2	637.2
Control	44	45	150	170	981	572

Monitoring of the Demonstration

Cultivars were monitored and compared with control plots with control varieties.

Source of testing adaptation option

This adaptation practice has been successfully tested in Juye in the context of the Strengthening Disaster Preparedness in the Agricultural Sector (TCP/CPR/3105).

Reference

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¹⁶ Wheat price was 2 RMB/kg