

**Extreme Weather Events, Disaster Information  
Services and Farmers' Adaptation to Climate  
Change in Crop Production of China**

**Yangjie Wang, Jikun Huang and Jinxia Wang**  
**Center for Chinese Agricultural Policy (CCAP)**  
**Chinese Academy of Sciences (CAS)**

# Adaptation to Climate Change

- **Global issues of adaptation to climate change:**
  - **Increasing extreme weather events**
  - **Incorporating climate change adaptation into national development plans**
  - **Many studies focus on such issues**

**However,**

Little empirical study that seeks to understand the role of government support through information services on farmer's adaptation decision.

# Adaptation to Climate Change

- **Empirical evidence for designing effective adaptation measures:**
  - What frequency of extreme weather events has been occurring and how they have affected agricultural production?
  - How have farmers responded to extreme weather events?
  - What adaptation measures have been adopted?
  - Why are some farmers able to respond to extreme weather events while others are not?
  - Has any information supported farmers when they face serious climatic shocks?
  - If yes, how these policies have being provided to farmers? How effective are these policies in helping farmers to take adaptation measures?

# Research Questions

- **How do farmers adapt to extreme weather events (Engineering measures)?**
- **How major factors affect farmers' adaptation when they face extreme weather shocks (Disaster information services)?**

# Presentation

- **Methodology/Data**
- **Adaptation Measures** against **Extreme Weather Events** by **Farm Households**
- **Relationship** between **Extreme Weather Events** and **Adoption of Engineering Measures** by **Farmers**
- **Impacts of Information Support** on **Adoption of Engineering Measures** by **Farmers**
- **Conclusions and implications**

# **Economic Approach**

- **Descriptive Statistics**
- **Econometric model: Regress adaptation (1=yes; 0=no) on extreme weather year dummy, information providing, characteristics of household and plot**

# Data...

- **A household and village survey** in three provinces in China: Guangdong in South China, Shaanxi and Qinghai in the Northwest China
- **In each province**, three counties from each province were randomly selected, subject to:
  - The counties had been shocked by a serious extreme weather event (e.g., drought or flood or frost or storm surge) in the past 5 years
  - The counties had been experienced a normal year in the past 5 years

# Data...

- **Within each county**, three townships and two villages from each township were randomly selected.
- **Within each village**, we randomly selected 10 households for face-to-face household interview.
- **In each household**, we further selected two plots to gather detailed crop production information by crops.



## Statistics of sampling plots by crops

Items	Extreme weather year	Normal year	Pool of the two years
No. of households (1)	620	620	620
No. of all plots (2)	1224	1224	2448
Of which,			
Plots for winter wheat			
-No. of plots (3)	197	197	394
-Share of plots (%) (4)=(3)/(2)	16	16	16
No. of plots for maize			
-No. of plots (5)	209	209	418
-Share of plots (%) (6)=(5)/(2)	17	17	17
No. of plots for early rice			
-No. of plots (7)	265	265	530
-Share of plots (%) (8)=(7)/(2)	22	22	22
No. of plots for late rice			
-No. of plots (9)	350	350	700
-Share of plots (%) (10)=(9)/(2)	29	29	29
No. of plots of the four crops			
-No. of plots (11)=(3)+(5)+(7)+(9)	1021	1021	2042
-Share of plots (%) (12)=(11)/(2)	83	83	83

Source: authors' survey

# Data...

- **Extreme weather year dummy data:** a **year type variable**
- **year type=1**; if the county of household  $j$  experienced a serious weather shock in the year of  $t$
- **year type=0**; if the county experienced a relatively normal year

# Data...

- **Information services data:**
  - measured at village level representing whether or not a village received government early warning and prevention information against extreme weather events.
  - It equals 1 if the village received the information support either before or during the occurrence of an extreme weather event
  - Otherwise, it equals 0

# Data...

- **Socio-economic Data**

- **Social capital**

- Measured by number of household's relatives (with three generations) who work in the government

- **Wealth**

- Measured by the value of household's durable consumption goods (10,000 RMB)

- **Family size**

- Measured by the number of population

- **Age of household head (years);**

- **Education of household head (years)**

- **Gender of household head (1 for female and 0 for male)**

# Data

- **Plot Characteristics Data**

- **Soil type**

- Measured by whether it is loam (1=yes; 0=no) or clay soil (1=yes; 0=no), the basis for comparison being sandy soil

- **Plot topography**

- Measured by whether it is hilly (1=yes; 0=no)

- **County Dummy Data**

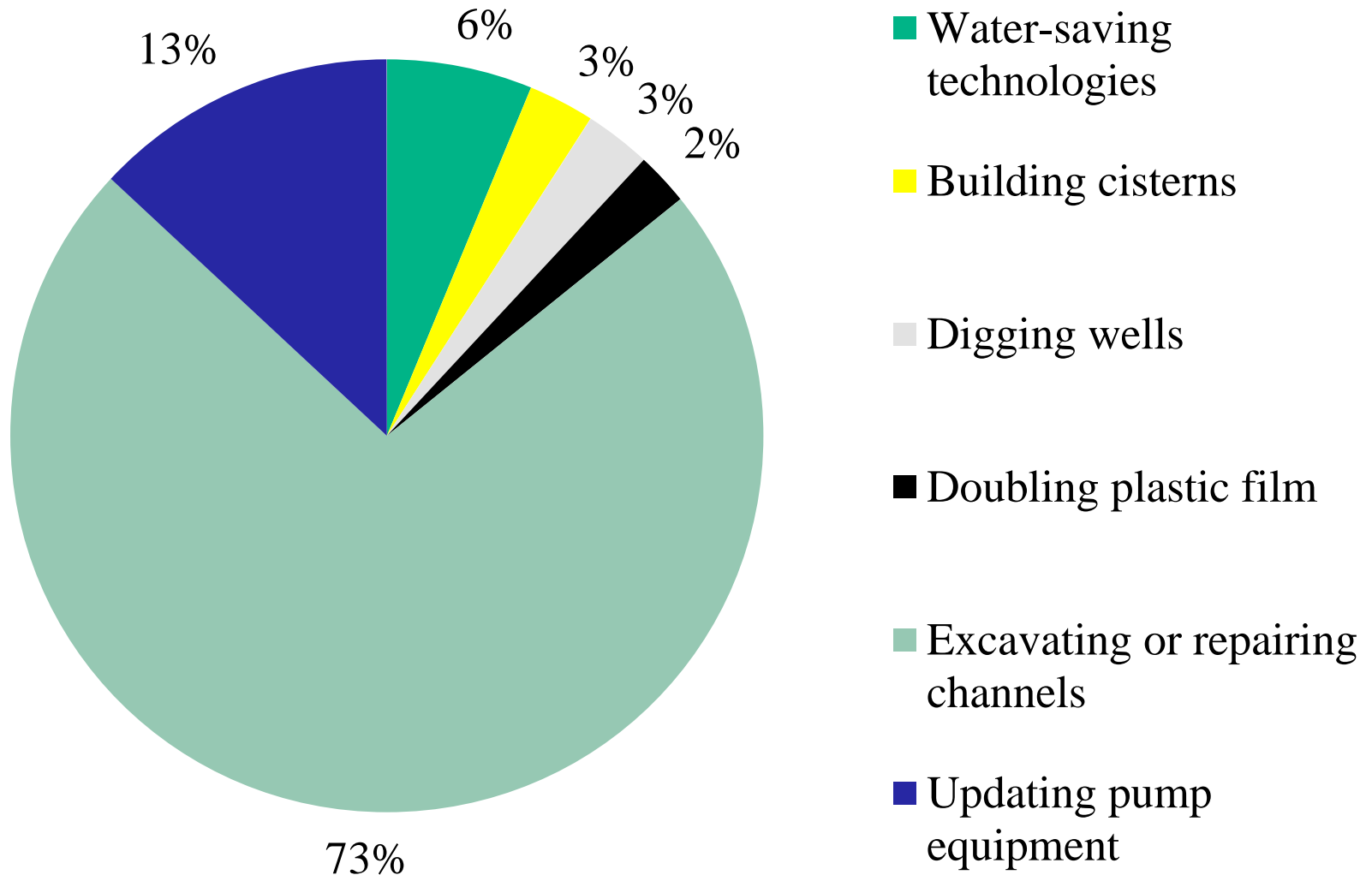
# Adaptation Measures against Extreme Weather Events by Farm Households

Engineering measures against extreme weather events by crops.

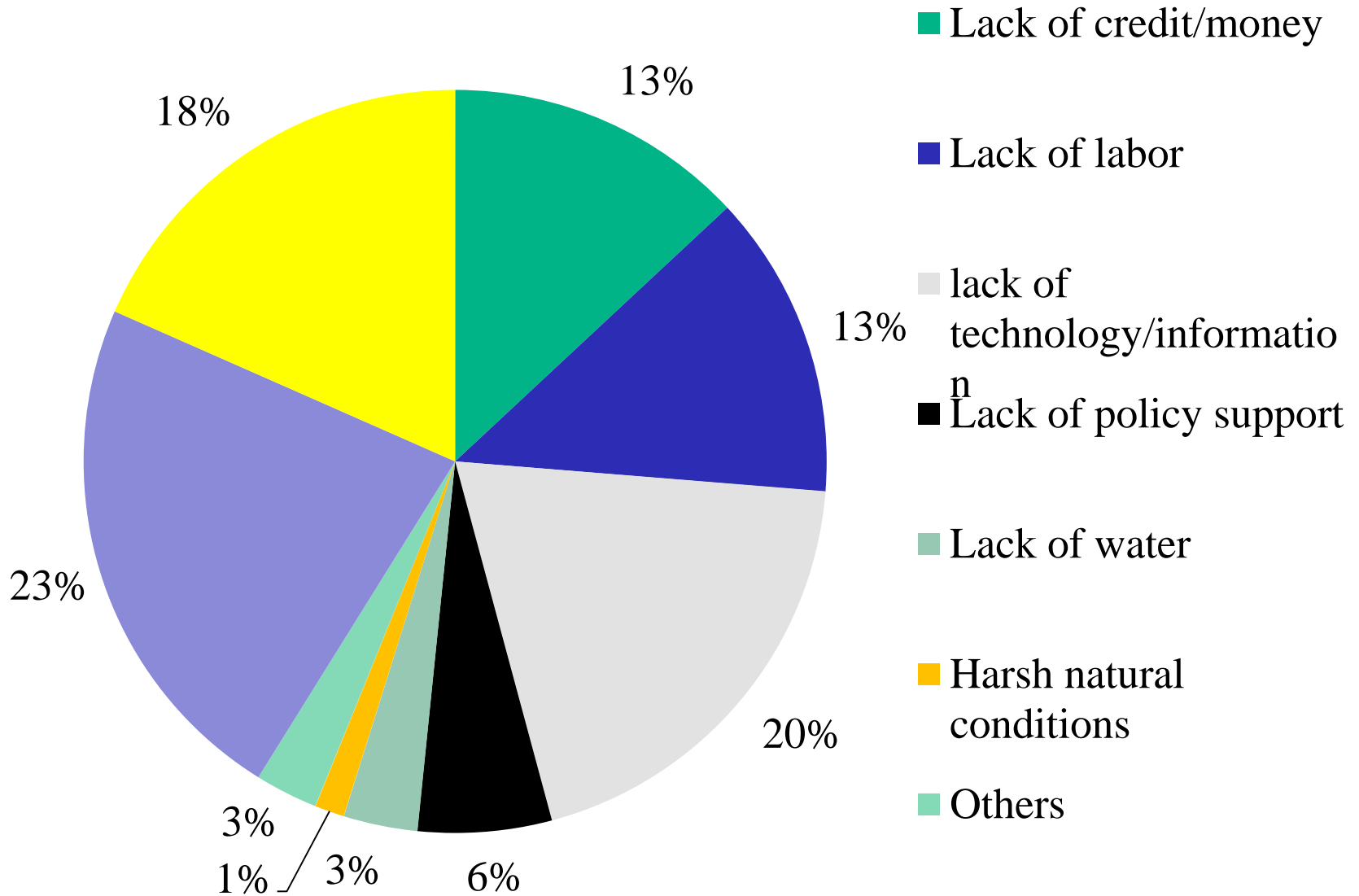
	Winter wheat		Maize		Early rice		Late rice	
	No. of plots	Share of plots (%)	No. of plots	Share of plots (%)	No. of plots	Share of plots (%)	No. of plots	Share of plots (%)
Total samples	394		418		530		700	
Without engineering measures	348	88	356	85	496	93	666	95
With engineering measures	46	<b>12</b>	62	<b>15</b>	34	<b>7</b>	34	<b>5</b>

Source: authors' survey

# Adaptation Measures against Extreme Weather Events by Farm Households



# Barriers to adaptation of farmers





# Relationship between Extreme Weather Events and Adoption of Engineering Measures by Farmers

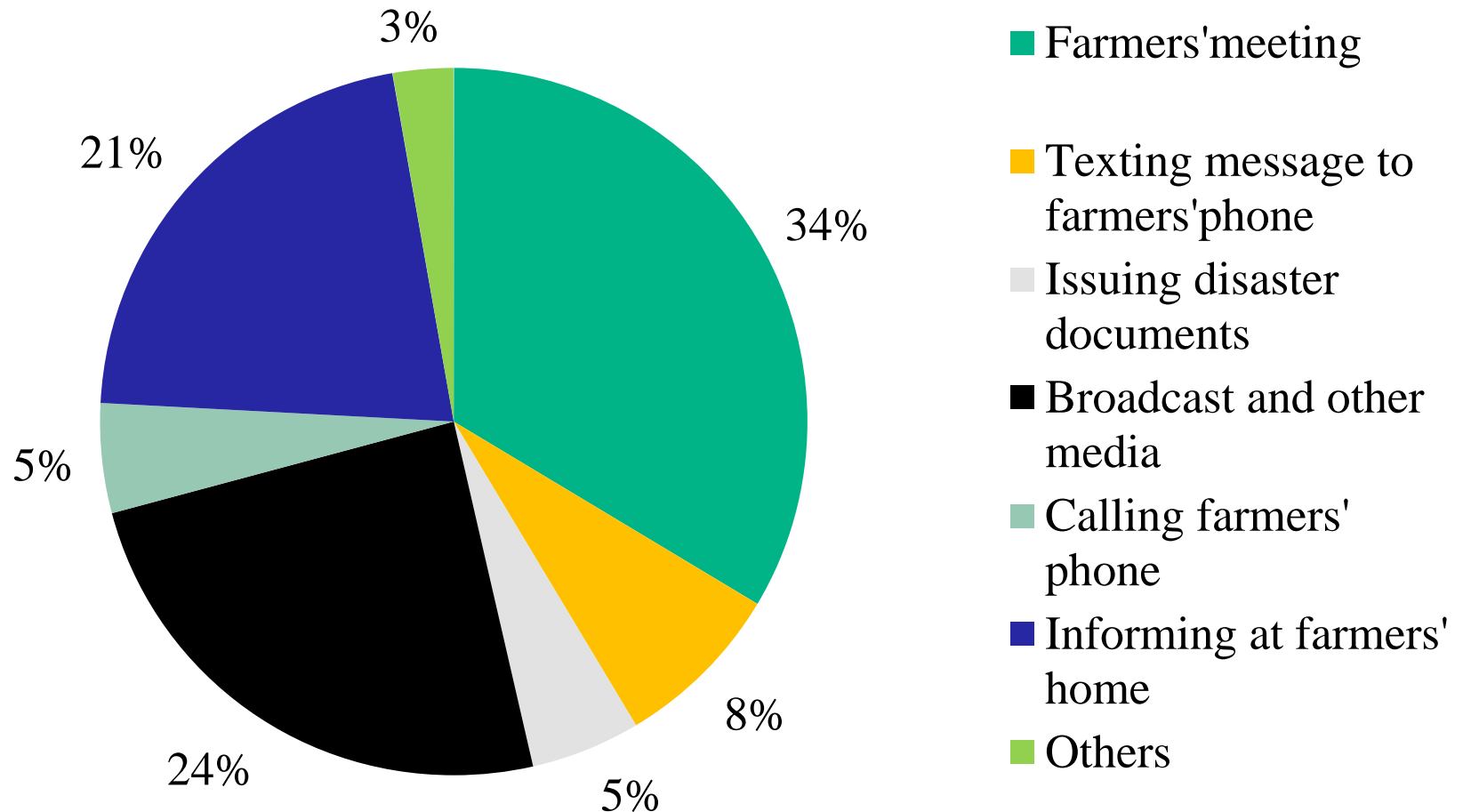
The adoption of engineering measures by farmers and information services in normal year and extreme weather year by crops.

	Winter wheat		Maize		Early rice		Late rice	
	Normal year (%)	Extreme weather year (%)	Normal year (%)	Extreme weather year (%)	Normal year (%)	Extreme weather year (%)	Normal year (%)	Extreme weather year (%)
Whether famers adapted								
No	89	87	88	82	94	93	96	95
Yes	<b>11</b>	<b>13</b>	<b>12</b>	<b>18</b>	<b>6</b>	<b>7</b>	<b>4</b>	<b>5</b>
Whether provided information to farmers								
No	71	66	72	70	63	38	64	39
Yes	<b>29</b>	<b>34</b>	<b>28</b>	<b>30</b>	<b>37</b>	<b>62</b>	<b>36</b>	<b>61</b>

Source: authors' survey

# Relationship between **Information Support** and **Adoption of Engineering Measures** by Farmers

**How the information services have been provided to farmers?**



# Relationship between **Information Support** and **Adoption of Engineering Measures** by Farmers

Relationship between information services and the adoption of engineering measures by crops

Items	Share of plots with adaptation measures (%)
Winter wheat	
Without information support	43
With information support	57
Maize	
Without information support	32
With information support	68
Early rice	
Without information support	15
With information support	85
Late rice	
Without information support	12
With information support	88

Source: authors' survey

# Impacts of Information Support on Adoption of Engineering Measures by Farmers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Winter wheat	Winter wheat	Maize	Maize	Early rice	Early rice	Late rice	Late rice
Dependent variable								
Adaptation (1=yes; 0=no)								
Independent variables								
Type of year (1=extreme weather year; 0=normal year)	0.038*		0.079***		0.028**		0.031**	
	(0.021)		(0.023)		(0.011)		(0.016)	
Information services (1=yes; 0=no)		0.057**		0.056***		0.083***		0.089***
		(0.031)		(0.012)		(0.019)		(0.014)
Social capital (number of relatives within 3 generations working in government)	0.044	0.045	0.132***	0.128**	0.008	0.012*	-0.005	-0.006
	(0.044)	(0.042)	(0.051)	(0.050)	(0.006)	(0.006)	(0.005)	(0.005)
Wealth (value of durable consumption) (10,000 RMB)	0.053**	0.055**	0.012	0.010	0.011***	0.010***	0.014***	0.013***
	(0.023)	(0.023)	(0.011)	(0.011)	(0.003)	(0.003)	(0.003)	(0.003)
Family size (population)	0.006	0.002	-0.002	-0.004	0.003	0.005	0.000	0.002
	(0.014)	(0.013)	(0.013)	(0.013)	(0.006)	(0.006)	(0.005)	(0.005)
Age of household head (years)	0.001	0.001	0.001	0.001	-0.001	-0.001	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Education of household head (years)	-0.000	-0.001	-0.001	-0.002	-0.001	-0.004	0.001	0.001
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.003)	(0.003)
Gender of household head (1=female, 0=male)	-0.047	-0.013	-0.105***	-0.085***	-0.088***	-0.088***	-0.045	-0.039
	(0.047)	(0.048)	(0.028)	(0.032)	(0.033)	(0.032)	(0.029)	(0.027)
Loam soil (1=yes; 0=no)	0.018	0.030	0.175***	0.179***	0.062***	0.060***	0.098***	0.100***
	(0.040)	(0.042)	(0.035)	(0.035)	(0.021)	(0.021)	(0.016)	(0.017)
Clay soil (1=yes; 0=no)	0.004	0.017	0.105**	0.114**	0.033	0.038	0.004	0.019
	(0.045)	(0.046)	(0.047)	(0.048)	(0.029)	(0.029)	(0.011)	(0.012)
Topography (1=hilly; 0=flat)	-0.052	-0.060	-0.106**	-0.102**	-0.050**	-0.033*	0.019	0.028
	(0.039)	(0.038)	(0.043)	(0.042)	(0.020)	(0.019)	(0.018)	(0.017)
County dummy	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
Constant	0.088	0.076	0.023	0.060	0.026	0.009	-0.007	-0.036
	(0.126)	(0.125)	(0.102)	(0.102)	(0.096)	(0.095)	(0.078)	(0.076)
Observations	394	394	418	418	530	530	700	700
R-squared	0.045	0.059	0.106	0.103	0.039	0.064	0.103	0.118

# Impacts of Information Support on Adoption of Engineering Measures by Farmers

	(1)	(2)	(3)	(4)
Variables	Winter wheat	Maize	Early rice	Late rice
<i>Dependent variable: Adaptation (1=yes; 0=no)</i>				
Type of year (1=extreme weather year; 0=normal year)	0.038*	0.079***	0.028**	0.031**
	(0.021)	(0.023)	(0.011)	(0.016)
Information services (1=yes; 0=no)	0.057**	0.056***	0.083***	0.089***
	(0.031)	(0.012)	(0.019)	(0.014)

# **Summary: Farmers' adaptation to extreme weather events in China**

- **About 10% of farmers do take some engineering measures to mitigate the impacts of extreme weather events on crop production**
- **Engineering measures adopted by farmers mainly include: digging wells, building cisterns, excavating or repairing channels, doubling plastic film and water-saving technologies**

## **Summary: When an Extreme Weather Event Occurs, How Farmers Make Response?**

- **How will extreme weather events influence farmers' adaptation decision?**
- **How will information services from government and village influence farmers' adaptation decision?**

# Effects of Extreme weather events and Information services on Famers' Adaptation in China

	Sign of Marginal Effect			
	Winter wheat	Maize	Early rice	Late rice
Extreme weather events	+	+	+	+
Information services	+	+	+	+

The occurrence of extreme weather events will promote farmers to take some engineering measures to mitigate the impacts on crop production.

Chinese farmers are more likely to adapt when provided early disaster warning and prevention information facing extreme weather events.



# Policy Implications

- **Public policy supports in terms of disaster information service matter**
- **The availability of information may raise farmers' awareness of the threats posed by the changing climatic conditions**
- **There is a great room for government in China to play in providing the early disaster warning and prevention information to local farmers**
- **Implications to the national adaptation plan on agriculture under climate change in some other developing countries**

# Further Interest Research

- **Are farmers' adaptation measures effective to reduce the shocks of extreme weather events ?**
- **What is the most successful adaptation option to climatic shocks?**
- **Priority of adaptation strategies in practice?**