

I. Results from NSF-funded project, “Impacts of El Nino-Southern Oscillation Events (ENSO) on Chinese Rice Production and the World Rice Market”

Rosamond Naylor, Walter Falcon, Scott Rozelle, David Battisti, Richard Palmer, Xiangzheng Deng, Jikun Huang. *Impacts of El Nino-Southern Oscillation Events (ENSO) on Chinese Rice Production and the World Rice Market* (NSF 0624359, \$650,000, September 2006-August 2010).

This project analyzed the impacts of ENSO on precipitation and temperature variability, and in turn on crop production in one of China’s major rice bowls, Jiangxi Province. Jiangxi is also one of China’s poorest provinces, where swings in crop production and prices can jeopardize rural incomes and food security. Because ENSO events can be predicted two to three seasons in advance of rice planting, this research provided a useful tool for policymakers in China to anticipate and mediate the impacts of ENSO events on rice production and food security. The results from this analysis have been combined with earlier results on ENSO-rice production linkages in Indonesia (NSF HD project) and the Philippines to construct a trade model to assess ENSO affects on regional and global rice prices and trade. The development of an ENSO-trade model provides an important intellectual contribution that permits further analysis of ENSO impacts on agriculture and food security throughout Southeast and East Asia. It also has practical policy implications for governments seeking to stabilize commodity prices under unstable climatic conditions.

The basic hypothesis of our project was that the Jiangxi rice-growing region receives more rain in the main (winter) cropping season during El Nino events and hence has increased rice production (and vice versa for La Nina events). Since the opposite effect occurs in Indonesia and the Philippines—El Nino events result in delayed monsoon conditions, reduced rainfall, and lower rice production during the main rice growing season—China (and Jiangxi in particular) can be expected to offset the production losses in Indonesia and the Philippines through regional rice trade.

The results of our survey and empirical analysis of ENSO and rice production in Jiangxi disproved our original hypothesis. The effects of El Nino events on rice production in Jiangxi were insignificant. Rainfall was indeed higher with El Nino conditions, but because of the widespread storage capacity via reservoirs throughout Jiangxi, the production linkage was not significant. Water managers did not appear to focus on El Nino and La Nina events specifically, as these events did not disrupt agricultural activities in the region. Farmers in our survey showed more interest regarding summer growing season rainfall—but (from our research perspective) summer rains are not directly affected by ENSO events. The farmers’ concerns led us to think more deeply about climate change in China, not just climate variability, because climate change will affect growing conditions in all seasons. Our initial research in this area showed many reasons why farmers should be worried about climate change, including: higher temperatures that will likely be “out of bounds” of growing season temperatures during the past century; changes in the pattern and intensity of rainfall throughout the year; temperature related moisture stress, and; alterations in pest and pathogen pressures. As a result of these general findings, our work focused primarily on climate variability (ENSO-rice production linkages), and also to some extent on climate change impacts on agriculture.

II. Research publications

i) Deng, X., Huang, J., Qiao, F., Naylor, R., Falcon, W., Burke, M., Rozelle, S., and D. Battisti, 2010. “Impacts of El Nino-Southern Oscillation Events on China’s Rice Production”, *Journal of Geographical Sciences*, vol. 20, 3-16.

ii) Huang, J., Yang, J., Rozelle, S., Naylor, R., Falcon, W., and D. Battisti, 2010. “Impacts of El Nino-Southern Oscillation (ENSO) events on the world rice market”, Center for Chinese Agricultural Policy (submitted to *Climatic Change*), July 20.

In addition to the two integrated climate-agricultural-market studies we have completed and are in the process of finalizing several related studies on climate dynamics in Jiangxi and in China:

i) Molnar, P, W.R. Boos, and D.S. Battisti, 2010. “Orographic Controls on Climate and Paleoclimate of Asia: Thermal and Mechanical Roles for the Tibetan Plateau”, *Annual Reviews of Earth and Planetary Sciences* 38: 77-102.

ii) Penny, S., G.H. Roe, and D.S. Battisti, 2010. “The source of the mid-winter suppression of the Pacific storm track”, *J. Climate*, 23: 634-48.

iii) Nicholas, R.E. and D.S. Battisti, 2010. “Empirical downscaling of high-resolution regional precipitation using large-scale reanalysis fields”, Department of Atmospheric Sciences, University of Washington (submitted to *J. Climate*), August.

iv) Nicholas, R.E. and D.S. Battisti, 2010. “Climate Change and precipitation in China”, Department of Atmospheric Sciences, University of Washington (to be submitted to *J. Climate*), in prep.

v) Nicholas, R.E., D.S. Battisti, D.Vimont, and R.L. Naylor, 2011. “Changes in the impacts of ENSO due to Global Warming”, (to be submitted to the *J. Climate*), forthcoming.

III. Regional networks and spin-off research projects related to climate, water availability and crop production in China conducted by the Center for Chinese Agricultural Policy (CCAP).

During this research process, we created a regional network to investigate the linkages between El Nino and agricultural production. The network included researchers and agency officials from:

i) The Center for Chinese Agricultural Policy (CCAP): Jikun Huang, Xiangzheng Deng, and Qiu Huanguang;

ii) The Chinese Meteorological Administration: Ren Guoyu, Luo Yong

iii) Local officials from Jiangxi's Mountain, River and Lake (MLR) Office: Yan Bangyou, Fang Yu, Liu Mingying; and

iv) Directors or deputy directors from the Water Resource Bureau, Science and Education Bureau, and Agricultural Bureau.

We have leveraged our NSF funded research into various other research and policy domains in China related to climate, water availability, agricultural production, and food security. These projects have been funded by other organizations and are listed below:

i) “East-West: China Establishing an Adaptation Screening Tool for the Water Sector in China” (World Bank Project, 2007-2008)

Participants: Jinxia Wang and Jikun Huang

Major outputs: Journal paper and report:

Wang, Jinxia, Robert Mendelsohn, Ariel Dinar, Jikun Huang, Scott Rozelle and Lijuan Zhang, 2008. "The Impact of Climate Change on China's Agriculture", *Agricultural Economics*, 40: 323–337. (SCI/SSCI).

Wang, Jinxia, Robert Mendelsohn, Ariel Dinar and Jikun Huang, 2008. "How China's Farmers Adapt to Climate Change?" World Bank Policy Research Working Paper, 4758.

ii) "Climate Change, Water Security and Agricultural Development in 3H Region" (World Bank Project, 2009-2010)

Participants: Jikun Huang, Jinxia Wang and Jun Yang

Major outputs: Report

Wang, Jinxia, Jikun Huang and Jun Yang, 2010. "Climate Change, Water Security and Agricultural Development in 3H Region". Report Submitted to the World Bank.

iii) "Impacts of Climate Change on Water Cycle and Water Security and Adaptation Policies in the Eastern Monsoon Regions in China" (Ministry of Science and Technology (MOST) Project, 2010-2014)

Participants: Jinxia Wang

Major outputs: This work is just beginning and we are currently conducting a field survey.

iv) "Harmonizing Adaptation and Mitigation for Agriculture and Water in China" (China-UK Sustainable Agriculture Innovation Network (SAIN) Project 1, 2010-13)

Participants: Jinxia Wang

Major outputs: The analysis for this project is underway.

v) "Low Carbon Agriculture and Mitigation of Greenhouse Gases" (China-UK Sustainable Agriculture Innovation Network (SAIN) Project 2, 2009-11)

Participants: Jikun Huang, Ruifa Hu, Xiangping Jia

Major outputs: publication and policy brief

Huang, Jikun, Ruifa Hu, Jianmin Cao, and Scott Rozelle, 2008. "Training Programs and in –the –field Guidance to Reduce China's Overuse of Fertilizer Without Hurting Profitability", *Journal of Soil and Water Conservation* 63 (5): 165-167.

Policy Brief: "Improved Nutrient Management in Agriculture: A Neglected Opportunity for China's Low Carbon Growth Path." Submitted to the State Council in May 2010 and noticed by vice-premier Hui Liangyu. The Ministry of Agriculture has arranged several meeting to discuss the policy recommendations from this policy brief.

vi) "Climate Change and China's Agricultural Sector" (International Policy Council (IPC) and International Centre for Trade and Sustainable Development (ICTSD) Project, 2009)

Participants: Jikun Huang, Jinxia Wang and Scott Rozelle.

Major outputs: Report

Wang, Jinxia, Jikun Huang and Scott Rozelle, 2010. "Climate Change and China's Agricultural Sector: An Overview of Impacts, Adaptations and Mitigation". Issue Brief No. 5, May 2010, ICTSD-IPC Platform on Climate Change, Agriculture and Trade.

vii) "Climate Change Adaptation Program for the Pacific" (Asian Development Project, 2010-)

Participants: Jinxia Wang

Major outputs: Involved in a regional network for this project; research just beginning.

viii) "Impacts of Land Use Changes on the Global Climate Change" (Ministry of Science and

Technology (MOST) Project, 2010-2014)

Participants: Xiangzheng Deng

Major outputs: The project is just beginning with the design of a modeling framework and field investigations

ix) “Strategic Study and Policy Simulation on Mitigating and Adapting to Global Climate Changes” (Knowledge Innovation Project from Chinese Academy of Sciences, 2010-2012)

Participants: Xiangzheng Deng

Major outputs: We have designed our protocols and are in the data-gathering phase for evaluating the impact of carbon sequestration management strategies of cropland in China.

IV. For more information and to view documents, please see:

1) Stanford University: Center on Food Security and the Environment (FSE)

China ENSO project:

http://foodsecurity.stanford.edu/research/impacts_of_ens0_events_on_chinese_rice_production_and_the_world_rice_market/

2) University of Washington’s links to the ENSO- China project:

<http://www.atmos.washington.edu/~david/china.html>

3) CCAP's work on climate variability, climate change, and agriculture:

<http://en.ccap.org.cn/show.php?contentid=3193>