

WORKING GROUP ON ENVIRONMENT IN U.S.-CHINA RELATIONS MEETING SUMMARIES

Environmental Financing in China

28 January 2000

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To better address environmental problems, the Chinese government has been slowly increasing funding for environmental projects. In the Tenth Five-Year Plan, the Chinese government plans to invest slightly over one percent of its GNP on pollution control.

Central banks, industrial ministries, or other central government agencies control between 20 and 25 percent of the total environmental protection investments in China. In stark comparison to central government contributions, city or county governments generate approximately 55 percent of the total financing for environmental protection projects and infrastructure. The approximate 300,000 foreign joint venture companies in China contribute between 5 and 10 percent of pollution control investments. Multilateral and bilateral lending sources, particularly the World Bank and the Asia Development Bank, fund approximately 15 percent of the environmental protection projects in China. Despite the diversity in funding sources, there is a great need for reliable revenue streams such as pollution fees or taxes in China. Currently, the capacity of environmental financing at the municipal level is low.

The environmental problems facing China present opportunities for U.S. government agencies to advise Chinese environmental and financial agencies on how to assess investment priorities and learn about a variety of financing mechanisms. The first step in such assistance would be to document the most serious environmental problems and identify facilities to address the environmental problems (e.g., facilities for wastewater treatment, water supply, and solid and hazardous waste disposal). Only after inventorying the needs for environmental facilities at different levels of government and setting priorities can officials begin to consider what may be the appropriate financing

mechanisms to address the pollution and conservation problems. There are a variety of financing mechanisms that can assist local governments to carry out environmental protection projects. Types of such mechanisms include: 1) user fees; 2) private funding; 3) multilateral assistance; 4) government transfers and subsidies; 5) loans; 6) revolving loans; and 7) municipal bonds.

The U.S. Environmental Protection Agency (EPA) has considerable experience in assisting local governments in the United States in setting up revolving loan funds. Internationally, the EPA's Environmental Finance Office has helped Russia create an offshore environmental infrastructure bond guaranty company. This EPA office also has created a draft proposal for a similar bond guaranty company for China that would aim to facilitate the financing of the foreign technology and other foreign goods and services related to environmental infrastructure projects, particularly within municipal governments in China. The purpose of creating such a guaranty company is to lower the interest rates and to lengthen financing terms to the maximum extent possible on the financing of the foreign content of such projects. This company would function as a financial guaranty insurance corporation.

The environmental infrastructure bond guaranty project would involve the creation and capitalization of an offshore corporation that will guaranty municipal bonds issued to finance the foreign content of environmental infrastructure projects. The reason for creating such a corporation offshore is threefold. First, debt guaranteed by such a corporation will obviate the sovereign credit rating of the Chinese government. Second, assuming such a corporation has a high investment-grade claims payment rating, it will broaden the market for bonds guaranteed by the corporation, thus assuring that the largest possible pool

of investors will be legally able to bid on such bonds. Third, a bond guaranty corporation will provide added comfort to international investors who fear any perceived risk that the Chinese government might permit the default on such bonds by the issuing municipalities. These factors will assure that such guaranteed bonds will have the longest possible terms and the lowest possible rates that will result in the

most favorable financial terms possible for Chinese environmental infrastructure projects.

For more details on this offshore environmental infrastructure bond guaranty company proposal, please contact the U.S. EPA, Environmental Finance Program: <http://www.epa.gov/efinpage/>



HIV/AIDS AND HUMAN SECURITY IN SOUTHERN AFRICA

“At least half of all 15 year olds in countries including South Africa, Zimbabwe and Botswana are projected to die from HIV/AIDS in the coming years. This is a catastrophe of staggering proportions.”

Lee H. Hamilton, Director, Woodrow Wilson Center

The Woodrow Wilson International Center for Scholars presents a 90-minute program to raise awareness of HIV/AIDS in Southern Africa. Formidable obstacles exist to stemming the tide of the disease in Africa, including poverty, lack of education and infrastructure, and cultural stigma. The distinguished panelists discuss the nature and scope of this devastating epidemic, efforts underway in Africa and internationally to control the disease, and approaches the global community should take in response to the unprecedented human suffering caused by HIV/AIDS.

Sponsored by the Woodrow Wilson Center’s Environmental Change and Security Project, Africa Project and *Dialogue*.

For more information go to www.wilsoncenter.org or ecsp.si.edu

Environmental Financing in China—Multilateral Activities

9 February 2000

Alan Miller, Global Environment Facility

Tim Ryan, International Finance Corporation

In this second meeting on environmental financing, the Working Group on Environment in U.S.-China Relations discussed the extent and potential of Global Environmental Facility (GEF) and International Finance Corporation (IFC) environmental financing activities in China.

IFC Financing for Environmental Projects

Before discussing IFC financing for environmental projects in China, Tim Ryan, an IFC Senior Investment Officer for East Asia, outlined the overall mission and role of IFC. The IFC aims to promote private sector investment in developing countries that will reduce poverty and thereby improve people's lives. IFC, which is a member of the World Bank group and is owned by 174 governments, only invests in private-sector projects that are both *commercially viable* and promote *sustainable development*. In fiscal year 1999, IFC approved U.S. \$3.5 billion of investments in 255 projects worldwide.

IFC does not accept government guarantees and instead targets its investments to act as catalysts to stimulate and mobilize private investment. Investment services provided by IFC come in a number of forms:

- Project finance, which includes loans and equity funds (the latter is often utilized in China);
- Mobilization of capital;

- Financial advisory work;
- Capital markets development, such as credit lines, direct agency lines provided to banks, and the creation of formal or secondary stock exchanges; and,
- Special development initiatives, such as investments in small and medium projects that contributed to the Mekong River development project.

Additionally, all IFC investments must follow four basic guidelines:

- The IFC investment can only be a maximum 25 percent of total project costs;
- IFC investment is based on market pricing and commercial rate of returns, for IFC views concessional financing as a distortion. IFC is, however, flexible on final maturity and allows some grace period for repayment. This investment guideline applies to IFC financing, not joint IFC/GEF funding;
- IFC does not accept government guarantees because they can distort the private market; and,
- All investments must meet IFC and host-country environmental guidelines.

Some specific guidelines for IFC equity and loans are presented in Table 1.

Table 1. IFC Investment Guidelines for Equity and Loans

Equity

- Normally 5%-15% Ownership
- Not Single Largest Shareholder
- No Direct Involvement in Management
- Long-term Investor: 8-15 Years
- Public Listing Preferred Exit Mechanism

Loan

- Hard Currencies
- Market Interest Rates
- Long-term: up to 15 Years
- Secured by Project Assets
- No Government Guarantees

IFC Investments in China

In China, IFC investment is highly desired, for IFC provides direct long-term funding and this investment acts as a catalyst for other investors and lenders, who could provide concessional funding. IFC is also welcomed because it is viewed as a neutral investment partner whose extensive due diligence on projects mitigates risks. From 1985 to 1999, IFC's cumulative portfolio in China has grown from about \$20 million to more than \$700 million, which means China is IFC's fastest growing portfolio. Strong interest in domestic and international private sector investment in China has fueled IFC's growth in activities.

IFC's strategy in China encompasses many areas of investment, such as: 1) project finance; 2) capital markets; 3) state-owned enterprise restructuring; 4) development in the interior provinces; and 5) domestic private sector. The latter sector includes investment in township village enterprises, a very difficult, but potentially rewarding sector for private investment. In China IFC has emphasized corporate governance and transparency in Chinese companies.

IFC already has learned some lessons in promoting successful private investments in China, of which the most critical is the selection of a partner who is reliable and committed. Sometimes too many partners join into the investment, and some are not sufficiently committed. Moreover, in a multi-partner arrangement there is often no true leader of the project. In investing in the private sector in China it is also important to identify legal and approval obstacles early. Sales and distribution networks in China are often insufficient, for it is often difficult to compete with state-owned firms that do not pay taxes. Overall, investors in China must always be prepared for surprises.

IFC's Environmental Projects Unit and China

IFC's Environmental Projects Unit (EPU) acts as a catalyst and an incubator to identify, develop, and structure IFC projects with specific environmental goals. Environmental Sectors in which EPU is involved include:

- Environmental services and infrastructure, such as clean water and waste management;
- EPU tries to promote energy efficiency through investments in: 1) industries, 2) transportation and distribution, 3) manufacturing, 4) energy service companies, and 5) financial intermediaries;
- Renewable energy, which includes investments in biomass, wind, solar, geothermal, and small-scale

hydro;

- Eco-tourism, sustainable forestry, and agriculture;
- Environmental funds; and,
- New Technology Development and Deployment in such fields as fuel cells, clean coal, and efficient vehicles.

In all IFC projects, environmental and safety criteria are emphasized. This puts IFC investments at a disadvantage in China, where such criteria are not strictly applied to domestic companies and projects. In the past IFC has not placed enough emphasis on environmental investments in China, but IFC's investment in the highly polluting township village enterprise sector could play a major role in pollution prevention. Moreover, as the energy sector becomes more privatized in China, the potential role of IFC will be greater. There are numerous examples of IFC environmental projects worldwide that could have application in China. A sample of such IFC projects is listed below:

- Honeywell Energy Service Company—IFC Power Department—\$300 million Multi-Project Facility;
- Renewable Energy and Energy Efficiency Fund—IFC Power Department—\$200 million Worldwide Fund (equity + debt);
- Terra Capital Fund—IFC Latin America Department—\$50 million Biodiversity Fund; and,
- Middle East/North Africa Environment Fund—IFC CAMENA Department—\$50 million Regional Fund.

GEF Activities in China

Alan Miller, a Senior Environmental Specialist for Climate Change at the GEF provided an overview of this financing institution and its work in China. The GEF is a financial mechanism that provides grants and concessional funding to developing countries and those with economies in transition for projects and programs that protect the global environment and promote sustainable economic growth.

GEF initially was set up as a pilot project in 1991 to address the growing need for a coordinated response to global environmental challenges. In 1994, 73 participating governments concluded negotiations to restructure GEF to satisfy the demands of developing countries and donor countries. Developing countries did not want GEF to be located inside the World Bank, but donor countries did not want to create a new independent institution to fund sustainable

Table 2. Sample of GEF Projects in China

Project Name	Program Entry	Implementing Agency	GEF Allocation	Total Costs
Development of Coalbed Methane Resources in China	1991	UNDP	\$10 million	\$10 million
Issues and Options in Greenhouse Gas Emissions Control	1992	UNDP	\$2 million	\$2 million
Sichuan Gas Transmission and Distribution Rehabilitation	1992	World Bank	\$10 million	\$122.7 million
Energy Conservation and Pollution Control in Township and Village Enterprise Industries	1995	UNDP	\$1 million	\$ 1 million
Efficient Industrial Boilers	1996	World Bank	\$32.81 million	\$101.38 million
Promoting Methane Recovery and Utilization from Mixed Municipal Waster	1996	UNDP	\$5.29 million	\$19.57 million
Energy Conservation	1997	World Bank	\$22.2 million	\$202 million
Capacity Building for the Rapid Commercialization of Energy-Efficient CFC-Free Refrigerators in China	1998	UNDP	\$9.86	\$41.15 million
Renewable Energy Development	1998	World Bank	\$35.73 million	\$408 million
Coal to Gas Boiler Conversion	1999	World Bank	\$25 million	\$462 million
Energy Conservation and GHG Emissions Reducation in Chinese Township and Village Enterprises (TVE), Phase II	1995, 1999	UNDP	\$ 8 million	\$18.55 million
Renewable Energy Partnership	2000	World Bank	\$350,000	n/a

development projects. The compromise was to create GEF outside the World Bank, but to mandate that GEF projects and programs be managed through three implementing agencies—the World Bank, UNDP, and the UN Environmental Programme. After this compromise was reached, thirty-four nations, including 13 of the recipient countries, then pledged U.S. \$2 billion to the international trust fund that would support GEF funding. Today, over 155 countries are GEF participants

Initially GEF funded projects in developing

countries that helped support their compliance with the Montreal Protocol to limit the production of substances that deplete the stratospheric ozone. Today, GEF focuses its funding on four planet-wide concerns: 1) climate change; 2) biological diversity; 3) international water; and 4) stratospheric ozone depletion. Activities concerning land degradation (primarily desertification and deforestation) and also that relate to at least one of the four focal areas, are also eligible for funding. While GEF supports projects supporting global environmental agreements, the

ultimate focus of all GEF assistance is on the local benefits.

Among the international development regimes, GEF has a unique niche in that it operates through environmental conventions and its three implementing agencies to complement existing aid programs. GEF does not substitute for regular aid programs. The main objective of GEF resources is to enhance projects with global environmental benefits for which official development funds are not available.

The newest international environmental agreement under which GEF has been operating is the UN Framework for Climate Change Convention. While GEF has also been conducting some experimental climate change assistance in transportation and carbon sequestration projects, its three main operational programs for climate change are: 1) removing the barriers to energy conservation and energy efficiency; 2) promoting the adoption of renewable energy by removing barriers and reducing implementation costs; and 3) reducing the long-term costs of low greenhouse gas-emitting energy technologies.

GEF is currently implementing 82 climate change projects, approximately a dozen are located in China

and are listed in Table 2. For climate change projects, GEF has a U.S. \$175 million commitment in China and total GEF assistance in China is U.S. \$900 million. In addition to funding climate change projects, GEF also pays for countries to submit their National Communication for the UNFCCC. Notably, China has delayed in taking this money and submitting its National Communication, for once China accepts the funds it must complete an inventory of greenhouse gas (GHG) emissions. This inventory would then become a published baseline for China's GHG emissions. The National Communication is very political for all countries.

The investments by both IFC and GEF are catalysts for private and multilateral investment. However, sometimes GEF provides 100 percent of the funding for technical assistance. In China the GEF often undertakes small projects to act as a model and demonstrate new technologies or policies. One current project aims to promote the conversion of all dirty boilers in Beijing. (*Editor's Note, See inventory in this issue of the China Environment Series for updated descriptions of GEF projects*).

UPCOMING WOODROW WILSON CENTER PUBLICATION

United States Energy and Environmental Cooperation in China
By Pam Baldinger and Jennifer L. Turner



**Woodrow Wilson
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This policy brief, which will be published in late summer 2001, provides a succinct summary of U.S.-China cooperation in the areas of energy and environmental protection. The authors highlight the current barriers to such cooperation, as well as explore how and why U.S. policymakers and nongovernmental organizations should have a keen interest in the energy and environmental policies China adopts, given the potential impact of these policies on the United States and the rest of the world.

In terms of energy cooperation, the authors argue that it is strongly in the interest of the United States to help China bolster its use of clean energy, energy efficient technologies, and energy conservation strategies in order to help prevent intensified competition for limited global energy resources and to mitigate environmental degradation in China. Improving cooperation with China in the clean energy and environmental protection sectors could not only help improve the quality of life in China, but also could contribute to foreign policy and economic policy goals in both the United States and China.

Overview of Recent U.S.-China Forum on Environment and Development and China's Response to Water Scarcity in the Hai River Basin

8 March 2000

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The environmental relationship between the United States and People's Republic of China (PRC) is one of the bright spots in U.S.-China relations. One key element of this growing "green" cooperation is the U.S.-China Forum on Environment and Development (hereafter "the Forum") that was established in 1997 by Vice President Al Gore and then-Premier of China Li Peng. Currently Premier Zhu Rongji leads the Chinese side of the Forum. This Forum was created to serve as a venue for bilateral discussion and cooperation between the United States and China on environmental issues at the most senior political level. To facilitate concrete cooperation, the Forum is divided into four working groups: 1) energy policy, 2) commercial cooperation, 3) science for sustainable development, 4) and environmental policy. The four working groups are co-chaired by representatives of various government agencies and these groups act as coordinating mechanisms for the activities that take place under the Forum. The Forum has met three times since 1997, with the most recent meeting 11-12 January 2000 in Honolulu, Hawaii. Plans are in place for a fourth meeting in late 2001.

Highlights of the Third U.S.-China Forum on Environment and Development

The meetings in Hawaii were co-chaired by Dr. Neil Lane—President Clinton's science advisor and the Director of the White House Office of Science and Technology Policy—and his counterpart in China, Minister of Science and Technology Madam Zhu Lilan. Both were the chairs of not only the overall Forum, but also co-chairs for the Science and Sustainable Development working group. Below is a summary of the discussions and agreements that were completed

within each session of the four working groups.

The Energy Policy Working Group

The Energy Policy Working Group met in conjunction with the U.S.-China Forum on Environment and Development in Hawaii. The meeting was co-chaired by David L. Goldwyn, Assistant Secretary for International Affairs, U.S. Department of Energy, and Madame Song Mi, Director General, State Development Planning Commission of the PRC. The Energy Policy Working Group meeting provided a valuable opportunity for both sides a) to share views on energy strategies, b) to review progress in U.S.-China bilateral energy cooperation, c) and to endorse next steps in this cooperation. In the course of the discussions, the two sides agreed on the following projects and initiatives:

- Both sides agreed to improve outreach and marketing of U.S. Export-Import Bank \$100 million clean energy program to facilitate the deployment of clean U.S. technologies in China.
- The U.S. Department of Commerce information administration signed a protocol with China's Statistical Bureau on energy information exchange to provide public exchange of information on energy resources in China.
- The United States agreed to send experts to China to explore issues of natural gas cooperation. This meeting took place 29 February-1 March 2000.
- The U.S. Department of Energy agreed to develop a new fossil energy protocol, which is aimed at enhancing cooperation in the field of fossil energy technology, and development utilization, a part of which includes promoting environmentally friendly

clean coal technology in China.

- Both sides agreed to continue cooperation in the area of renewable energy (*Editor's note: A bilateral renewable energy forum and study tour was held in Washington D.C. 19-20 April 2000*).

Commercial Cooperation Working Group

Commercial cooperation was a major focus at the forum in Hawaii. A few highlights of the commercial discussions include:

- The first project utilizing the Export-Import Bank clean energy facility will be a wind power project in Inner Mongolia.
- The U.S. Department of Commerce planned to send an energy efficient building materials trade mission to China in the summer of 2000.
- The U.S. Department of Housing and Urban Development will receive a Chinese delegation of construction officials to review newest technological developments in U.S. housing industry.

Science for Sustainability Working Group

At the January meeting, global climate change was one of the major areas of discussion within the Science for Sustainability Working Group. The fact that the United States and China are the world's top two emitters of greenhouse gases underlines the importance of joint cooperation on climate change reduction. The two sides agreed to pursue a study on climate science to improve observations and understanding of the interaction between global climate change and the world's oceans. Moreover, the two sides also agreed to jointly assess the economic potential for China in abating greenhouse gas. The meeting ended with an exchange of letters between Vice President Gore and Premier Zhu Rongji in which they agreed to hold a high-level dialogue on climate change. This dialogue would include discussions of implementing the Buenos Aires Plan of Action, development of Kyoto Protocol mechanisms, and views of the Conference of Parties negotiation scheduled for November 2001 at The Hague. Overall, the U.S. side is viewing the global climate change discussions at the Forum as productive and a good beginning to deeper cooperation.

Within the Science for Sustainability Working Group, the National Oceanic and Atmospheric Administration and China's State Oceanic Administration agreed to continue to expand cooperation on coastal and marine management. Such cooperation would include protected area management,

marine and environmental monitoring, and marine disaster reduction. The two sides also agreed to co-host an Asian Pacific Symposium on marine conservation issues.

Environmental Policy Working Group

The mandate of this working group is broad in that it encompasses discussions of environmental agency cooperation, pollution prevention strategies, and development and enforcement of environmental laws and regulations. During the January Forum meetings, the Environmental Policy Working Group focused on developing an agreement between China's State Environmental Protection Administration (SEPA) and the U.S. Environmental Protection Agency (EPA) to implement technical assistance for phase II of the urban air quality-monitoring program. This phase will include active participation by U.S. industry. The Chinese side also agreed to participate in the first international conference on transpacific transport of atmospheric contaminants that will take place in Seattle later in the year 2000. Both sides also resolved to pursue closer cooperation on issues of development and enforcement of environmental laws and regulations.

Reflections on the Forum

This third round of the U.S-China Forum led to productive meetings in the four working groups. The agreements stemming from the working groups provide a framework for continued Sino-U.S. discussions and strengthen ties on science and technology and sustainable development that previous Forum meetings and protocols have built over the years. At the January Forum meeting, the two sides also recognized the role environmental nongovernmental organizations (NGOs) could play in improving the bilateral environmental cooperation. Therefore, environmental NGOs will be invited to participate in future Forum activities.

The Forum also provides an opportunity for the United States and China to pursue cooperation in the fields of green chemistry and environmentally clean production. At the Forum, the U.S. EPA took the lead on the topic of green chemistry. On the Chinese side, the Ministry of Science and Technology, State Environmental Protection Administration (SEPA), and the Chinese petrochemical industry have expressed a strong interest in the topic of green chemistry. Over the past several decades, problems of pollution impacts on human health, environment, and sustainable development have been viewed from the perspective of trying to clean up the pollution after it has been

produced. Green chemistry adopts the view that existing scientific knowledge enables chemists to design non-toxic substances and prevent pollution. More specifically, green chemistry is the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products. Utilizing green chemistry into production processes can save companies money and subsequently make economic protection economically profitable. This area is drawing the interest of both the U.S. and Chinese governments because green chemistry could protect human health and the environment efficiently and at low cost.

The U.S.-China Water Resources Management Working Group

The U.S.-China Water Resources Management Working Group is a direct project of the U.S.-China Environment and Development Forum. In the first Forum meetings, water resources management was identified as a critical issue that crossed the core interests of the different working areas of the Forum. The initial focus of this water resources, working group was to identify and prioritize common problems associated with water resources, both quantity and quality. This was accomplished through ongoing dialogue culminating in a bilateral workshop in Tucson, Arizona in April 1999. One of the recommendations of the bilateral workshop was the formation of a Water Resources Working Group under the Joint Commission Meeting (JCM) of the Science and Technology Agreement. The Water Resources Management Working Group would be established by the JCM as a working group reporting directly to it and serving to coordinate joint activities on water resources management that respond to the priorities of the U.S.-China Forum on Environment and Development and its working groups and the U.S.-China Agreement on Science and Technology Cooperation. The Working Group will be chaired by the U.S. Office of Science and Technology Policy and by the Chinese Ministry of Science and Technology.

The central purpose of the Water Resources Management Working Group is to create a common understanding of critical water problems in both countries and work together toward solutions with strong mutual benefit. To achieve this goal, the Water Resources Management Working Group must meet the following objectives:

- Coordinate a broad spectrum of U.S. and Chinese organizations in the identification of common problems associated with water resources, both quantity and quality.
- Develop and implement a joint strategy for cooperative water resources management activities;
- Develop public and private sector support and funding for joint activities.
- Increase communications among the existing bilateral water resources programs.
- Conduct regular bilateral water resources information exchanges.
- Develop of educational materials and systems for water resources management.
- Promote clean production and green chemistry to decrease the discharge of wastewater.

The activities of the Water Resources Management Working Group will reflect the crosscutting interests of both countries in sustainable development. Wherever possible, activities will address environment, energy, science and technology, commercial, and other mutual interests to promote sustainable development. Notably, the activities of the working group are intended to coordinate and enhance existing bilateral projects and bilateral agreements, not to replace or manage them. Proposals for new projects that were discussed at the U.S.-China Water Resources Working Group at the January Forum meeting are listed below. (More information on the U.S.-China Water Resource Management Program can be found at: <http://w10.lanl.gov:80/chinawater/procpres.html>):

- Water resources development and ecological protection in western China;
- Early warning system for flood management in major rivers;
- Study of water resources evaluation methodology;
- Training courses on desalinization of ocean water and water-saving irrigation;
- Demonstration projects for dry-land water saving agriculture in China;
- Construction of management system for agriculture water resources;
- China-U.S. seminar on water supply and wastewater treatment in the Yellow River Basin in 2000;
- Impact of global warming on water resources in northern China; and,
- Polluted water treatment technology.

China's Response to Water Scarcity in the Hai River Basin

The Chinese Ministry of Water Resources (MWR), Ministry of Agriculture (MoA), and the U.S. Department of Agriculture have a three-year agreement to exchange teams and undertake water research in the United States and China. Dr. Crook gave a presentation on the most recent Sino-U.S. water study. The study focused on the Hai River Basin, which is an important industrial and agricultural region encompassing Hebei Province and the cities of Beijing and Tianjin. The Shanxi Plateau is in the western part of the basin and the plain on this plateau contains a very complex system of overlapping aquifers and overlapping lenses of deposited materials. The U.S. researchers learned from their Chinese colleagues that the water table in this plateau has been dropping quite severely due to deep pump wells supplying water to wheat and corn crops. The trend of over-extraction began in the 1960s and 1970s when farming in the area shifted away from predominantly dry-land agriculture to irrigation. Simultaneously, urbanization, which has fueled a doubling of the population, has increased water demand in the region significantly.

The shift to irrigation enabled the Hai River Basin area to become grain self-sufficient and even to produce surpluses. While the central government has become aware of the water shortage problems in this area, the MWR still tends to prioritize water issues for urban areas and industry over rural potable water and agricultural water issues. The Chinese MoA is resource poor, so they cannot compete with the MWR over setting water management priorities. The MoA has therefore responded to the area's water shortage by developing a dry-land farming program in which they encourage their seed breeders to develop drought resistance seeds. In order to conserve water, this program

also aims to change cultivation practices and improve irrigation efficiency thorough the promotion of drip systems and other water conservation techniques.

Independent of government programs, Chinese farmers in the Hai River Basin have responded to the drought by changing crop mix adopting spray irrigation systems, plastic canal pipes, and new cultivation practices. Continued water shortages most likely will lead more Chinese farmers to shift away from rice to either corn or wheat production. The final choice of crops could have a big impact with the agriculture trade with the United States. Dr. Crook stressed that the innovations and experimentation by Chinese farmers facing drought should not be underestimated, for some of the major rural reforms (such as the household responsibility system and the growth in township village enterprises) emerged from experimentation by rural citizens in China.

The water study researchers argue that the Hai River Basin's water scarcity will not dramatically change China's aggregate agricultural output or threaten food security, for there exists a huge potential for water savings, particularly if the price of water, which is currently extremely cheap, increases. The U.S. and Chinese water study team estimate that water in China has a price elasticity of two to six percent, which means if water prices are raised by 10 percent, farmers will reduce their water use by two to six percent. In addition to price changes, more efficient water use is being created through the gradual adoption of clearer water use rights and institutions to allocate water to the highest valued users. Agricultural output can also be maintained if drought resistant varieties of crops, which could reduce water by 40 to 80 percent, are adopted. Additionally, as water becomes more expensive in China more attention will be given to sewer water treatment plants, which could recycle water for agriculture.