

# Shanxi Farmers Embrace Modern Irrigation Methods to Adapt to Climate Change

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## CHALLENGES

Shanxi Province in the People's Republic of China (PRC) is experiencing reduced water security for the agricultural sector. Changing climate conditions, including reduced rainfall, are increasing reliance on groundwater resources in the province. Unsustainable groundwater use for food production intensifies the impacts of climate change, and cost-effective adaptation responses are needed to better equip vulnerable agricultural regions.<sup>1</sup>

Groundwater is the main source for many local farmers in Shanxi province. Water is often being used with inefficient and outdated irrigation techniques. Most traditional farmers are eager to improve and modernize their crop production and adopt more sustainable agricultural methods.

Given both its increasing agricultural and industrial water use, Shanxi's groundwater tables have been declining since 1956, a problem compounded by the impacts of climate change. Currently, roughly a quarter of the province's land area—especially the fertile valleys—is experiencing falling groundwater tables. Moreover, a decrease in rainfall of 12% over the last 50 years and a rise in temperature of 1.2 degree Celsius (°Celsius) over the same period increase pressure on groundwater availability. As such, it is estimated that from 2000 to 2007, overall water availability decreased by 5% annually from 8.2 billion m<sup>3</sup> to about 7 billion m<sup>3</sup>. The proportion of water available for irrigation reportedly decreased from 95% in the 1950s to 59% in 2007.

## APPROACH

**A Climate Change Grant.** The Asian Development Bank approved in 2009 the Shanxi Integrated Agricultural Development Project to strengthen agricultural production in 26 counties in the Shanxi province. Complementing the project is a \$500,000 grant from the Water Financing Partnership Facility to support climate change adaptation through groundwater management. The grant was given to Qixian, Xi, Pingshun, and Lishi counties after a competitive selection process among local governments and farmers.

The objective of the grant was to support farmers introducing

## Highlights

- Climate change and declining water resources threaten food production systems worldwide, increasing the need for efficient agricultural processes.
- Four counties in the Shanxi Province of the People's Republic of China were selected as pilot areas where traditional farmers learned modern methods of groundwater use and management.
- As a result, more sustainable use of groundwater was introduced while farm labor was reduced. Crop yields increased and water is used more efficiently.



water conservation and energy efficient water use practices and increase climate change resilience to halt declining groundwater levels. Declining groundwater tables lead to higher pumping costs and lower water security, making support for farmers to adopt such sustainable practices in selected pilot sites in Shanxi highly relevant.<sup>2</sup>

**Testing Modern Systems.** About 600 farmers in four counties were introduced to modern and efficient horticultural irrigation systems. Groundwater is being used more sustainably to maintain its buffer and contingency supply for periods when demands may be higher.

- **Qixian**—Farmers in the Xiliuzhi village changed irrigation practices from flood to drip irrigation in their greenhouses. The new system has pressure meters, dual distribution lines, a centrifugal filter to remove impurities from water, and a frequency converter, the last being an innovation that reduced energy consumption by 40%.
- **Xi**—The innovation introduced in the Quyan village was the use of large diameter micro irrigation pipes (0.8 millimeter or mm) that do not clog easily. The water supply comes from a natural spring feeding the main pipe 110 mm in diameter, which was itself enlarged from its previous 90 mm diameter to increase pressure on the supply pipes.
- **Pingshun**—In the villages of Wanli, Wanggu, and Henantan, cultivation of prickly ash shoots, a local delicacy, got a boost in

<sup>1</sup> ADB. *Addressing Climate Change in Asia and the Pacific*. <http://adb.org/sites/default/files/addressing-climate-change.pdf>

<sup>2</sup> ADB. 2010. *ADB Climate Change Programs: Facilitating Integrated Solutions in Asia and the Pacific*. <http://www.indiaenvironmentportal.org.in/files/adb-climate-change-programs-brochure.pdf>

production with the introduction of micro-sprinklers suspended in mesh tents. In addition to irrigating, this system washes down remaining aphids and avoids the soil getting too wet.

- **Lishi**—Farmers in Xiaoshentou village, which battles the cold temperature of its irrigation water<sup>3</sup>, were introduced to a drip sprinkler irrigation combined with warming ponds in greenhouses.

The grant financed the additional water saving investments, which varied from 1,200-6,000 RMB per mu<sup>4</sup> (or \$3,000-\$15,000 per hectare). It is estimated that the micro-irrigation investments can be paid back within a year. For perennial crops, though, the benefits flow starts only after about three years. Farmers are interested to adopt such systems, often with some support from agro-business. Source development is externally financed, and often a collective responsibility.

**Getting Communities Involved.** The pilot sites began with soil surveys and discussions with farmers. In some cases, it took time to convince farmers of the benefits of pressurized irrigation systems due to their novelty. Intense dialogue with the farmers, coupled with training courses on the use of the technology, helped the farmers' understanding and final acceptance of the new systems. Eventually the irrigation systems were designed and became operational in 2012 and farmers saw the effects of improved groundwater management first-hand. Today, water associations promote the irrigation systems in tandem with county authorities.

## RESULTS

As the pilots began operating, the farmers experienced multiple benefits. In several cases this encouraged others to replicate the systems practiced.

In Qixian, the drip systems combined with inexpensive plastic mulch led to 40-60% water savings and 35-40% fertilizer savings. Simultaneously, the new systems translated to 25-40% crop yield increase.

In Xi, the system is poised to produce a yield of 1,500 kilograms (kg) of apples per mu, compared to 600 kg per mu without the system.

<sup>3</sup>If irrigation water is colder than 10°C, plants will not do well. In Lishi, irrigation water for a large part of winter is close to or below 0°C.

<sup>4</sup>Chinese unit of land measurement (1 mu = 667 m<sup>2</sup> or 15 mu = 1 hectare).



Above, Pingshun's micro-sprinkler. At right, Lishi's cold weather irrigation research site.

Photos by Frank van Steenbergen

In Pingshun, the estimated average income increase is 15-20%, achieved with less labor. The micro-sprinkler also promises to bring better-quality leafy produce as aphids are washed out and pesticide use is reduced.

In Lishi, Xiaoshentou's cooling ponds make it possible to grow a third greenhouse crop. The drip sprinkler irrigation system is designed to give farmers a 10% increase in crop yields with lower labor inputs. Fertilizer and pesticide consumption is likewise expected to decrease by 20%.

ADB's support for agricultural modernization resulted in savings in water, energy, fertilizers, and pesticides. They also required less labor, which benefitted many farmers in Shanxi, a significant number of whom are elderly. Gradual replication in various stages is currently underway, financed by counterpart funds from the Shanxi government. It is a clear indication that despite climate change's adverse impact on water resources and food production, there are opportunities for traditional farmers in Shanxi Province to adapt to these changes and make agricultural production more sustainable.

## Related Links

- ADB Report and Recommendation of the President to the Board of Directors. <http://www2.adb.org/Documents/RRPs/PRC/38662-01-PRC-RRP.pdf>
- Project Data Sheet 38662-013: Shanxi Integrated Agricultural Development Project. <http://www.adb.org/projects/38662-013/details>
- Climate Change Adaptation through Groundwater Management. <http://www.adb.org/projects/documents/grant-agreement-mdtf-wfpf-shanxi-climate-change-adaptation-through-groundwater-ma>

## KNOWLEDGE CONTRIBUTORS



**Frank Radstake** ([fradstake@adb.org](mailto:fradstake@adb.org)) is senior environment specialist at ADB East Asia Department's Environment, Natural Resources, and Agriculture Division. He leads the subprojects for agricultural development in the river basins of Shanxi Province.



**Frank van Steenbergen** ([ivansteenbergen@metameta.nl](mailto:ivansteenbergen@metameta.nl)) is water resources specialist with MetaMeta Research. He specializes in groundwater management, water for food and flood-based farming systems.



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