Pro-poor Interventions in Irrigated Agriculture

Issues, Options and Proposed Actions

China

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Reforms have cut China's rural poverty dramatically. Key contributions have been made by effective agricultural reforms, overall equity in land and water distribution, decoupled land and water rights, relatively greater investments in irrigation in downstream areas, and the introduction of financial-incentive-based irrigation management. But, in the face of increasing water shortages, reforms need to be implemented more widely and more effectively, to enable more villages to move towards farmer-participatory or contract-based management of irrigation.

Pro-poor Interventions in Irrigated Agriculture in China:

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Introduction

Reducing poverty is a major development goal. But to achieve this, we need to answer some basic questions. What contribution does irrigated agriculture make to reducing poverty? How does the performance of irrigation systems impact upon poor men and women? Have recent irrigation reforms improved access to water and lifted the poor out of poverty? And, what practical actions will give the best return on investment in terms of alleviating poverty?

This briefing answers those questions in the context of China. It is one of a series produced by the project 'Pro-poor Intervention Strategies in Irrigated Agriculture in Asia', which took a holistic approach to understanding poverty, in order to identify practical, pro-poor interventions. In-depth, multidisciplinary studies were carried out in each of six Asian countries, and primary data was collected from 5,408 households in 26 irrigation systems using a standard set of methods, to provide new insights that are valuable contributions to the fight against poverty.

Overview: Context and Country-specific Issues

China has made remarkable progress in reducing poverty. From 1978 to 2000, more than 200 million rural poor were lifted out of poverty. Plus, the incidence of rural poverty dropped dramatically from 30.7% to 3.4%.

Generally, this is attributed to dramatic rural growth resulting from broad-based economic reforms. These helped the country shift from a centrally planned to a more market-oriented economy, quadrupling GDP after 1978. Reforms in the agricultural sector—which boomed—became the cornerstone of reforms throughout the economy.

Most important was the introduction of the 'household responsibility' system. This assigned collective land, formerly held by communes, to households on long leases. Households could then decide what they grew, and whether to keep their produce or sell it for profit. Equitable redistribution of land, based on family size, boosted productivity and agricultural performance. So, rural incomes jumped from 220 yuan per year in 1978 to 964 yuan per year in 1997. But, to be fair, land distribution was based on land quantity, quality and location—leading to very small holdings per family (often less than half a hectare in total), scattered over 5-6 plots.

Investments in rural infrastructure, including irrigation, also contributed significantly to growth and poverty alleviation. The proportion of cultivated area under irrigation increased from 18% in 1952 to more than 50% by the late 1990s. Generally, provinces with a high share of irrigated areas have a relatively low incidence of poverty—suggesting the importance of irrigation in poverty reduction. But, opportunities for irrigating new areas are limited—irrigation systems have already been developed in most suitable areas.

Water shortages are a key problem. Demand for water is rising fast, especially from rapidly growing industry and expanding urban populations. So, the amount available for agriculture is dropping—which will probably affect food production. The country has limited water resources per capita, and exploiting new resources is often prohibitively expensive. Plus, because surface-water irrigation systems are falling into disrepair, and farmers have no incentive to use water carefully, agricultural water use is often inefficient. So, only around 40% of the surface water allocated to agriculture is used efficiently for crop production.

To address this, China's policymakers have promoted water-management reforms since the early 1980s. Participatory irrigation management—through farmer 'water user associations' (WUAs)—has been developed as a key way of improving irrigation management. Now, water supply corporations (WSCs) operate and maintain reservoirs and branch canals, selling water to WUAs on demand, at prices designed to recover capital and operating costs. Water is charged for according to a measured volume, which encourages

WUA farmers to be less wasteful. WUAs collect water charges from their members, and are legally responsible for maintenance and water delivery at the farm level. Around 250 WUAs and 17 WSCs have been established in eight provinces.

Given the importance of irrigated agriculture in poverty reduction, and the urgent need for efficient water use, IWMI and the Center for Chinese Agricultural Policy (Beijing) critically assessed irrigation system performance, poverty, and relevant institutions. In-depth studies were made of four large-scale irrigation systems in two provinces, including interviews with 231 households in 2001-2002 (see Box 1 and Figure 1). This, coupled with a national survey (1,199 households in 6 provinces), helped pinpoint policy actions that could make the country's irrigation systems more efficient and more pro-poor. Poverty was measured using the government's poverty line of 52.1 yuan[1] per capita per month—equivalent to US$0.90/day in purchasing power parity terms.

Box 1. Scope and location of studies.

National survey

To assess the impacts of irrigation on poverty, primary data was collected from an almost nationally representative sample of 60 villages in 6 provinces of rural China (Hebei, Liaoning, Shaanxi, Zhejiang, Hubei, and Sichuan).

In-depth studies: Yellow river basin (YRB)

To assess irrigation systems' performance and the implications of irrigation management reforms, key stakeholders were interviewed, and primary household-level data was collected using a comprehensive, multi-topic questionnaire.

Table 1. Characteristics of areas studied relevant to pro-poor interventions.

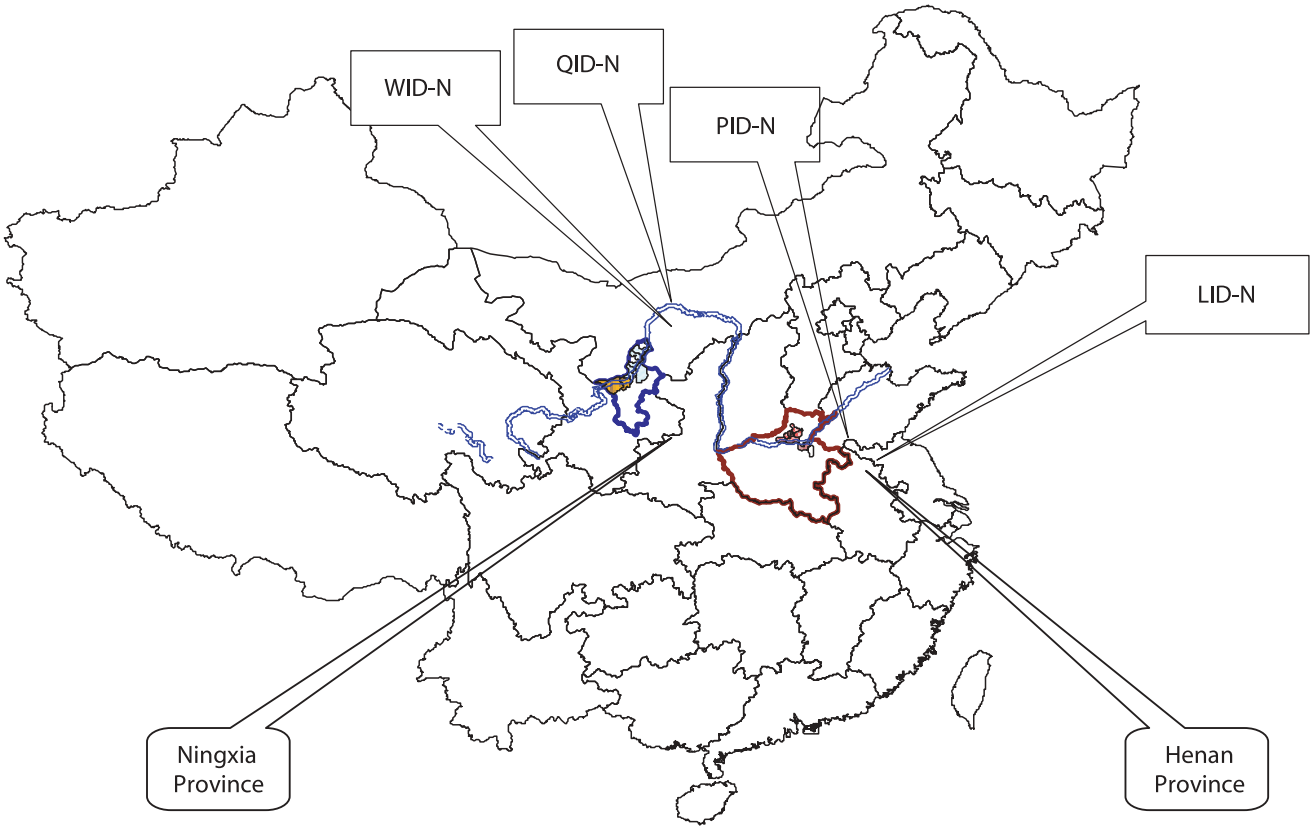
	Ningxia Province	Henan Province
Irrigation Districts studied	Weining (WID-NP) Qingtongxia (QID-NP)	People's Victory (PID-HP) Liuyuankou (LID-HP).
Per capita annual income (yuan)*	1,724	1,984
Poverty rate: percentage of people below national poverty line (52.1 yuan/month)	7	8
Poverty rate: percentage of people below World Bank poverty line (73.2 yuan/month)	10	14
Location in YRB	Upper reaches	Lower reaches
Water abundance	High	Low
Water use per hectare (cubic meters)	24,500	3,800
Percentage of cultivated area that is irrigated	48	66
Source of irrigation water	Surface water	Surface and ground water
Annual rainfall (mm)	200	630
Main crops grown	Wheat, maize, rice	Wheat, maize, rice
Amount of wheat produced per cubic meter of water (and value)	0.8 kg (US$0.09)in WID-N	2.1 kg (US$0.25)in LID-H
Water price (yuan per cubic meter)	0.012	0.04
Recovery rate of operations and maintenance costs (%)	61	23

*Incomes were lower than the national average—by 25% and 12% in Ningxia and Henan, respectively.

The irrigation districts' (IDs) command areas range from 31,000 hectares (LID-HP in Henan) to 304,000 hectares (QID-NP in Ningxia). All four IDs suffer ageing infrastructure, outdated water-delivery technology, and chronic funding shortages for canal maintenance. The climate is dry, and seasonally variable in both provinces (with 90% of rain falling in summer), so irrigation is important. Farm sizes are small: 0.45-1.03 hectares per family.

[1]US$1 = 8.3 yuan

Figure 1. Location of the four selected irrigation districts



Key Study Findings and Outcomes

Impacts of Irrigation on Poverty: National-level Survey

Compared with other countries in Asia, a high proportion of China's cultivated land is irrigated (52%). Ninety-five percent of rice, 61% of wheat, and 45% of maize crops are irrigated. But, most low-value staple crops are not. For almost all crops, irrigated plots yield more than rainfed ones—by 71% for wheat, 16% for maize, and 200% for cotton. Access to irrigation also increases the annual output of land, as farmers can grow two crops per year. It also allows them to grow more high-value crops. So, irrigated plots give much higher revenues (price times yield) than non-irrigated plots—79% higher overall. And, poorer farmers benefit more than richer ones: irrigation increases revenues by 93% in poor areas, and 89% in richer areas. Plus, because cropping revenues comprise 40% of total incomes in poor areas, but only 10% in rich ones, irrigation boosts incomes by 38% in poor areas, but only by 9% in rich areas. Raising the incomes of poor men and women by this amount—through irrigation—would lift the vast majority of them above the poverty line.

Poverty, Agriculture and Irrigation in Irrigation Districts

Poverty rates in the irrigation districts (IDs) studied were double the 3.4% national average (Box 1). They were slightly higher, overall, in the lower reaches of the Yellow river basin, where less water is available (Box 1). But—importantly—farmer poverty within each ID was not related to their location in the upper or lower reaches (Figure 2). Also, farm size was not related to poverty—because land was equitably distributed. Lower incomes were, however, associated with larger families, and lower education levels.

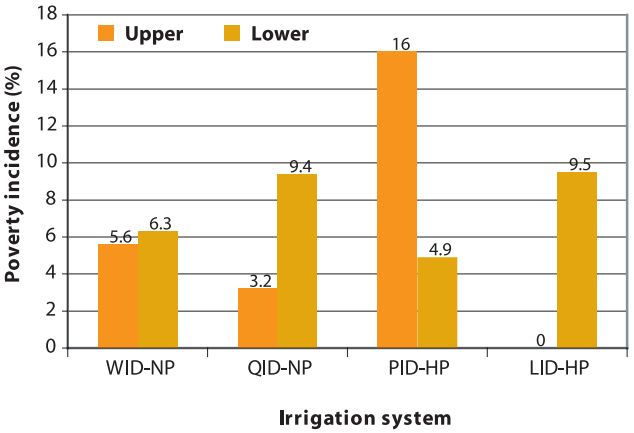


Figure 2. Poverty incidence (percentage of people falling below the national poverty line of 52.1 yuan/month) across the reaches of four irrigation systems. No clear pattern is obvious.

Poorer households rely much more on agriculture than wealthier ones. The poorest group (earning only 373 yuan/year) gained 87% of their income from crops and livestock; the figure is only 46% for the richest group (earning 5,877 yuan/year). So, any policy changes that boost agricultural incomes—by increasing the area irrigated or improving irrigation efficiency—will increase poor farmers' incomes relatively more than those of rich farmers. Plus, because net incomes from irrigated crops are between 86% and 173% higher than those from rainfed crops (Figure 3), the benefits irrigation provides to poor men and women are large.

In general, the smallest and the largest farms had equal access to water. Plus, in all four systems studied, the poorest farmers had the greatest access to water in terms of per capita and per household use. Seventy-five percent of farmers said their water supply was reliable. Plus, where farmers had no problem accessing water when they needed it, they obtained higher crop yields.

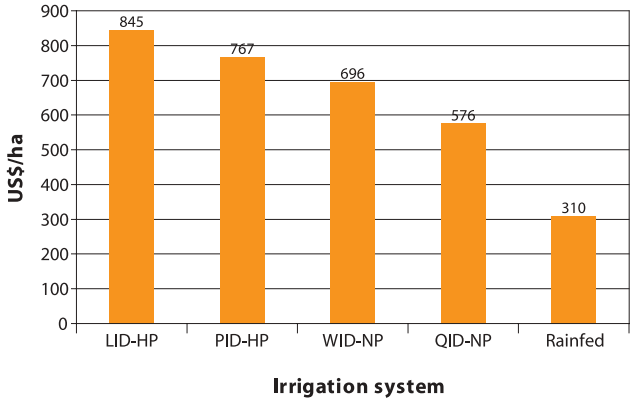


Figure 3. Net crop income from irrigated and rainfed areas. The differences show high benefits from irrigation.

Irrigation investment was also important to farmers' incomes and poverty levels. For example, in one ID in Henan, no poverty was found in villages where irrigation investment was high (more than 8,000 yuan/hectare). But, villages where investment was less than 400 yuan/hectare had poverty rates as high as 19%, with large gap between incomes and the poverty line. Once irrigation investment per hectare rose from around 400 yuan to 8,000 yuan, farmers' total income rose by nearly 50%—and incomes from agriculture and cropping rose by 12% and 9%, respectively.

Importantly, investment has been greater in the lower reaches of systems than in the upper reaches—by 30% in QID-NP, and by 70% in PID-HP, for example (Figure 4). The result is a more reliable water supply, and equitable access to water within systems. This, coupled with equitable land distribution, explains why the gross and net values of crops produced per unit of land are generally similar among the head, middle, and tail reaches of systems.

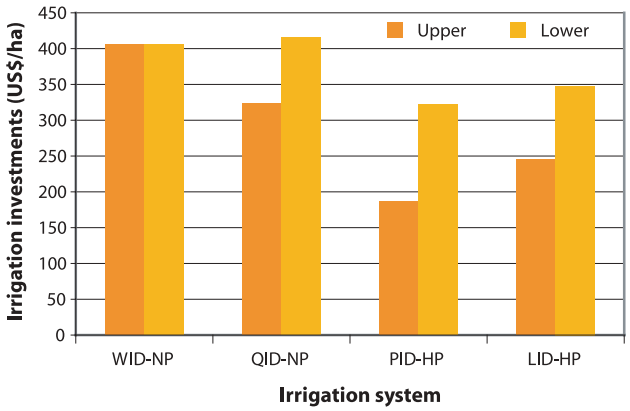


Figure 4. Irrigation investment in upper and lower reaches of four irrigation systems. Investment has favored the lower reaches–to increase access to water there and improve reliability of the supply.

Around six times more water is used per hectare in the upper reaches of the Yellow river (Ningxia) than in Henan in the lower reaches (Box 1). It is also used less productively—upstream farmers produced only one-third as much wheat as downstream farmers (Box 1). Large differences also occurred among crops. In Ningxia, for example, one cubic meter of water produced only 0.3 kg of rice, but 1.0 kg of wheat, and 1.5 kg of maize. Such large production differences among crops and regions indicate that water could be reallocated to optimize water use.

Water Allocation

Water reallocation has already begun in the Yellow river basin—in upstream regions, supplies have been cut and water prices raised. The Ningxia government doubled the price of agricultural water to 0.012 yuan/m^3 in 2000, allowing water authorities to regain some of their lost revenues. However, as upstream regions are generally poorer, care is needed in water allocation, to minimize any negative impacts on the poor.

In China, water resources are state-owned (and water rights are not coupled with land rights). So, at both first-level (main) and second-level canals, allocation is controlled by a government agency. Regulations exist that prioritize downstream areas, lift irrigation, agriculture (rather than forestry), and vulnerable groups, among others. Water volume, canal capacity, water quotas, and water-delivery efficiency are also considered.

At the tertiary-canal level, local water managers are responsible for water allocation. Four water-allocation approaches were used in the sample areas:

- *Equity*—equal allocation to all users along the canal, allowing the poor and other vulnerable groups to access water (13% of villages)
- *Efficiency*—irrigation of fields nearest the intake first, as, logistically, this is the most efficient way of allocating water (70% of villages)
- *Payment capacity*—'first come, first serve' method (0% of villages); 'first pay, first serve' method (2% of villages)
- *No established rules*—15% of villages.

Irrigation Charges

Despite price rises, China's agricultural water is still believed to be under-priced. Charges vary among systems and, at the farm level, are usually based on the area irrigated. Fees are set by local government bodies based on provincial and central government guidelines. So, the charging system can be considered to be fairly decentralized.

Ningxia Province uses a three-part irrigation charging system:

- Volume-based water charge (0.012 yuan/m^2)—applied at outlets of the main or branch canals (where water can be measured) and passed on to the ID management body to cover staff salaries and the operation and maintenance (O&M) of main canals
- Local water maintenance and management fee of 6 yuan/mu[1] (up to a maximum of 90 yuan/ha)—40% is passed to the County Water Resources Bureau and 60% to the Township Water Resources Bureau, to cover facility maintenance and staff salaries

[2]1 mu =15 hectares

Box 2. Water management systems used in the four IDs in 2001.

- Collective management – the village leadership, through the village committee, is directly responsible for water allocation, canal O&M and fee collection (used in 61% of villages studied)
- WUA management – a farmer-led WUA, and its member-elected board, controls the village's water (used in 14% of villages studied)
- Contract-based management—the village leadership contracts an individual to manage the village's water (used in 22% of villages studied).

- Dry and gravity irrigation areas—2 yuan/mu
- Lift irrigation areas—7 yuan/mu.

Water charges per cubic meter are higher in downstream Henan (0.04 yuan) than in upstream Ningxia (0.012 yuan), where water is more plentiful and supply costs lower. But, farmers in Ningxia use more than six times more water per hectare than farmers in Henan (Box 1). So, annual irrigation charges (per hectare) are actually higher in the two IDs in Ningxia (US$59 and US$67) than they are in the two IDs in Henan (US$26 and US$34). Overall, annual irrigation charges are fairly high, and tend to be related to the costs of O&M and supply, as well as to relative water scarcity.

In the four systems studied, the charge collection rate is just over 80%. But, rates are higher where private contractors and WUAs operate at the local level—as they tend to cut supplies when charges are not paid.

Implications of Irrigation Sector Reforms

Key to China's irrigation reforms is the transfer of management from the village collective to farmers and contractors (Box 2) over the past 5 years. But water-management reform still varies across the four sample IDs. Progress has been significant in Ningxia's IDs. In one, 50% of villages use contractors and 27% use WUAs. In the other, 49% of villages used either contractors or WUAs. In Henan, by contrast, only 8% of the villages in one ID, and none in the other, have shifted to either system. This is probably because Ningxia's provincial government issued several mandates for reform, while Henan's did not. However, even in Ningxia, the new water managers are still strongly linked to the village leadership—so, in reality, the new systems differ little from collective management.

Managers receive a fixed payment from water fees collected from farmers. But, financial incentives also encourage them to cut water use. So, for example, ID officials set a *target* volume of water per village, based on past use patterns and other criteria. The price of this volume is then divided by the village's total amount of land, and each farmer pays a volumetric fee based on his or her land area. If the *actual* volume of water delivered—at the request of the water manager—is less than the target volume, the difference between the fees collected and the amount the manager pays for the water is his/hers to keep. The study showed that, given financial incentives, managers will try to improve water management, significantly reducing the amount of water delivered to farmers. Very importantly, results showed that using such incentives will not negatively affect farmers' output, farm income or poverty.

However, incentives are used in only 41% of villages in the sample IDs. To cut wasteful water use, the government should continue to support incentive-based water-management reforms, while ensuring reforms are implemented more effectively.

Recommendations and Interventions

Target Irrigation Investment at Poorer Areas

Because irrigation improves crop yields, crop revenues, and farm incomes—and because farmers in poor areas rely more on crop revenues—more investment in poor areas will boost the incomes of the poor relatively more than those of richer farmers.

Reallocate Water within River Basins to Address Water Shortages

In areas that receive less irrigation water per hectare, productivity is not necessarily lower, and poverty rates are not necessarily higher. For example, water is used more productively in the Yellow River's lower reaches, where IDs are allocated less water than those in the upper reaches. So, water allocation could be evened out by reducing supplies to upper reaches, to boost overall water-use efficiency.

Rehabilitate Infrastructure Regularly

To improve the reliability of water supplies, more has been invested in the lower reaches than in the upper—resulting in higher productivity and returns to farming. Irrigation investments have been shown to increase farm incomes and reduce poverty. So periodic, government-funded rehabilitation should continue, to encourage users to invest in maintenance.

Increase Water Charges and Improve Fee-Collection Rates

China's agricultural water is still believed to be under-priced. Water charges need to be increased, to cover the full cost of O&M. Plus, because nearly 20% of water fees are not collected, collection rates should be improved. Private contractors/managers have more success collecting fees—sometimes by adopting strict measures—so this is a point in favor of moving away from collective management.

Continue Reforms that Favor Contracting and the Creation of WUAs

Where water-management reforms are being implemented (by creating WUAs or using private contractors/managers) irrigation systems generally perform better than those under collective management. So, reforms are working, and should be continued.

Improve Implementation of Reforms that Involve Water-saving Incentives

Water-management reforms that provide strong financial incentives for managers to increase water-use efficiency will reduce overall water use with no adverse impacts on farm incomes and poverty. So, the government should continue to support institutional reforms in irrigation management, implementing them more widely and effectively.

Train Water Managers

The capacity of water managers should be developed through training programs, to help them implement water-sector reforms effectively.

Lessons for Other Developing Countries

China's small- and large-scale farmers have almost equal access to water. Indeed, water is sometimes allocated to favor the poor. Such overall equity results not only from the use of water-related institutions and water policies. A combination of other policies facilitates the equal distribution of land and rapid expansion of off-farm employment, while ensuring that irrigation water is allocated and distributed based on farms' cultivated land area.

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Full references for the information presented in this briefing are contained in the above reports.

Acknowledgement

Thanks are due to ADB, which financed this project, and the GWP Advisory Center in Colombo, for financial contribution for these briefings.

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