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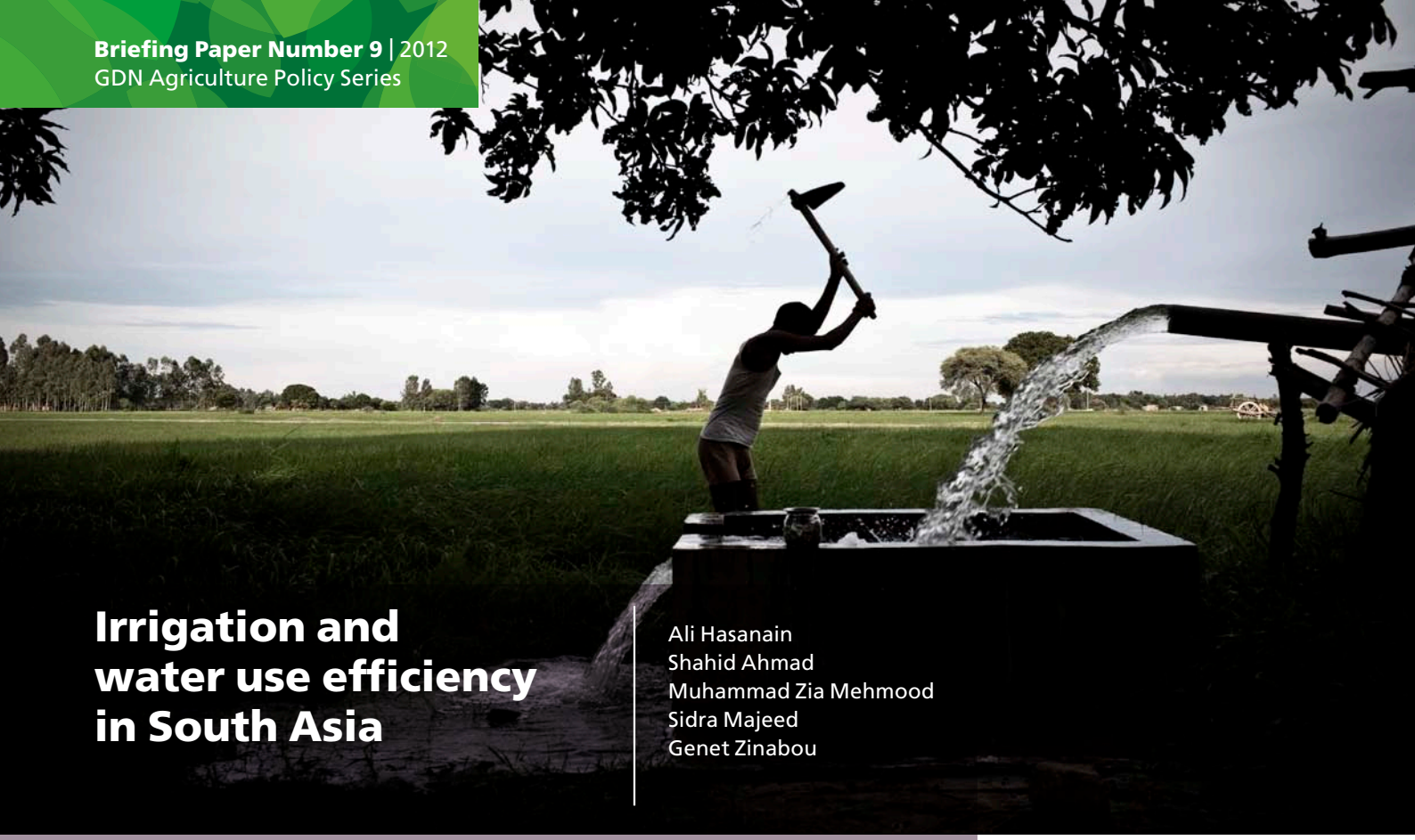

Irrigation and water use efficiency in South Asia

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South Asia has one of the world's highest rates of irrigated agriculture but its dwindling water resources need to be used more efficiently. This briefing explores how governments can improve irrigation practice by regulating prices, clarifying rights to water sources and strengthening governance systems.

A farmer opens a channel to irrigate his farmland using a water pump near Akhori village in Unnao.
SANJIT DAS | PANOS PICTURES

Key messages

- South Asia has one of the world's highest rates of irrigated agriculture yet this is nevertheless under stress because of poor management and a growing population. More efficient management of water requires the state to help to remove barriers to investment in the sector.
- South Asian countries should establish mechanisms to make water investment decisions objectively and then look for alternative sources of finance to execute them. They should not depend on foreign aid when making surface water investment decisions.
- Enforcing charges by the volume of water used, in line with costs, and ensuring that charges are effectively collected will increase the efficient use of irrigation water. The establishment of effective collection mechanisms is a societal challenge – and requires collaboration between government, farmers and community organizations.
- Short-term subsidies on water conservation technologies for farmers prior to increasing water prices may reduce the expected backlash.
- The major precondition for pricing groundwater is the assignment of rights to groundwater sources. This may, however, be difficult in the case of shared aquifers. Land reform can lower the barriers to cooperation between citizens.
- Development of water markets cannot proceed in isolation from the institutional and technological context of irrigation in developing countries. Community organizations have a potentially important role to play in advising, educating and managing the allocation of water among users.

This briefing paper is one of the 10-part Global Development Network (GDN) Agriculture Policy Series for its project, 'Supporting Policy Research to Inform Agricultural Policy in Sub-Saharan Africa and South Asia'. It is based on a longer synthesis paper, ***Irrigation and water use efficiency in South Asia***, which draws on extensive published and unpublished research. The full paper can be downloaded at: **www.agripolicyoutreach.org**

It will be of value to policymakers, experts and civil society working to improve agriculture in South Asia.

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South Asia, one of the world's most densely populated and poorest regions, also has the highest rates of irrigated agriculture. Irrigated and rain fed crops coexist in every village, with 58 per cent of South Asia's cultivated land being rain fed, and its irrigation rate standing at around 40 per cent.

Irrigation is essential for food security and economic development in South Asia, but it can be made more efficient by improving the ways in which water is used, by developing the management system to collect and allocate surface water and by judiciously regulating groundwater irrigation.

A girl pours water into an irrigation channel next to paddy fields in the Daw Abari river bed area of Hatibandha Upazila, Bangladesh. Many countries in South Asia now want to increase the productivity of irrigation schemes through improved management.
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Background to the research

This briefing is based on an extensive literature review of publications and reports by international organizations, in particular the International Water Management Institute (IWMI), the World Bank, the Food and Agriculture Organization (FAO) and the International Food and Policy Research Institute (IFPRI); publications from national governments such as water policies and irrigation sector strategies; academic works and journal articles; conference proceedings and other unpublished material. It reflects the water policy experiences of India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan and the Maldives.

It is further supplemented by interviews with various stakeholders in irrigation policy in Pakistan conducted in October 2011. These stakeholders included delegates from the departments of irrigation and water, both at national and provincial levels.

In the 1980s public spending on irrigation declined – a result of a drop in grain prices which reduced the rate of return on irrigation investments, increased construction costs and growing environmental opposition to dams. Many countries are now interested in increasing the productivity of existing irrigation schemes through water-saving technologies, the restoration and maintenance of deteriorating infrastructure, and the improved management of irrigation systems and water markets. The use of groundwater for irrigation has become so extensive that experts and governments are now worried about its overexploitation and a future reduction in water resources.

Successful water markets include incentives for users to conserve water, use it efficiently and trade it. Establishment of a well-functioning surface water market will require clear definition of water rights and effective measurement of water use and return flow. The market will include enforcement and sanctioning mechanisms. Policymakers would also be advised to concentrate on removing the barriers to investment by individuals, to identify how existing water resources can be used efficiently and equitably and how productivity in rain fed areas can be increased. It is very important that farmers are educated about the water code, register their water rights, and have the resources necessary to function in a formal market.

Management reforms include devolving power to Water User Associations (WUA) and encouraging greater participation by farmers in both the operation and maintenance of infrastructure and water pricing.

Groundwater challenges

Groundwater irrigation is a core element of livelihood creation programs for poor people in many regions. It forms the basis of 60 per cent of irrigation in India and is often supported by subsidies for tube well equipment and pumping electricity. There is little scope for further development in most South Asian countries, with the exception of some parts of India and Nepal. Nevertheless, governments persist with extraction policies, rather than emphasizing the importance of increasing water use efficiency. This creates a risk of groundwater depletion and, if crops fail, of food shortages and the subsequent abandonment of whole clusters of villages, as has been the case in Southern Rajasthan, coastal Saurashtra, Tamil Nadu and Northern Gujarat in India.

There is little disagreement among policymakers as to what ideal policy interventions would look like or on how to set up a market in groundwater. These include the formulation and enforcement of groundwater laws, establishing unambiguous tradable property rights for water – treating groundwater as an economic good in terms of pricing – and implementing a licensing and permit system to regulate groundwater extraction. However, a lack of clarity over property rights often prevents individuals from investing in water extraction and no South Asian country has been able to adopt these measures effectively on a sufficiently large scale.

In the absence of 'tied ownership' (ie the linking of water rights to property rights), the prevalent rule tends to be 'first possession' (whoever pumps the water is its rightful owner), increasing the danger of overexploitation. For groundwater markets to be successful, the most important precondition is assigning and enforcing rights in a bid to limit over-extraction, a difficult goal for governments.

Surface water management

Surface water irrigation structures such as dams, canal irrigation and large water storage systems are usually managed by the state. In the past this involved substantial foreign investment, which has since declined. Surface water infrastructure investment is perhaps the most important area of focus for South Asian governments, that must now avoid becoming dependent on aid when making such investment decisions.

In centrally managed systems, water is priced for two reasons: to cover operation and maintenance costs and to encourage farmers to use water carefully. Where water prices do not fully recover the costs, the quantity of water consumed will be greater than is socially optimal.

Governments have typically based water charges on the size of the farm accessing the water source or on the type of crop being irrigated. This, however, does not allow for the fact that similar types of users will use varying quantities of water for different purposes, and with variable productivity.

Volumetric charges set at unit cost are harder to implement, but preferable. At present, surface water prices are too low and unmonitored (and thus untaxed). Farmers have no direct economic incentive to be efficient or careful using water. For a surface water market to function, it must have well-defined water rights, a consistent way to measure water use, enforcement and sanctioning mechanisms and specifications concerning return flows.

The challenges of applying surface water charges

Water charges can be assessed and collected by the state at the national level as in the case of the Philippines, or at the scheme level as in China. The prerequisite for any type of water pricing is an improvement in the collection of charges, which remains very low in South Asian countries. In Pakistan, for example, water prices are not linked to costs, revenues from water charges are not reinvested in irrigation, and there is little motivation for the farmer to pay or penalty for failing to do so.

In a positive example from Haryana, India, a canal system of irrigation has been productive due to the scheme's strong governance (see case study below) and farmer participation. In most cases, however, farmers are not involved in water management and have few incentives to get involved, to pay for water or to allocate it in any way. This resistance also stems from powerful local elements, corruption and formal political resistance.

If collection and enforcement mechanisms are strengthened, water markets create incentives to conserve water, to use it more efficiently or to trade it. The potential flexibility of being able to buy and sell water is also increasingly important for the allocation of water across industries. Any reallocation of water can only take place with the consent of the original water user. Nevertheless, problems arise due to market failures or a lack of prerequisites to support functioning markets.

A successful centrally priced canal system in Haryana, India

In this scheme water is divided equally over the command area through a canal system that automatically apportions the water among farmer groups, who then share access to the water in rigidly fixed turns. Water charges cover organization and management (O&M) costs but not capital costs and are based on geographical area and crop type, amounting to approximately 0.5 per cent of the average net farm income. Allocation and scheduling of water among canals is the responsibility of the irrigation department, but once the water reaches the outlets, farmers are fully responsible for the O&M.

Fees are collected by the state revenue department and collection rates are high – between 85 and 95 per cent. The government can take land away from defaulters, operation and maintenance costs are very low, and the highly centralized management team has few staff and substantial levels of farmer participation.

This system is one of the most productive in India because of strong peer pressure governance. A farmer who steals a turn from another farmer can cause instability throughout the entire canal as can a delay or shortfall in supply from the irrigation department.

A farmer squats on a small dam on the Wakal River, Rajastan, India; the dam reduces soil erosion and raises the groundwater table.
DIETER TELEMANS | PANOS PICTURES

'The relative prices of water in Pakistan are absurd: a one-liter bottle of water costs 30 rupees whereas a farmer gets 60,000 liters of surface water for 1 rupee. The result is that people are very careful with bottled water supplies and very wasteful with agricultural water supplies.'

Nawaz Khan

Senior Research Associate
Food and Agriculture Division
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Pricing groundwater

Markets in groundwater are fundamentally different. They are localized and personal and their infrastructure requirements are smaller. Groundwater trade already exists in various parts of South Asia and there is a high level of competition for investment in water pumps. Among those trading water, suppliers of the water via wells and pumps use a higher proportion of their well capacity and enjoy a higher return on their investment.

The benefits to water buyers include better access to irrigation water and increased crop output, leading to more opportunities for hiring unskilled agricultural laborers and in some cases the added bonus of lowered water tables in waterlogged areas.

However, as discussed earlier, the absence of 'tied ownership' (ie the linking of water rights to property rights), 'first possession' (whoever pumps the water is its rightful owner) prevails. This creates an incentive to pump water aggressively, and raises the danger of overexploitation.

The most effective condition for wasting less water is assigning and enforcing 'tied ownership' rights that limit over-extraction.

A Bhumji woman carries an irrigation tube in the village of Dhusra, in the Indian's state of Jharkhand, on the way to one of her fields.
HELDUR NETOCNY | PANOS PICTURES

Adopting improved technologies

The price paid for water greatly affects how efficiently it is used, but water use efficiency can also be improved by adopting better technologies. These include:

- Pressurized irrigation systems (high initial costs but an increase in cropping intensity of 200 per cent per annum).
- Laser land leveling, still to become a popular technology across South Asia.
- Furrow irrigation and raised bed planting which shows more modest reductions in water use (35 per cent) and improvements in yields (10 per cent).
- Zero tillage (reduction in preparation, time, fuel and water use).
- Improved water courses with modest water savings (16–28 per cent) and modest yield gains (12–36 per cent).

A mother and her daughters collect water from a pump in Chainpur, Nepal. The run-off is used to irrigate their vegetable garden. Water efficiency can be improved through the adoption of new technologies.
CAROLINE PENN | PANOS PICTURES

'There is large scope for private companies to provide High-Efficiency Irrigation Systems (HEIS) and other production technologies, but maintenance services must be improved. Over 70 per cent of farmers surveyed never saw the company again after initial installation of HEIS.'

Dr. Bashir Ahmad

Director (Water)
Natural Resources Division
Pakistan Agricultural
Research Council
Islamabad

If water efficiency is so economically advantageous, why is it not more prevalent?

Among the obstacles to the take-up of improved water-saving technologies that farmers face are lack of funds, an aversion to taking up new technology, and a lack of technical know-how, which can increase their management costs.

Governments can play a role in technology adoption by demonstrating that it works, and can lead to economic benefits for farmers such as better produce, fewer pests and monetary savings. When water is overly cheap, as is the case in South Asia, a technology that saves a lot of water but carries none of these ancillary benefits is unlikely to be widely adopted.

The question of subsidies

Subsidies should only be available for technologies that have not been sufficiently embraced in particular regions. If subsidies are employed, the government can then set rules that will eventually reduce the subsidy over time. Extension services and technical literature should also be available to farmers.

The greatest efficiency gains within the existing infrastructure may come from enforcing volumetric charges for water that are proportional to costs, and ensuring that charges are collected effectively and promptly. Preceding increases in water charges with short-term subsidies on investments in adopting water conservation technologies may reduce the expected backlash.

The policy options mentioned above have their own inherent problems. South Asian states have limited financial resources and their institutional frameworks are weak. Decisions are most often politicized and many states have a history of failing to provide services to their citizens. An uneducated workforce has also often led to a less dynamic private sector and a less sophisticated and internally competitive civil service within the state. Water use efficiency will only evolve in each country as the direct result of the country's progress toward political maturity and good governance.

- **Self-sufficiency in financing**

  South Asian governments must look at domestic sources for financing of large-scale surface water infrastructure

- **Using water user associations and farmer organizations more effectively**

  There is potential for expanding the role of users in surface water infrastructure operation and maintenance; countries need to learn how water user associations and farmer organizations can be used more effectively.

- **More efficient collection of water charges**

  The greatest efficiency gains from the existing infrastructure may come from enforcing water charges, based on the volume used, that are proportional to costs, and ensuring that charges are collected effectively and in a timely manner.

- **Demonstrate the ancillary benefits of water management**

  Farmers should be informed through extension services of the advantages inherent in the judicious and equitable management of water: improved crops, fewer pests and monetary savings.

- **Short-term subsidies**

  Short-term subsidies on investments in adopting water conservation technologies and linking subsidies with charge increases may reduce resistance to raising water prices.

Kareze irrigation – a traditional and sustainable groundwater system

A kareze is an unlined tunnel in the hillside, bringing water by free flow from underground aquifers to be used for surface irrigation. This ancient system harvests groundwater through a series of wells that begin at the base of mountains and link with underground channels to bring groundwater to the surface. Karezes are prevalent in the world's highlands irrigating 15 million hectares – 6 per cent of the world's irrigated lands. Half of these are in Iran and the rest are in Afghanistan, Pakistan, Central Asian states, Oman, the Maghreb, Morocco and Mexico.

A survey of over 1,146 karezes in Balochistan, Pakistan, indicates that their construction and maintenance is still based on traditional participatory approaches. Kareze provided water sustainably until the 1970s when, with the increasing take-up of tube wells, the water table started declining, adversely affecting the kareze system.

Various organizations are undertaking kareze modernization through the improvement of mother wells and water flow control devices, the lining of water conveyance channels with PVC pipes between the two wells, by the lining of vertical wells and the storage of water at its destination.

Private sector involvement in the adoption of drip and sprinkler irrigation in India

Drip irrigation was introduced in Tamil Nadu in the 1970s but its adoption remained slow until the 1980s because of a lack of promotion. In 1995, the Government of India involved the corporate sector in adopting drip and sprinkler irrigation. The company Jain Irrigation Systems Private Limited started promoting sprinkler/drip irrigation systems through local manufacturing and by providing integrated services to farmers. This enhanced farmers' willingness to pay for premium use of water and resulted in high compliance from irrigation engineers and private sector firms. This was the beginning of large-scale technology adoption in India for high-value horticulture using high-efficiency irrigation systems.

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The full paper ***Irrigation and Water Use Efficiency in South Asia*** is available for download at **www.agripolicyoutreach.org**

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Further information

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