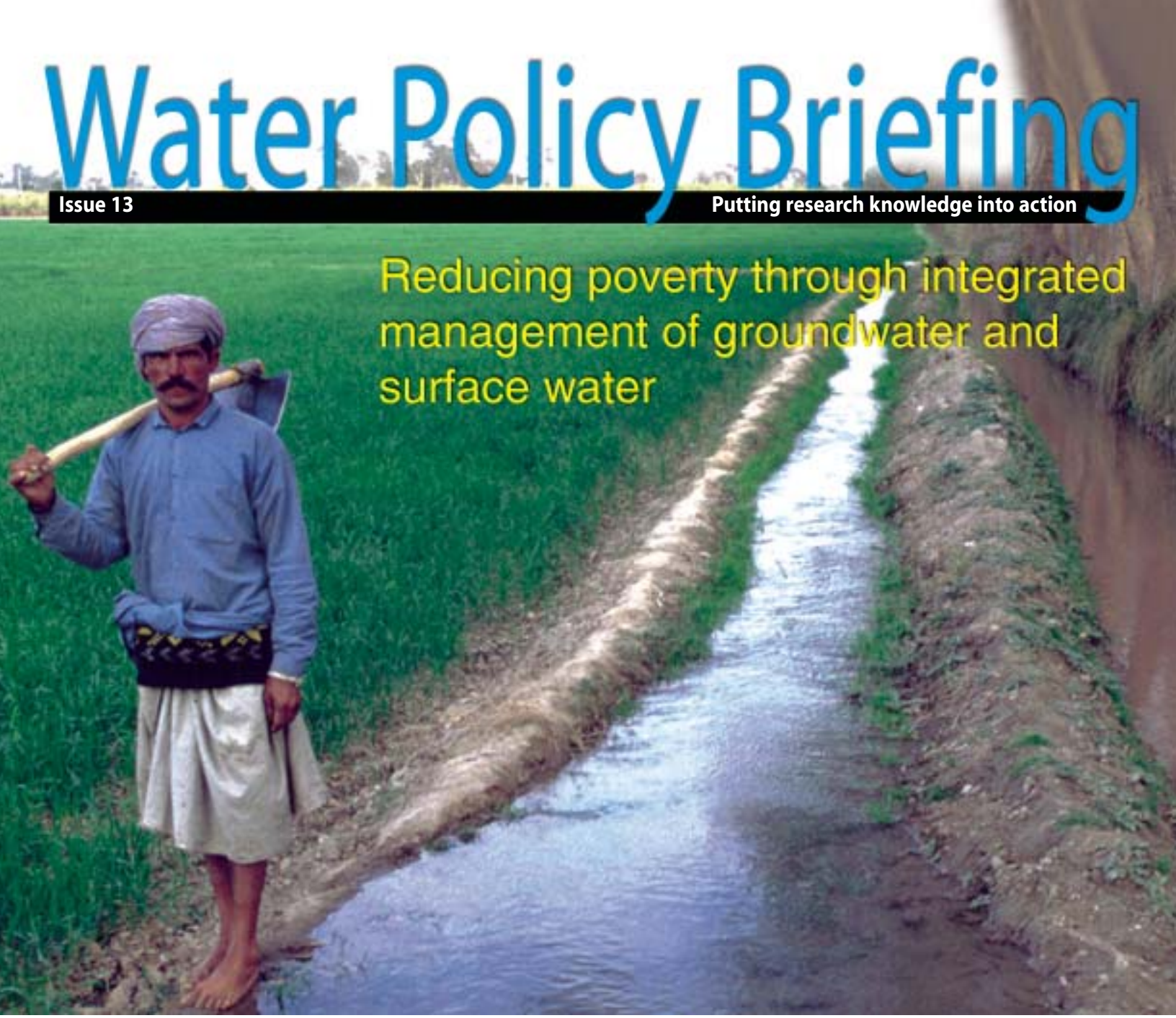
Water Policy Briefing

Issue 13 Putting research knowledge into action



IWMI International Water Management Institute

Global Water Partnership

GWP Advisory Center at IWMI

By considering groundwater availability and quality when allocating surface water for irrigation, water managers could improve the equity, sustainability and productivity of irrigated systems.

The prevailing situation—where there is separate management of groundwater and surface water—has contributed to land salinization in areas with poor quality groundwater and to low agricultural productivity and high vulnerability for farmers in the tail ends of systems.

An opportunity to improve equity, efficiency, and sustainability in irrigated areas

The full poverty-fighting potential of existing irrigation schemes is not being realized—largely because of inequitable water distribution and unsustainable land and water management practices.

An integrated water resources management (IWRM) approach reveals opportunities to reduce poverty and improve overall agricultural productivity and sustainability in these systems. Research in India and Pakistan has highlighted one such opportunity—integrated management of surface water and groundwater—that has great potential for water-short systems with variable groundwater resources.

By considering groundwater availability and quality when allocating surface water, water managers could improve the situation of millions of poor farmers with inadequate access to both surface water and groundwater and overall productivity in irrigated systems. The prevailing fragmented approach—where groundwater and surface water are managed separately—has contributed to high vulnerability and low agricultural productivity for farmers in the tail ends of canals and to land salinization in areas with poor quality groundwater.

Irrigation and poverty

Research has confirmed that irrigation development does reduce poverty.[1] It directly boosts yields and gives farmers the "water security" they need to risk investing in other productivity-enhancing inputs, such as fertilizers and improved seed.

Because irrigation development has focused primarily on overall growth in production, the implications for people living in poverty have frequently been ignored.[2] In many cases, irrigation development has failed to help the poorest—leaving those living at the end of the canal line in the more remote, usually poorer settlements with little or no water. The result is that there are still millions of poor living within established irrigation schemes. The "trickle down" approach has proved inadequate to the task of eradicating poverty.

The research in Pakistan found that farmers with better access to water—whether through reliable canal irrigation or good-quality groundwater—were able to earn roughly twice as much per hectare as those with poor access to water. In India, the difference in income per hectare between farmers with the best access to good-quality water and those with the worst access proved to be less dramatic, but still showed a clear correlation between the degree of access and income. Overall, in Pakistan and India, gross margins were lowest in areas with the poorest-quality groundwater.

Taking an integrated and pro-poor approach to reforming irrigation management and policies and to rehabilitating infrastructure can reduce poverty, as well as lessen the need for new infrastructure. In areas where the development of new irrigation systems is a necessity, taking a pro-poor approach to design and

[1] Hussain, Intizar and Munit A Hanjra, "Does Irrigation water matter for rural poverty alleviation? Evidence from South and South-East Asia," Water Policy 5 (2003): 429-442.

[2] See TEC Background Paper 8: Poverty Reduction and IWRM, p. 17.

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implementation contributes to poverty reduction goals, as well as to household food security and overall productivity.

Impact of land and water degradation

Environmental degradation is another factor that has inhibited the poverty-reduction payoffs from irrigation development. Soil degradation presently affects 30 percent of the world's irrigated lands.[3] Unsustainable irrigation management has resulted in the salinization of millions of hectares of agricultural land and, again, it is the poor living at tail ends of canals, where water supply is insufficient to flush salts from the soil, who have been most affected. In the Pakistani and Indian studies, the poorest farmers were those who did not have sufficient access to canal water or good-quality groundwater, with the result that they were forced to irrigate with saline groundwater, further salinizing their fields.

Lessons for Preparation of National IWRM and Water Efficiency Strategies

- **Access to water for irrigation does reduce poverty.** But to maximize irrigation's poverty-fighting potential, a specific pro-poor focus is needed. This means ensuring the poor have a voice in irrigation development and management, monitoring equity and poverty within irrigation schemes, and setting irrigation performance standards that include equity, poverty and sustainability as well as efficiency criteria.
- **Management of surface irrigation impacts on groundwater quality and availability.** The two resources are inextricably linked and cannot be sustainably managed separately.
- **When assessing access to water for poverty reduction, quality and reliability can matter more than quantity.** Quality and timing, as well as quantity impact yields and influence farmers' willingness to invest in productivity-enhancing inputs.
- **People, particularly in poor, rural communities in dry areas, often use irrigation water for domestic purposes, small-scale industry, and fishing.** Not taking into account these multiple uses of irrigation water in irrigation planning and management misses out on a valuable opportunity to improve the situation of poor women and men—at little additional cost. And it puts these groups in jeopardy and contributes to the deterioration of water quality. When setting irrigation water quality standards, it is important to consider the health of domestic users as well as of crops.

Multiple uses of irrigation water

Communities, women in particular, also benefit from irrigation as a source of water for domestic uses, cottage industries, and fishing. In semi-arid and arid areas, irrigation water may be the primary source of water—used for everything from drinking to bathing to watering livestock. However, these multiple uses of water are seldom recognized due to the prevailing sectoral approach to water management. This situation leaves poor people vulnerable to ill-health, especially due to poor-quality irrigation water. It also contributes to pollution of the resource. For example, activities such as bathing, watering livestock, and washing clothes, dishes and vehicles in irrigation canals have an impact on water quality—with implications for human and crop health.

Integrating management of surface water and groundwater

In irrigated areas, there is an intimate connection between groundwater and surface water, yet these resources are often managed completely separately. Research in India and Pakistan demonstrates how an integrated approach of managing both surface water and groundwater can promote social equity, economic efficiency and environmental sustainability—the three "E's of IWRM."

The research examined four distributaries—two in Pakistan and two in India—where canal supplies are inadequate and groundwater quality is variable. In all four systems, a fairly large proportion of irrigation demand must be met through groundwater pumping. In Pakistan's Lalian and Khadir distributaries, groundwater accounts for 60% and 90%, respectively, of water use per hectare. The corresponding proportions in India's Rohera and Batta are around 90% and 73%, respectively.

In both Pakistan and India, irrigation managers already consider groundwater availability when allocating water between distributaries, but even within distributaries the availability and quality of groundwater resources vary. And in terms of addressing poverty, the variation within distributaries may be more significant. Poverty assessment in the study areas (see table 1) showed that the incidence of

[3] Jønch-Clausen, Torkil, "Integrated Water Resources Management (IWRM): Why, What and How?" TEC Background Paper No. 10, p. 11.

Policy Recommendations for Integrated Management of Groundwater and Surface Water

- Groundwater resources within irrigation systems should be mapped and monitored, with respect to quantity/depth and quality.
- In areas with good groundwater resources within irrigation schemes, farmers should be encouraged to sustainably tap these resources.
- The availability of good-quality groundwater should be taken into account when allocating irrigation water at system and distributary levels.
- In irrigated areas underlain by saline aquifers, irrigation efficiency measures should be promoted to prevent further salinization of freshwater resources.

poverty at tail ends is higher than at head and middle reaches, with the exception of Khadir where tail-end farmers have access to good-quality groundwater.

Yields also vary greatly across farms and distributaries (see figures 1 to 4) and are closely correlated to access to good-quality water. In general, yields are higher in head reaches than in tail reaches except in Khadir, where groundwater quality in the head is poorer than in the tail.

Taking water quality into account

When conjunctively managing groundwater and irrigation, considering groundwater quality is as important as its availability for the health of the system. At the present level of groundwater salinity, the use of only groundwater for irrigation (i.e., 100% groundwater with no canal water) would reduce wheat yields on average by 199 kg/ha in India, and by 411 kg/ha in Pakistan. In the Lalian tail end where salinity levels are high and per hectare water use is low, the use of only groundwater would reduce wheat yields on average by 622 kg /ha. The key to improving productivity in this situation is promoting conjunctive use of groundwater and canal water.

The study concludes that reallocating canal water more equitably across reaches of the systems will improve overall gains from irrigated production. In terms of improved incomes, farmers at the Lalian tail end, which is the poorest area among all reaches in the four study areas, stand to benefit the most—with gross margins increasing by Pakistan Rs 3,188/ha (around US$50) (see table 1). This amount is equivalent to 0.5 tons of wheat—enough to provide a family of four with wheat for a year.

In distributaries such as Lalian and Batta, where canal water availability is relatively high and significant, inequities in its distribution exist, but significant gains in aggregate yields and overall crop profitability can be achieved through canal water reallocations to reaches where groundwater is of poorer quality. Under such situations, canal water reallocation would be helpful in achieving not only efficiency and equity of water distribution but also sustainability of the resource use. But where canal water is in extremely short supply, as in Khadir and Rohera, no significant gains in aggregate yields and crop profitability can be expected through canal water reallocations—even if there are significant inequities in canal water distribution across reaches.

Impact on domestic supply

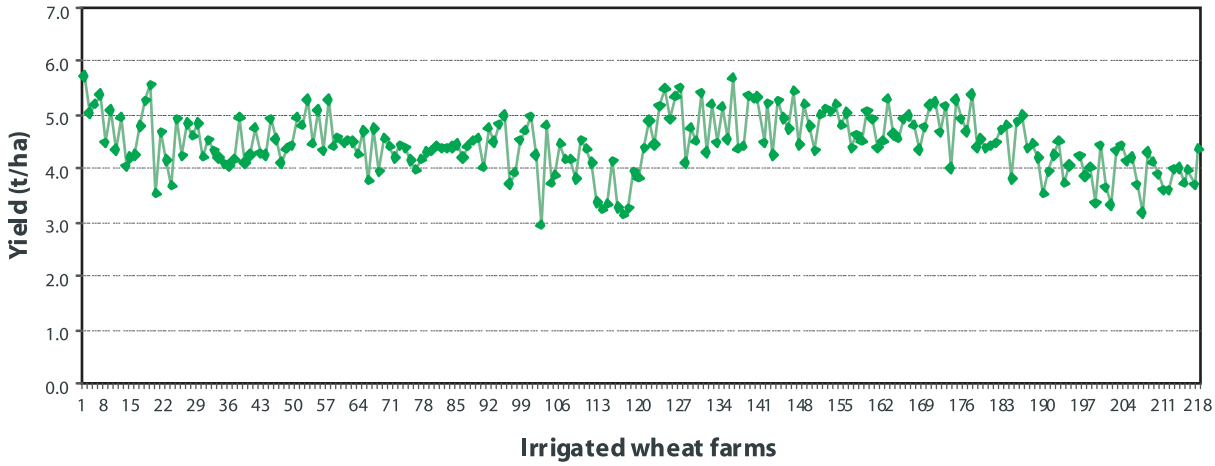
In areas with poor-quality groundwater and without domestic water supply schemes, people depend on irrigation water to meet all their water needs—using water directly from the canal, from community storage structures, or from shallow groundwater recharged from irrigation seepage. By reallocating good-quality irrigation water to areas with saline groundwater, there is an opportunity to improve domestic supply and, if combined with simple household storage structures and education in hygiene, to dramatically improve health. However, it is important to monitor groundwater in

How Integrated Water Resources Management Contributes to Millenium Development Goals

An outcome of the World Summit on Sustainable Development (WSSD) in 2002 was a specific directive calling for all countries to develop IWRM and Water Efficiency Strategies by 2005. The directive states that all countries should have a strategy—regardless of their level of financial or water resources—and that developing countries must be supported in the process of preparing their strategies. The content of these strategies is to be wide-ranging, covering institutional, financial and technological change.

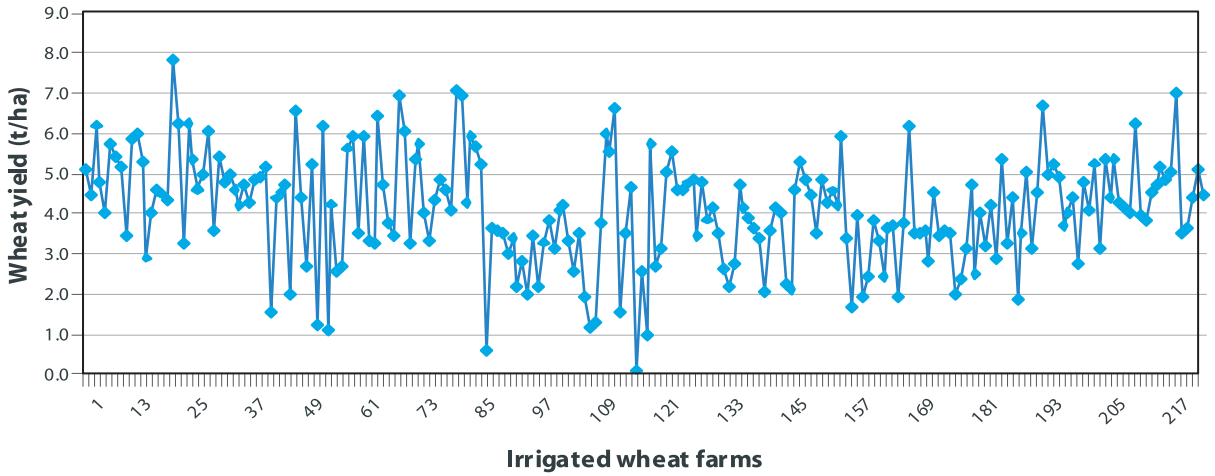
Figures 1 and 2. Irrigated yields per hectare across farms at selected distributaries in Bhakra canal system in India and lower Jehlum canal system in Pakistan.

India



Note: Based on crop cutting experiment in the study areas, 2000–2001.

Pakistan



Note: Based on crop cutting experiment in the study areas, 2000–2001.

areas which are no longer receiving as much irrigation water. Decreased irrigation supplies may impact availability and quality of groundwater in these areas, thereby affecting not only irrigation supplies but also domestic wells. Water managers need to carefully balance recharge needs in these areas with water needs of areas with poor-quality groundwater.

Sustainability issues

Allocating more canal water to areas with saline groundwater will reduce land salinization, but it is important to ensure that it does not at the same time contribute to further salinization of freshwater resources. Improving irrigation efficiency is of vital importance in these areas to avoid freshwater seeping

into saline aquifers. Matching allocation as closely as possible to crop water requirements; lining canals; introducing low-cost precision irrigation technologies, such as laser land-leveling and drip; and conservation tillage practices will not only improve productivity in these areas but also improve sustainability.

As mentioned above, groundwater levels need to be monitored carefully. Wheat yields begin to be affected when water tables rise above 1.5 meters.

Water rights and community dialogue

Improving equity within schemes will require enforceable water rights and strong political commitment—particularly in this situation where canal water is being taken away from an advantaged group and reallocated to the disadvantaged. Community dialogue is another important ingredient. This means establishing fora for consensus-building and, if necessary, conflict resolution around the proposed changes.

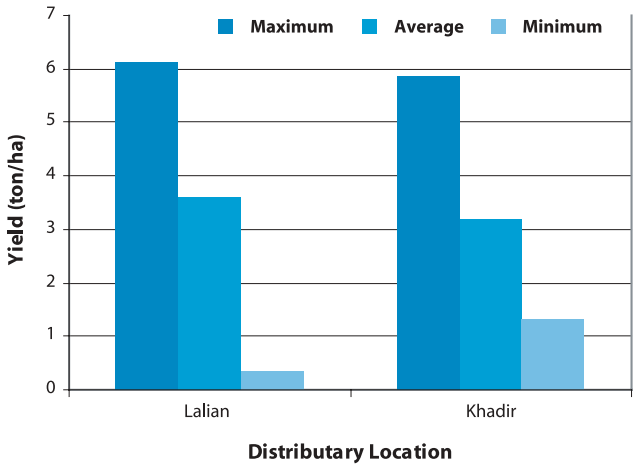
Closing the productivity gap

Average wheat yields in India and Pakistan have increased steadily over the past three decades. But in recent years, the rate of growth in average yields has slowed considerably, causing concern among policymakers and planners in both countries. How to spur yield increases? Previous studies focused on soil and agronomic factors; however, water-related factors at system and farm-levels may be just as important if not more so. This study suggests that poor groundwater quality leading to the accumulation of salts in the soil is a key factor influencing wheat yields. For many systems, allocating more canal water to areas with saline groundwater may be a big part of the answer to improving average yields and overall productivity.

Access to good-quality water on its own will only go partway to closing the productivity gap. Other factors such as the use of good-quality seed and fertilizer, reliability and timing of irrigation, and timing of sowing also have a big impact on productivity. In Pakistan, where farmers are using older seed varieties and less than the recommended amount of fertilizer, overall yields are considerably less than in India.

Promoting on-farm agronomic practices such as newer seed varieties, and dissemination of knowledge on planting dates and timings and application rates of inputs, particularly water and fertilizers, can help reduce productivity gaps.

Figures 3 and 4. Irrigated yields per ha across selected distrib system, Pakistan.

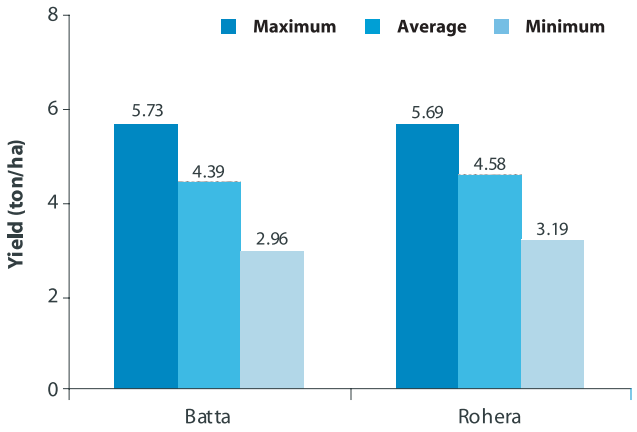


Note: Within the two distributaries studied in Pakistan, yield variations are directly related t

Table 1. Income and access to water

Habitat	Household Income in US$/year	Poverty (%)	Current water availability/ quality
Lalian			
Head	1,376	45	Good access to canal water and high-quality groundwater
Middle	2,021	42	Good access to canal water and high-quality groundwater
Tail	887	58	Canal water insufficient; groundwater saline
Khadir			
Head	1,037	54	Canal water insufficient; access to good-quality groundwater
Middle	1,302	60	Canal water insufficient; access to good-quality groundwater
Tail	1,354	62	Canal water insufficient; access to good-quality groundwater

utaries in Bhakra canal system in India and lower Jehlum canal



o the quality and availability of water.

Impact of water reallocation on gross margins for 1 cropping season in US$/ha	Calculated value according to purchasing power parity in US$/ha
+11.71	+45
5.41	-20
-	
+50.93	+194
+0.44	+2
-1.07	-4
+5.74	+24

Further Reading

GWP publications (available at www.gwpforum.org)

TEC Background Papers:

- Poverty Reduction and IWRM (no. 8)
- Integrated Water Resources Management (no. 4)
- Integrated Water Resources Management and Water Efficiency Strategies by 2005: Why, What and How? (no. 10)

IWRM ToolBox Case Studies:

- Pakistan community action for equitable water distribution (no. 195)
- Pakistan: Integrated management of groundwater in Baluchistan (no. 194)
- India: Gujarat Jal-Disha 2010—community water management in the context of drought (no. 40)
- Spain: Managing water demand in the upper Guadiana basin (no. 18)
- Oman: Guidelines for groundwater abstraction by the organization, Petroleum Development Oman (no. 163)

IWRM ToolBox References:

- C2.1 National Integrated Water Resources Management Plans
- C2.3 Groundwater management plans
- C5 Conflict resolution—managing disputes, ensuring sharing of water resources

IWMI publications (available at www.iwmi.org/pubs)

- "Land and Water Productivity of Wheat in the Western Indo-Gangetic Plains of India and Pakistan" (IWMI Research Report 65)
- "Multiple Uses of Water in Irrigated Areas" (SWIM Paper 8)

Useful websites

- Dialogue on Water, Food and Environment—www.iwmi.org/dialogue
- GWP IWRM ToolBox—www.gwpforum.org
- Agriculture water and poverty, and domestic use of irrigation water—www.iwmi.org/propoor and www.iwmi.org/health
- Tutorials and training material on IWRM—www.cap-net.org

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The Global Water Partnership

The Global Water Partnership (GWP) is a world-wide network created in 1996 to promote Integrated Water Resources Management (IWRM) through knowledge exchange and partnership building. The GWP operates through regional, country, and area water partnerships—bringing stakeholders and leading water professionals together to discuss shared problems and devise appropriate IWRM solutions.

For policymakers and water management professionals, the GWP provides the tools and knowledge needed to move away from fragmented, sectoral policies and practices and towards integrated, cross-sectoral approaches. Since the World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002, a key aspect of this work has been to support countries in developing national Integrated Water Resource Management (IWRM) and Water Efficiency Strategies, in accordance with the WSSD's Plan of Implementation.

More information on the GWP and IWRM tools and publications are available at **www.gwpforum.org**

The GWP Advisory Center at IWMI

The GWP Advisory Center at IWMI provides research and knowledge to support countries and regions in developing and implementing Integrated Water Resources Management (IWRM) and Water Efficiency Strategies. The core work of the Advisory Center is to facilitate the formation of partnerships at multiple levels, promote knowledge of IWRM tools and practices, provide support for dialogue on IWRM issues and policy, and identify knowledge gaps and support research to fill them.

The Center provides support to the GWP's extensive network of partners in Asia and Africa —drawing on IWMI's expertise in water and land-resource management. The services provided are demand-driven—determined by the needs expressed by countries and regions. Partners include government agencies, public institutions, private companies, development agencies and others committed to sustainable water management.

GWP Advisory Centers are also located at DHI Institute of Water and Environment in Denmark and at HR Wallingford in the UK.

More information on the GWP Advisory Center at IWMI is available at **www.iwmi.org/gwp**.

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