Water for farming to fight poverty

Artist: Thim Sophal, Cambodia

4 Reversing the flow: agricultural water management pathways for poverty reduction

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Overview

Access to water for productive and consumptive uses, poverty reduction, and sustainable livelihoods for rural people are all intimately linked [well established]. Apart from labor and land, water is one of the most important resources of poor people in rural areas. Improving access to water and productivity in its use can contribute to greater food security, nutrition, health status, income, and resilience in income and consumption patterns. In turn, this can contribute to other improvements in financial, human, physical, and social capital, simultaneously alleviating multiple dimensions of poverty. Indeed, the productivity of other assets often depends on water use, while sustainable patterns of water use can contribute to the conservation of all natural resources.

This chapter recognizes that poverty prevails in all farming systems and in all regions of the developing world, although with varying severity and intensity [well established]. For instance, in Sub-Saharan Africa, the absolute number of poor people is very high in rainfed systems. Although the underlying causes of poverty vary by farming system, difficult access to water and its growing scarcity stand as threats to future advances in poverty reduction in all such systems. Other water-dependent groups that are highly vulnerable to poverty include rural small-scale fishing and herding communities. For them, problems of access will worsen because of climate change and water-related disasters that can undermine their livelihood strategies.

Where there is equity in resource distribution, the impact of improved water management on agricultural productivity growth has been more poverty reducing [established but incomplete]. Inequality, particularly gender-based inequality, tempers the effectiveness of poverty

reduction efforts. Women, who produce an estimated two-thirds of the food in most developing countries, are important stakeholders in poverty reduction in irrigated and rainfed systems. Yet they often have inadequate access to land, water, labor, capital, technologies, and other services. This situation is unjust and prevents women from realizing their full potential as human beings and citizens and compromises efforts to target water management for poverty reduction.

Better water management is a promising pathway to fight poverty, improve equity, and empower poor men and women

Water is an important livelihood asset, particularly for the rural poor who depend on agriculture [well established]. Better water management is a promising pathway to fight poverty, improve equity, and empower poor men and women. No blueprint strategies are presented here to reduce poverty and inequity. Strategies have to be context-specific and must begin with the recognition that water should be an integral part of realizing the right to a sustainable livelihood for poor men and women.

Broadly conceived poverty reduction strategies will entail four elements:

- Ensuring the right to secure access to water for the poor (securing water and developing appropriate technologies and financing options).
- Empowering people to use water better (raising water productivity).
- Improving the governance of water resources.
- Supporting the diversification of livelihoods.

Based on a review of experiences, we propose broad areas of focus for investments in agricultural water resources development and management. These investments need to be informed by a thorough understanding of the constraints and aspirations of poor people themselves. Some of these proposed strategies are:

- Developing new water systems without repeating the mistakes of the last 50 years. For countries that have not yet developed their water resources, there are two basic approaches: large infrastructure development or a range of small-scale, low-cost technologies, including farmer-managed technologies, community irrigation systems, rainwater management, and informal irrigation. Both approaches are justified in different situations. Small-scale systems can target poverty head-on but may not be able to protect poor people's limited assets under conditions of greater climate variability. Investments in big infrastructure aim at general economic growth with the goal of reaching the poor both directly and through multiplier effects on production, consumption, and human capital.
- Increasing the productivity and equity of existing systems, including upgrading rainfed systems to improve crop and livestock productivity; diversifying into high-value, high water-productivity crops; and engaging in value-adding processing activities and other small businesses.
- Ensuring secure access to water for agriculture for poor women and men by clarifying water rights.
- Facilitating local management by acknowledging the importance of customary laws and informal institutions in the management of water and other natural resources.
- Providing policy and technical support to informal irrigation systems, which are vital to many poor farmers.

- Designing and developing water resources infrastructure, applying a multiple-use systems perspective (including domestic use, livestock, fisheries, and aquaculture) to maximize benefits per unit of water for poor women and men.
- Supporting agricultural water research that targets poverty head-on, looks at low-cost and gender-suited technologies, and investigates policies most likely to reduce poverty and inequality.

While agricultural water management and development play an important part in poverty reduction, they cannot banish poverty alone [well established]. Also needed are complementary investments in education, health, rural infrastructure, capacity building, and supportive institutions, together with pro-poor, pro-gender research on low-cost and gender-suited technologies, crop research advances, and improved agronomic and water management practices and related dimensions of social exclusion, equity, and empowerment. This requires a complementarity of actors, including nongovernmental organizations (NGOs), research organizations, governments, the private sector, and donors. Holistic and integrated assessment of needs, possible interventions, and their interactions will be the key to achieving sustained improvements in water use for poverty reduction.

Crop and livestock production, agroprocessing, fishing, ecosystems, and human health are all influenced by the quality and quantity of available water and in turn affect human well-being

Understanding water poverty

Water is essential for life and human well-being. Water is used in both productive and consumptive activities and contributes to rural and urban livelihoods in myriad ways. Adequate access to water is a prerequisite for realizing of the right to development.[1]

Lack of access to drinking water is an indicator of poverty, but the role of water in human well-being is far more complex. Crop and livestock production, agroprocessing, fishing, ecosystems, and human health are all influenced by the quality and quantity of available water (see chapters 6 on ecosystems, 12 on inland fisheries, and 13 on livestock) and in turn affect human well-being.

In many cases poor people lack access to enough water for both productive and consumptive uses simply because the resource is physically scarce (see chapter 2 on trends). Here, the issue is water availability. In other cases water resources development costs are prohibitive and water is economically scarce. In still others water is physically available but generates lower than potential economic gains and constricts human welfare. It has low water productivity (see chapter 7 on water productivity) because of poor management, or the gains are distributed inequitably in ways that disadvantage poor people (institutional water scarcity). Mismanagement of water resources can even contribute to poverty, as in the case of groundwater overdraft (see chapter 10 on groundwater). Changes in water allocation due to social preferences and political decisions may also create scarcity, as some groups get water while others are denied access. This can increase poverty and vulnerability.

It is highly likely that problems of water scarcity, mismanagement, and water-related disasters will intensify due to population increases, rising demand for water for agriculture and other uses, and greater climate variability. Pressure on coping structures will affect patterns of water ownership and accessibility. Increasing scarcity is likely to deepen current inequalities, to the detriment of the poor, particularly women and marginalized groups.

Human vulnerability will increase unless systems are able to adapt more rapidly to the ensuing shocks (Pannell and others 2006).

Water resource development can address poverty, improve well-being, and enhance people's freedoms and opportunities to accumulate assets to lead dignified lives. For many of today's rural poor, water security is vital for livelihood security. Essential accompanying factors include an enabling policy environment, supportive pro-poor institutions, appropriate cropping technologies, financial and technical support joined to local demand, and investments in institutions and training that enhance people's capacities and freedoms to participate in defining the development they want (see chapter 5 on policies and institutions).

Poverty and the availability of water are linked, but the prevalence and severity of poverty appear to depend more on the development of water resources than on the endowment

The agricultural water rights and management agenda to fight poverty is clear. It entails ensuring the right to secure access to water for the poor, empowering people to use water more effectively, improving the governance of water resources and supporting services, and supporting the diversification of livelihoods.

Increasing overall water productivity for poor people remains the main pathway to reduce poverty, but how best to match the agricultural water management package (technology, institutions, policies) to the needs of the heterogeneous poor living in diverse agroecological settings remains unclear. Understanding how improvements in water management can reduce poverty and enabling the necessary changes are two of the most important policy and research challenges for the coming decades.

The profile of poverty and water

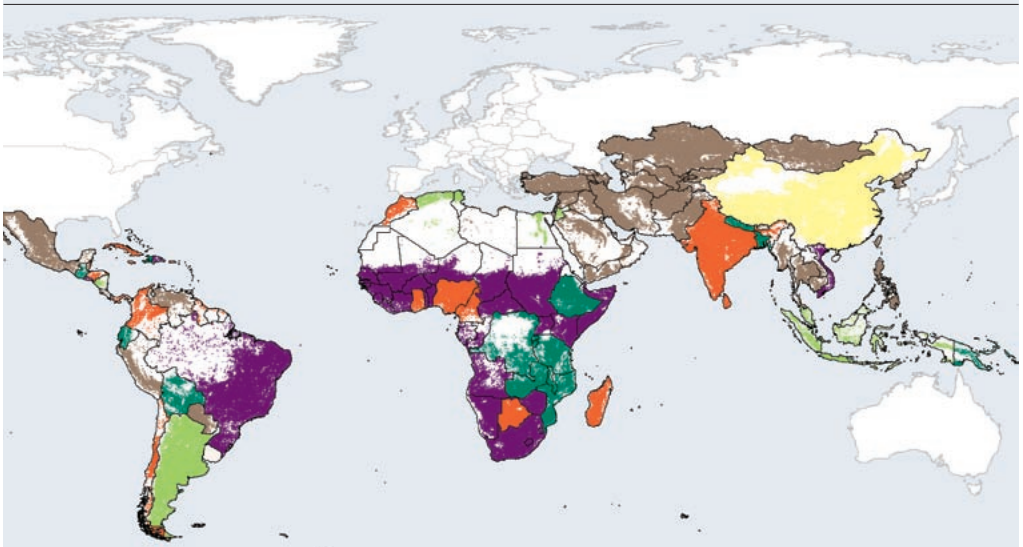
While the proportion of poor people may be falling, more than 1 billion people still live on less than $1 a day, and 2.8 billion live on less than $2 a day (OECD 2001). According to the UN Millennium Project (2005) the number of people living on less than a $1 a day dropped between 1990 and 2001, from 1.218 billion to 1.089 billion. But in some countries the absolute number of poor people is still rising. In Sub-Saharan Africa the number of poor people living on less than a $1 a day increased from 227 million in 1990 to 313 million in 2001 (UN Millennium Project 2005). Global poverty is highly regionalized, rural, and disproportionately female. Estimates of rural poverty range from 62% (CGIAR 2000) to 75% (IFAD 2001) of all poor people. South Asia and Sub-Saharan Africa are the core areas for absolute poverty, with 70% of the world's poor. South Asia has 44% of the people below $1 per day, but the depth of poverty is worse in Sub-Saharan Africa (map 4.1).

Poverty and the availability of water are linked. Not all poor regions lack adequate water resources, however, and other factors come into play. The water resources endowment of the most poverty-stricken regions compares reasonably well with that of better-off countries, and the prevalence and severity of poverty appear to depend more on the development of water resources than on the endowment. For instance, eastern India—part of South Asia's so-called poverty square—is endowed with enormous amounts of groundwater and surface water resources. But while western India forged ahead with the green revolution in 1960s and 1970s, eastern India lagged behind, due mainly to the slow pace of groundwater development (Shah 2001).

A third of the world's people experience water scarcity as a result of rising and competing demands for water from the rapid expansion of irrigation, growth in industry, power

map **4.1** **Share of population below the poverty line**

0%–15% 16%–25% 26%–35% 36%–45% 46%–55% More than 55%



Note: The poverty line is roughly equivalent to a standard of living at $1 a day in purchasing power parity income, which adjusts for differences in price levels across countries.

Source: Thornton and others 2002.

generation, and demography or from the lack of investments in infrastructure or capacity (see chapters 2 on trends and 3 on scenarios). The available water supply and its productive capacity are further strained by climate change, land degradation, deterioration of water quality, and the need to maintain environmental flows and protect aquatic ecosystems (Murgai, Ali, and Byerlee 2001; Postel 1999; Janmaat 2004; Davidson 2000; World Bank 2003). The bulk of this "water-scarce" population resides in the semiarid regions of Asia and in Sub-Saharan Africa, where poverty is deep-rooted. The increasing competition for water tends to lead to growing inequity in its provision.

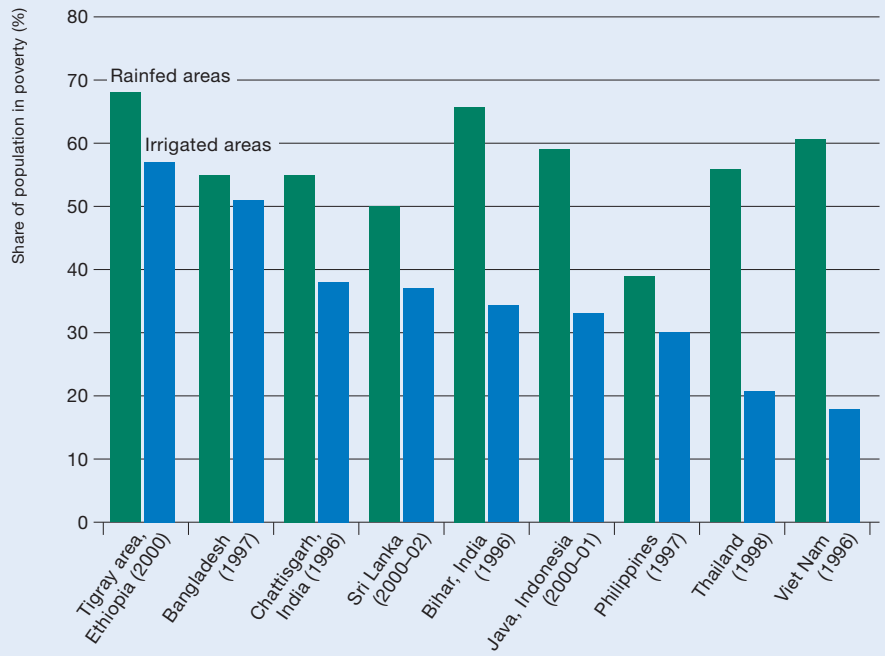
Mismanagement of water resources—as with extensive arsenic poisoning of groundwater in Bangladesh and fluoride contamination of well water in western India—produces health problems and affects livelihood opportunities (see chapter 10 on groundwater). The shifting allocation from rural to urban areas is common throughout the world and puts more pressure on water resources (Molle and Berkoff 2006). Future rapid shifts in rural-urban population ratios will intensify the scramble for water. In the high-altitude Andean watersheds rising competition for water is linked to increases in irrigated agriculture and urban populations. Water customarily used by peasants and indigenous peoples has been diverted for hydropower projects or for high-profit users who live outside the area (see chapter 16 on river basins). Finally, poor people are generally most vulnerable to these water-related issues because their limited access to assets means that they have low resilience to induced changes or shocks.

Farming systems, water, and livelihoods

Agriculture is the main source of livelihood for the world's rural poor and is pivotal to the economies of many developing countries. Women produce an estimated two-thirds of the food in most developing countries (UNDP 2006). Even with the diversification of rural livelihoods and with increasing urbanization, an estimated 50% or more of poor people will remain in rural areas by 2035, a significant number of whom will be smallholder producers (IFAD 2001). For poor farmers agriculture is a disadvantaged activity because of poor people's limited access to livelihood assets and their exclusion from formal decisionmaking and priority setting in agriculture. Water scarcity is one of the main factors that constrains their agricultural output, income, and profitability. The well-being that people derive from water therefore depends on the interaction between farming systems and livelihood systems.

Farming systems. Poverty prevails in all farming systems and in all regions of the developing world, with varying depth and severity. For instance, in Sub-Saharan Africa the incidence of poverty is lower in irrigated farming than in other farming systems, and the absolute number of poor is relatively small (Dixon and Gulliver 2001, p. 33). Poverty rates are generally lower in irrigated than in rainfed settings (figure 4.1). A study in the Mwea irrigation scheme in Kenya found that households outside the scheme are relatively

figure **4.1** | **Poverty is generally lower in irrigated than in rainfed areas**



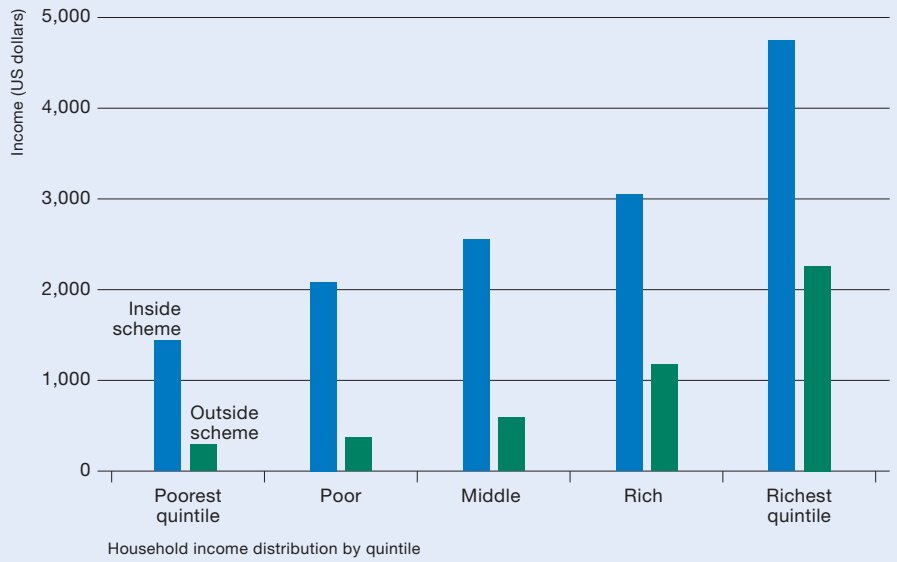
Note: Data refer to selected settings in each country.
Source: Hanjra, Ferede, and Gutta forthcoming; Hussain and others 2006.

income-poorer than their counterparts within the scheme. Households in the middle income quintile within the irrigation scheme are wealthier than households in the richest quintile outside the scheme (figure 4.2).

Although the underlying causes of poverty vary by farming system, growing scarcity and competition for water are a threat to future advances in poverty reduction. Indeed, most of the areas of persistent poverty can be described as "water scarce." However, many irrigated areas with large-scale systems, particularly in India and Pakistan, remain home to large numbers of poor people in both absolute and relative terms. This is due largely to inequity in access to land and water resources and the resulting low productivity, particularly in downstream areas.

Livelihood systems. The productivity of farming systems depends on the amount of capital assets available to farmers. The sustainable livelihoods framework is useful for portraying how various forms of capital shape rural livelihoods. It recognizes that in rural communities the capacity to resist poverty and to improve livelihoods often depends on the opportunities offered by natural resource–based production systems, conditioned by the wider economic, institutional, and political environment. Livelihoods analysis prompts assessment of the assets used for existence (both those owned and those obtained through formal or customary rights or exchange) and of how they are used in livelihood activities. Inequity in household access to assets is seen to affect the coping mechanisms of individuals within households and their ability to deal with crises and external risk factors

figure **4.2** | **Household income within and outside the Mwea irrigation scheme in Kenya**



Source: Nguyo, Kaunga, and Bezuneh 2002.

(Bebbington 1999; IDS 1999). Men and women, because of their different access to assets, will have different capacities to withstand or escape poverty.

Along with land, water is generally the most important natural asset for poor people. Improving access to water and productivity in its use can contribute to other improvements in financial, human, physical, and social capital, simultaneously alleviating multiple dimensions of poverty. Productive but sustainable patterns of water use may also contribute to the conservation of water resources and other aspects of natural capital. Poverty and environmental degradation are closely linked (see chapter 6 on ecosystems). A degraded environment provides fewer development opportunities, less water security, greater health risks, and increased exposure to landslides, droughts, and soil erosion (PEP 2002). Hence, any assessment of how improvements in agricultural water management can affect poverty must consider impacts on these varied dimensions of poverty and their interactions. It must also consider whether changes are in absolute or relative terms and long lasting or transient and consider their distributional incidence in terms of gender and social groups.

The wide gap in agricultural productivity between irrigated and rainfed systems offers hope that the potential for fighting poverty through catalyzing productivity growth remains substantial

Agricultural water management and its transmission pathways affecting poverty

This section looks at how the effects of investment in agricultural water management on poverty are transmitted through interrelated pathways (table 4.1). The poverty reduction impact can be direct or indirect, negative or positive, depending on the nature of these pathways (Hussain 2005). The net welfare effects of investments in agricultural water management depend individually and synergistically on investments in related agricultural science and technology, rural infrastructure, basic health and education, conducive policies and institutions, provision of public goods, quality of governance (such as the prevailing social power relations), gender roles, degree of participation of the poor in decisionmaking, and the natural resources endowment and climate (Dixon and Gulliver 2001).

Production and productivity. Improved agricultural water management boosts total farm output. Increased output may arise from improved yields, reduced crop loss, improved cropping intensity, and increased cultivated area. Reliable access to water enhances the use of complementary inputs such as high-yielding varieties and agrochemicals, which also increases output levels (Smith 2004; Bhattarai and Narayanamoorthy 2003; Hasnip and others 2001; Hussain and Hanjra 2003, 2004; Huang and others 2006). Food and Agriculture Organization (FAO 2003) data show that the major sources of growth in crop production for all developing countries during 1961–99 were yield increase (71%), area expansion (23%), and cropping intensity (6%). Empirical evidence for a sample of 40 countries shows that for each 1% improvement in crop productivity $1 a day poverty fell by about 1% and the human development index rose by 0.1% (Irz and others 2001). There seems to be a solid link between yield growth, poverty reduction, and human development.

The wide gap in agricultural productivity between irrigated and rainfed systems offers hope that the potential for fighting poverty through catalyzing productivity growth remains substantial (Hussain and others 2004). In some South and Southeast Asian countries

table **4.1** **Agricultural water management and its transmission pathways for reducing or increasing poverty**

Impact area	Possible positive impacts	Possible negative impacts	Key target groups
Production and productivity	Increased food production through yield improvement, area expansion, cropping intensity gains, and shift in cropping and production patterns	Higher production usually requires more water, leaving less water elsewhere (pasture land and watering points), affecting livestock and fish stock	Landowners
Employment	Increased demand for labor, higher wage earnings, reduced pressure on nonagricultural employment, less time accessing and collecting water, and more time for other productive and livelihood-enhancing activities	Loss of employment opportunities for nomadic herders, fishers, and those directly dependent on ecosystem services, and deterioration in labor relations	Landowners, landless laborers, poor urban dwellers
Consumption and food prices	Lower prices for staples and food	Downward pressure on producers' income	Rural and urban poor, landowners
Backward linkages and second-round effects	Increased use of production-intensifying inputs such as fertilizer, pesticides, improved seeds, and other agricultural services; shift to high-value crops and increased demand for crops of nonirrigated areas; increased employment in the agricultural services sector	May contribute to monoculture and to loss of local varieties and agrobiodiversity	Rural and urban poor, landowners
Nonfarm rural output and employment	Increased expenditure on nonfood products, increased demand for nonfood goods and services	Locally available wage employment may encourage child labor	Food processors, transporters, traders, construction firms, microentrepreneurs
Output and income stabilization	Reduced variance of output, employment, and income; increased spending on lifecycle events	Expensive credit, proclivity to spend on lifecycle events and indebtedness	Land owners, laborers and urban poor
Nutrition	More stable food supply, better balanced diet, with adequate intakes of micronutrients	Monocropping of cereals, may also lead to negative nutritional effects	Smallholders, urban poor
Multiple uses of agricultural water supply	Use irrigation water for drinking, sanitation, homestead gardens, trees, livestock, replenishment of aquifers, rural industry, artisanal fishing, aquaculture, and other purposes, which enhances value per drop of water	Possible use of polluted and unsafe water for drinking	Women, herders, poor farmers, fisher folk
Equity	Redistribution of public monies as broadly as possible among rural populations, and resettlement of poor people from overcrowded urban or marginal areas	Displacement of people and social disruptions, increased inequality between geographic areas, land consolidation in which poor people may lose rights to land and water	Rainfed farmers, women, urban poor
Environment and health	Intensification can ease pressure on natural resources by limiting expansion of land and water use; more income and better nutrition, leading to better health and well-being	When poorly managed can lead to land and water degradation (waterlogging and salinization), spread of waterborne diseases, pollution of surface and groundwater, propagation of aquatic weeds	Tailend irrigators, downstream water users, fisher folk

irrigated areas are more than twice as productive as nonirrigated areas, but productivity varies widely within and across systems (Hussain 2005). Variation depends on a range of factors, including policies, local conditions, system management, broader economic and political factors, and the agricultural water management regime. In India, for example, output per hectare is higher for groundwater irrigation than for both canal and tank irrigation systems (Lipton, Litchfield, and Faurès 2003). Productivity also varies widely in aquaculture and livestock systems.

Wood, You, and Zhang (2004), in their analysis of the spatial patterns of crop yields in Latin American and Caribbean countries, found that agricultural research and development in recent decades has been biased toward generating technologies for use in areas with better access to reliable water supplies or irrigated areas. Consider rice. About 90% of the estimated 275 new varieties released in Latin American countries over the past three decades were targeted to irrigated and rainfed wetlands. Average yields in irrigated regions rose from 2.8 metric tons per hectare in the mid 1960s to 4.4 metric tons per hectare in the mid-1990s, while average yields in rainfed regions have changed little over four decades (table 4.2).

table **4.2** **Rice production in irrigated and rainfed areas in Latin American countries**

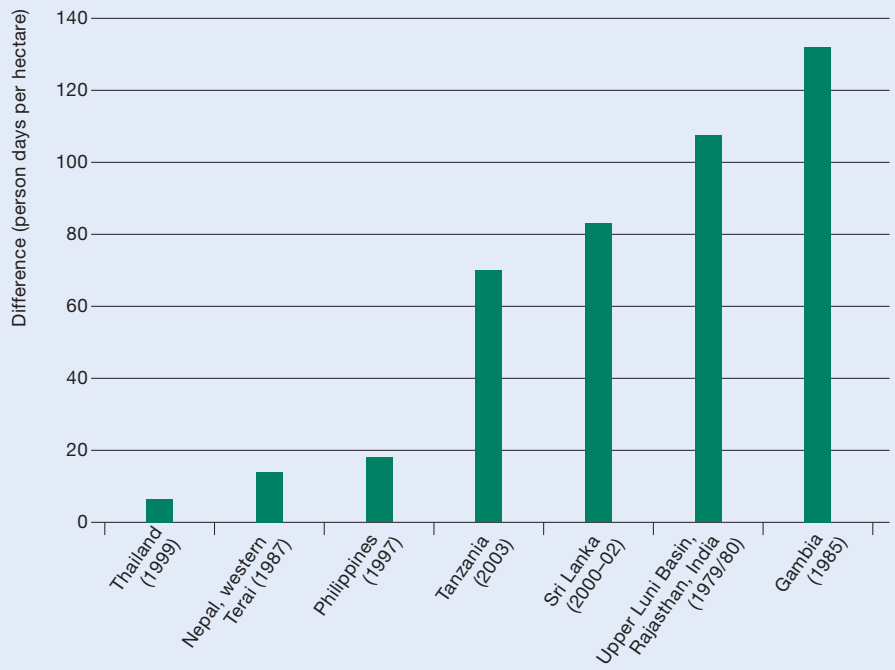
Farming system	Variety	1967	1981	1989	1995
Irrigated					
Area (thousands of hectares)	Modern	—	1,546.5	2,801.4	3,340.3
	Traditional	1,573.1	924.4	446.8	462.4
Production (thousands of metric tons)	Modern	—	6,281.5	1,2490.7	1,5201.9
	Traditional	4,436.2	3,285.3	1,727.8	1,693.0
Yield (metric tons per hectare)	Modern	—	4.1	4.5	4.6
	Traditional	2.8	3.6	3.9	3.7
Rainfed					
Area (thousands of hectares)	Modern	—	499.0	580.3	675.3
	Traditional	4,258.1	5,285.9	3,847.1	2,373.2
Production (thousands of metric tons)	Modern	—	556.9	1,287.0	1,509.4
	Tradtional	5,945.2	5,607.3	4,323.4	2,680.8
Yield (metric tons per hectare)	Modern	—	1.1	2.2	2.2
	Traditional	1.4	1.1	1.1	1.1
Total					
Area (thousands of hectares)		5,831.2	8,255.9	7,675.7	6,851.2
Production (thousands of metric tons)		10,381.7	15,727.4	19,828.8	21,100.9
Yield (metric tons per hectare)		1.8	1.9	2.6	3.1

Note: Modern are semidwarf varieties.
Source: Wood, You, and Zhang 2004, p. 372.

The Comprehensive Assessment finds that the rainfed areas of the semi-arid, arid, and subhumid tropics in developing countries have the greatest potential for productivity gains (see chapters 7 on water productivity and 8 on rainfed agriculture).

Employment. Investment in agricultural water management also affects poverty through its effects on employment by creating additional demand for labor (Damiani 2003; FAO 2000; van Imschoot 1992; Narayanamoorthy and Deshpande 2003; von Braun 1995). Water resources development and management projects require labor for construction and ongoing maintenance of canals, wells, and pumps (Hussain 2005), an important source of employment for the landless rural poor and rural households with excess labor. Increased farm output also stimulates demand for farm labor during the main cropping season and the dry cropping seasons made possible by improved water management, increasing both the number of workers required and the length of employment (Chambers 1988). For example, annual labor use per hectare in the Ganges-Kobadak irrigation system of Bangladesh is about 100 days more than that in nearby nonirrigated areas (Hussain 2005). The same holds for other settings (figure 4.3).

figure **4.3** **Employment per hectare is higher in irrigated than in rainfed areas**



Note: Data refer to selected settings in each country.

Source: Hussain and Hanjra 2003, 2004 for Thailand, Philippines, Sri Lanka, and India; Thapa, Otsuka, and Barker 1992 for Nepal; Mwakalila 2006 for Tanzania; von Braun, Puetz, and Webb 1989 for Gambia.

The effects may extend to urban areas if water resources development and management projects reduce migration and so relieve the downward pressure on urban wages and the upward pressure on prices of housing and other urban infrastructure (Smith 2004). For landless laborers increased cropping intensity and cultivated area have the greatest impact on employment. In southern Palawan, in the Philippines, irrigation increased labor use on lowland farms, raising demand for local labor from 18 days per hectare in 1995 to 54 days per hectare in 2002 (Shively and Pagiola 2004).

Improved agricultural water management boosts food output and lowers staple food prices, making food available and affordable to the poor

The employment impact of irrigation may extend beyond command areas. For example, landless workers in the Terai in Nepal and Bihar State in India migrate long distances to take advantage of seasonal employment opportunities in intensively irrigated systems in the Indian states of Haryana and Punjab. Among upland households in southern Palawan 68% had at least one household member working on a lowland irrigated farm in 2002, and a substantial number of upland households consider wage employment on lowland farms as a viable alternative to upland cultivation (Shively 2006). However, irrigation benefits may approach a zero-sum game over the long run without structural change in the economy because areas with intensive irrigation development act as magnets that attract poverty from their surroundings (Shah and Singh 2004).

Consumption and food prices. Improved agricultural water management boosts food output and lowers staple food prices, making food available and affordable to the poor—nearly all consumers benefit (Datt and Ravallion 1998). Falling food prices put downward pressure on producers' income, but the losses are more than offset by gains in productivity, leaving all better off in irrigated areas. Those whose productivity does not rise, such as farmers in marginal rainfed areas, may suffer a loss of income. Reaching these poor households poses the largest challenge to poverty reduction efforts (Evenson and Gollin 2003). A major share of the consumption benefits that accrue to the poor do so indirectly through linkages and in the long run. Studies show that for every $1 in new farm income earned in Sub-Saharan Africa, at least one additional dollar could be realized from second-round effects. The estimates show that adding $1 of new farm income should boost total household income (including the original $1 stimulus) to $2.57 in Zambia, $2.48 in the Central Groundnut Basin of Senegal, $2.28 in Burkina Faso, and $1.96 in Niger. These estimates depend critically on the selections of a region's catchment area (local, regional, national) and the classification of commodities in terms of their tradability. Consumption linkages dominate; the share of growth linkages attributable to consumption linkages alone was 98% in Zambia, 93% in Burkina Faso, 79% in Niger, and 42% in Senegal (Delgado and others 1994, 1998).

Backward linkages and second-round effects. Access to agricultural water has second-round effects on poverty through output, employment, and prices. Access to reliable agricultural water encourages farmers and fishers to increase their use of inputs, fertilizers, pesticides, improved seeds, and other agricultural inputs and services (World Bank 2005). Modern inputs like fertilizers are highly complementary to water, and hence the demand for these inputs is influenced by the availability of water. Access to reliable water also enables farmers to switch from staples to higher value market-oriented products and to

practice more integrated approaches, including incorporation of livestock and fisheries. For such developments to play an even greater role in poverty reduction, farmers need to be able to manage market risks associated with price fluctuations. The switch in crops may also create or expand demand for crops of rainfed areas, leading to poverty reduction in these areas (Lipton and Longhurst 1989).

Nonfarm rural output and employment. As farm output and incomes rise and food prices fall, enriched farmers and workers will increase their expenditure on nonfood products, boosting demand and increasing employment opportunities in nonfarm income-generating activities. These may include transportation, construction, secondary processing of animal products, food preparation, and trading (World Bank 2005). However, such effects are likely to be less effective under certain conditions. One is when income and land distribution are highly skewed and the consumption patterns of the better-off are oriented to imports and capital-intensive goods and services rather than to the output of rural nonfarm suppliers. Another is when the poor face barriers to entry in nonfarm employment and microenterprises because of ethnicity or caste, gender, skill and education levels, access to information, mobility, transaction costs, and risks. A third is when diversification requires investment in specific assets for which the poor lack the necessary resources without access to well functioning credit and insurance markets (Reardon and others 2000).

Reliable access to agricultural water not only raises crop output levels, but also usually reduces variance in output across seasons and years

Lower benefits to the poor through these pathways are plausible, since poor people are often badly positioned, locationally and otherwise, to benefit directly from nonfarm jobs. The literature points to a close association between nonfarm sector diversification and poverty reduction, but the causal links between the two are difficult to establish (Ellis 2000). Studies in Viet Nam (van de Walle and Cratty 2004) show that the determinants of participation in nonfarm markets and escape from poverty are not the same, though having irrigated land and education are common shared determinants.

Output and income stabilization. Access to agricultural water reduces poverty and vulnerability by lowering the variance of output, employment, and income. Two factors contribute to output fluctuations: rainfall variability and the relative prices of outputs. Food grain output is sensitive to variations in rainfall (Smith 2004; Lipton, Litchfield, and Faurès 2003). Reliable access to agricultural water not only raises crop output levels, but also usually reduces variance in output across seasons and years. For instance, the entropy index of rice yield dispersion in irrigated areas in Brazil fell from 5.3 in 1975 to 2.7 in 1995, while in rainfed areas it rose from 8.0 to 13.7. Moreover, the mean difference in yield between irrigated and rainfed areas also widened (Wood, You, and Zhang 2004). But stabilization of farm output cannot be achieved merely through a reliable system of agricultural water management. Reducing risk and increasing predictability for farmers requires improving the general environment for farming (Smith 2004).

Nutrition. Access to agricultural water may have positive impacts on nutritional outcomes through diversification of crops and greater stability and availability of food supplies (Lipton 2001) and domestic water, thus ensuring a better balanced diet with adequate intakes

of micronutrients. A comparison of food security for households inside and outside the Mwea irrigation scheme in Kenya revealed that food insecurity was much lower inside the scheme (13% of households) than outside (33%; Nguyo, Kaunga and Bezuneh 2002). A study of rice irrigation projects in The Gambia (involving pump irrigation and drainage intervention) concluded that the projects increased real income by 13% (von Braun, Puetz, and Webb 1989). It found that a 10% increase in income leads to a 9.4% increase in food expenditure and a 4.8% increase in calorie consumption and that a 10% increase in calorie availability per capita leads to a 2.4% increase in the weight-for-age index, a robust indicator of nutritional status and poverty. The nutritional impact of the adoption of microirrigation technologies is particularly notable. Following the adoption of bucket kits, poor farm families in India and Nepal, especially female farmers, were able to improve their vegetable and fruit intake (Namara, Upadhyay, and Nagar 2005; Upadhyay, Samad, and Giordano 2004). Changes in agricultural water management may adversely affect the nutrition intake of the poor, however, when they lead to monocropping of cereals at the expense of pulses, oilseeds, and coarse grains. For instance, the rapid expansion in the area of boro rice and wheat facilitated by an expansion of irrigation infrastructure in Bangladesh was achieved partly through reduction in the area planted in pulses and oilseeds. These two crops are important sources of protein and micronutrients, particularly for the poor (Hossain, Naher, and Shahabuddin 2005).

Targeted investments in agricultural water management can be an effective way to reduce societal inequity when used to provide opportunities for the rural poor

Multiple uses of agricultural water supply. Poor rural households may use agricultural or domestic water in multiple ways. Agricultural water may be used for drinking, sanitation, homestead gardens, trees (outside formal irrigation system command areas), livestock, replenishment of aquifers, urban water supply, rural industries, artisanal fishing, and aquaculture. Examples of such multiple uses are abundant (Nguyen-Khoa, Smith, and Lorenzen 2005; Laamrani and others 2000; Moriarty, Butterworth, and van Koppen 2004; Jehangir, Mudasser, and Ali 2000) and are spreading rapidly (Alberts and van der Zee 2004). The benefits may be especially critical for women (for domestic and income-generating purposes) and for other vulnerable groups (who may depend on fishing or brick-making, for example). Thus when irrigation is seen as a low-value water use compared with alternatives, this range of uses and associated benefits may be neglected (Bhatia 1997; Meinzen-Dick 1997; Yoder 1983). Evidence from the Lower Mekong River, Lake Chad Basin, Amazon River, Lao PDR, and Sri Lanka shows how inland fisheries provide 10%–30% of incomes for farmers. A study in South Africa found that the income from productive uses of domestic water represents about 17% of average household income in villages with very limited domestic water provision compared with 31% in comparable villages with adequate domestic water provision (Perez de Mendiguren Castresana 2004).

Equity. Targeted investments in agricultural water management can be an effective way to reduce societal inequity when used to provide opportunities for the rural poor. For example, large public irrigation systems have been built to stimulate economic development in poor regions. Programs to support water harvesting and treadle pumps have

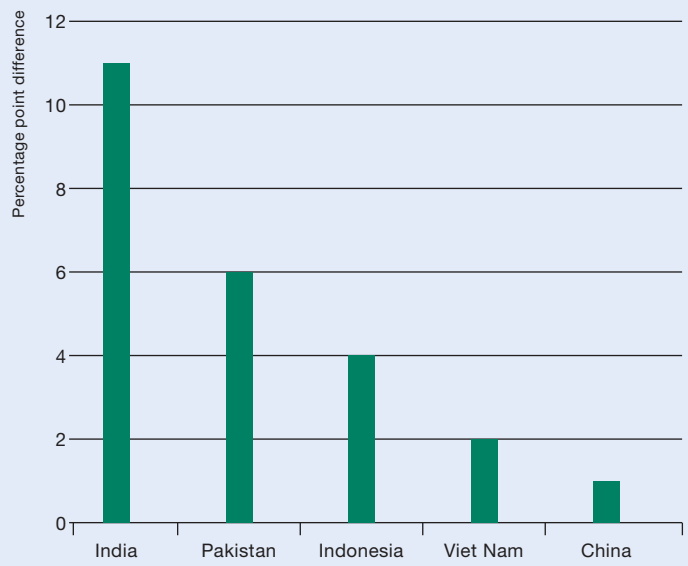
been introduced to reach the disadvantaged. But investments can increase inequity if the rich and powerful capture the benefits or if poor people are displaced (Cernea 2003). The equity impacts of agricultural water management projects vary with time, in both the nature and number of beneficiaries and the nature and extent of the benefits (Smith 2004). Tailend farmers, often the poorest, suffer a twin disadvantage—less water and more uncertainty (figure 4.4).

As agricultural water management spreads, inequality tends to fall. The full equity impacts can be assessed only after a significant time lag, and policies to facilitate adoption by the poorest may be merited (Kerr and Kolavalli 1999). Studies in China show that income from crops grown on irrigated land has the highest marginal effect on lowering inequality (Huang and others 2005). A 1% increase in income from crops grown on irrigated land for all households would decrease the Gini coefficient for total income inequality by 0.1%. Inequality is attenuated by the presence of irrigation (figure 4.5).

Factors that improve equity in agricultural water management include equitable land distribution, with secure ownership or tenancy rights; efficient input, credit, and product markets; access to information; and nondiscriminatory policies for smallholder producers and landless laborers (Hussain 2005; Smith 2004). These conditions are rarely met.

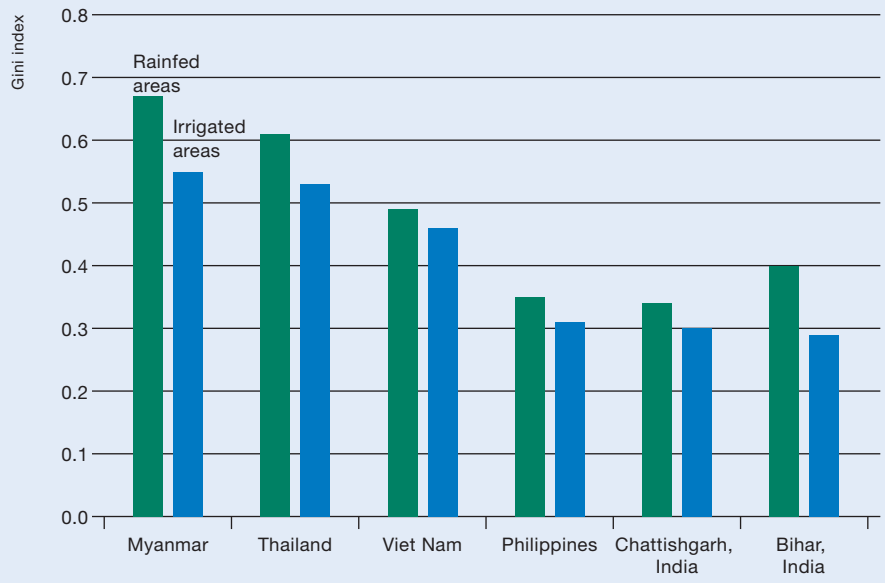
figure **4.4** | **Poverty is higher among tailend farmers**

Poverty among tailend farmers relative to headend farmers, 2001



Note: Data refer to selected sites in each country.
Source: Hussain 2005.

figure **4.5** | **Inequality is lower in irrigated than in rainfed areas**



Note: Data refer to selected sites in each country.
Source: Hussain and Hanjra 2003.

Absolute poverty for some may worsen if investments in agricultural water reinforce processes of land consolidation in which poor households lose rights to land and water or if investments are associated with displacement of labor by mechanization or herbicide use. Poor people may be displaced by the construction of reservoirs and canals, or their livelihoods may be adversely affected by upstream or downstream impacts (Hasnip and others 2001). Larger and relatively resource-rich water infrastructure users will benefit most, even if poor people usually still benefit in absolute terms.

Rising prosperity in irrigated areas has turned the spotlight on the plight of poor people in rainfed areas. Investment in agricultural water management will inevitably be better suited to some regions than to others, and hence geographic inequity may be unavoidable. Moreover, depression of output prices following the introduction of irrigation may reduce the income of poor rainfed farmers, when their productivity does not rise. Women typically have less access to productive resources such as land, water, credit, training, fertilizer, and marketing channels (Agarwal 1994). Women's traditional tasks such as livestock keeping, secondary processing of products, and weeding and transplanting increase with more reliable water, whereas plowing and land preparation, traditionally male tasks, may not. Thus training, credit, input delivery programs, and water delivery schedules that account for gender differentiation of labor, methods of production, and resource access within households can harness opportunities to reduce poverty by facilitating women's activities.

Environment and health. Investments in agricultural water management have both negative and positive impacts on environment and health. Higher income due to better agricultural water management can enhance farmers' abilities to invest in land improvements that enhance sustainability (see chapter 15 on land; Morrison and Pearce 2000; Shively 1999). Investments in agricultural water management, by reducing pressure on surrounding marginal areas, can help to avoid deforestation, land degradation, and loss of biodiversity (Shively 2006; Shively and Pagiola 2004). The population absorption capacity of an irrigation-led strategy may be greater, and pressure on natural resources less severe, than for alternatives (Carruthers 1996). Agricultural water management improves health status through better nutrition, availability of drinking water, and increased spending to combat diseases like malaria.

The marginal impact of agricultural water management on poverty reduction is strongest at the initial stage and then declines as economies grow

The negative environmental impacts of water use in agriculture are extensively documented (see chapter 6 on ecosystems; Urama and Hodge 2004; Dougherty and Hall 1995; Goldsmith and Hildyard 1992; Petermann 1996). Most commonly cited are the upstream and downstream impacts of water diversions (Gichuki 2004), waterlogging and salinization within irrigation command areas (Khan and others 2006), and increased agrochemical usage and pollution and eutrophication of water bodies (Hendry and others 2006). Badly designed or managed irrigation can harm public health and human capital through the spread of waterborne diseases, usually with a greater effect on the poor (Ersado 2005). Negative social and environmental consequences often hurt the poor more than the nonpoor because the poor lack political power and the financial resources to avoid the potentially adverse impacts of irrigation, from physical displacements to health risks and land degradation (Hussain 2005).

A net welfare impact assessment of investments in agricultural water management that takes into consideration the total benefits (including the multiplier effects) and the total corresponding costs (including social, environmental, and health costs) has yet to be conducted (see chapter 9 on irrigation). What we can present here, however, are the direction and magnitude of the poverty impacts of potential agricultural water management interventions that are discussed throughout the book, differentiated by impact pathways (table 4.3).

The nature and magnitude of the poverty alleviation impacts of agricultural water management interventions change over time and with economic development (as illustrated in table 4.3). The marginal impact of agricultural water management on poverty reduction is strongest at the initial stage and then declines as economies grow. For example, the correlation coefficient between irrigation and poverty across 14 Indian states halved from 1973–74 (–0.63) to 1993–94 (–0.30) (Bhattarai and Narayanmoorthy 2003). Moreover, the relative significance of the poverty reduction pathways changes with time. The employment impact pathway is strong at the initial stage, whereas the effect of the productivity pathway is greater toward the later stage.

Using comprehensive datasets from 80 agroclimate subzones of India for 1984–85 and 1994–95, Saleth and others (2003) provide evidence for the declining impact of irrigation over time and for a change in the relative significance of its employment and productivity effects. The analysis shows that since the initial influences of irrigation were

table **4.3** **Strength of poverty impacts of agricultural water management and related interventions by pathways**

Potential agricultural water management interventions	Production/ productivity	Employment	Consumption and price	Backward linkages and second-round output effects
1. New systems				
Large-scale public surface irrigation	High	Medium	High	High
Diffuse forms of irrigation: communal or private operated systems, groundwater, and so on	High	High	Medium	Medium
Fisheries and aquaculture	Medium	High	Low	Low
Multiple use systems: production plus, domestic plus	Low	Medium	Low	Low
Integrating livestock	Medium	Medium	Medium	Low
2. Maintaining ecosystem resilience	Low	Low	Low	Low
3. Improving existing systems				
Improving agricultural water productivity	Medium	Medium	Medium	High
Reversing land degradation	Medium	Low	Medium	Medium
Management of marginal-quality water resources	Low	Low	Low	Low
4. Rainwater management	Medium	Medium	Medium	Medium
5. Water policies and institutions	Medium	Low	Low	Low

a. Mixed positive and negative impacts.

(continues on facing page)

mostly in terms of expanded cultivation, intensive land use, and crop pattern changes, its poverty alleviation impact came largely through the employment pathway. But when the limits for these influences were reached, the poverty reduction contribution of irrigation through the employment pathway declined much faster than the increase in its contribution through the productivity pathway.

At a lower spatial scale an analysis of 256 districts in India shows that districts with above average stock of rural infrastructure have higher values of agricultural output than districts with below average levels of infrastructure, including irrigation, fertilizer, literacy, school, rural roads, and rural electrification (Narayanamoorthy and Hanjra 2006). The impact of infrastructure variables on the value of output turns out to be stronger when they are used as lagged variables in the regression analysis. In particular, the impact of irrigation infrastructure on the value of agricultural output appears to have increased over time.

Irrigation creates winners and losers. Often the gains are far larger than the losses. But who gains and who loses? Studies rarely capture the distributional impacts of irrigation across human and social scales. An exceptionally rare study by Gidwani (2002) shows that the effects of irrigation are ambiguous, both in shaping people's perceptions of well-being and in transforming the material landscape. It uses Sen's (1999) paradigm of "development as freedom" and disaggregates these impacts into a broad set of "functionings," or freedoms to achieve lives that the villagers value. It shows that both laborers (mostly members of the

Nonfarm rural output and employment impacts	Income stabilization	Nutritional impacts	Multiple use	Socioeconomic effects	Environmental and health impacts
High	Medium	Medium	High	Mixed[a]	Mixed[a]
Medium	High	Medium	High	Mixed[a]	Mixed[a]
High	High	High	High	Medium	High
Low	Low	High	High	High	Medium
High	High	High	High	Medium	Mixed[a]
Medium	Low	Medium	High	Low	High
Medium	High	Medium	Low	Mixed[a]	Mixed[a]
Medium	High	Medium	Low	Low	High
Low	Medium	Mixed[a]	Low	Mixed[a]	Mixed[a]
Medium	High	Medium		High	Medium
Low	Medium	Low		High	Medium

lower castes) and employers (mostly members of the landowning and the trading castes) are better off as a result of canal irrigation. In particular, the well-being of laborers has improved or is generally rising on all counts, except their control over cultivable land. Laborers have experienced improvements in their employment conditions and social status or caste dominance, while employers' control over laborers has permanently diminished as has their caste dominance.

Generally, declining control over land by the laborers stems from expensive credit, lower mobility into nonfarm jobs, and a tendency to resort to land mortgages to raise money for marriages and other lifecycle events. Although irrigation seems to have created conditions for land transfers from weaker to richer population segments, it is far less clear that irrigation is the underlying cause of land mortgage transfers. The impact of irrigation intervention on the freedom of villagers is by no means unequivocal: there are often commonalities as well as divergences—laborers say that their employment and living conditions have improved, while employers complain about deterioration in labor relations; laborers are losing control over land, while employers are gaining control. There is nevertheless virtual unanimity among the residents of the irrigation project that despite various unanticipated negative effects, irrigation development has been a positive intervention: all have benefited, albeit disproportionately, depending on their initial entitlements.

The antipoverty impacts through agricultural water management pathways are conditioned by multiple socioeconomic and agroecological factors, shaping welfare and equity outcomes and impacts across spatial, temporal, and human scales. The main implications of this message are:

- In closed basins—where all water is already allocated and where the pathway for further poverty reduction through new investment initiatives is increasingly limited—improving the management of existing systems is the preferred strategy (see chapters 7 on water productivity and 16 on river basins). This is particularly the case for many countries in Asia, the Middle East, and North Africa.
- Where there is economic water scarcity—where exploitable water supplies are available in nature, but people have difficulty accessing them—investment in new agricultural water management (both small-scale irrigation to upgrade rainfed systems and larger scale irrigation) is recommended, but care must be taken to avoid the social and environmental ills of the past. Considerations for terrestrial and aquatic ecosystems; integration of fisheries, aquaculture, and livestock; and application of the multiple-use systems concepts (Van Koppen, Moriarty, and Boelee 2006) in the initial agricultural water management planning process would increase value per drop of water and ensure ecosystem resilience.

In most food-producing areas of the world historical sources of growth in productivity are being rapidly exhausted and investments are urgently needed to buffer adverse effects and protect food and livelihood security.

Challenges and pressures

This section examines some of the challenges and pressures associated with improving agriculture and enhancing food production. The dramatic increase in world food production over the past half century has come from increased crop yields (see chapter 2 on trends). But in most food-producing areas of the world (Brazil, China, India, Iran, Pakistan, Western Europe) the historical sources of growth in productivity are being rapidly exhausted (Brown 2005; see chapter 7 on water productivity), and a significant share of irrigated land is now jeopardized by scarce river water, groundwater depletion, a fertility-sapping buildup of salts in the soil, or some combination of these factors (Postel 2003). Investments are urgently needed to buffer these adverse effects and protect food and livelihood security. In some areas land expansion is limited, and in closed basins water resources have been exhausted. In other areas, particularly in Sub-Saharan Africa, productive potential remains. In areas where the productive potential has been achieved, other opportunities, such as shifting to higher value produce, diversifying income sources, or even exiting from agriculture, must be sought.

Increasing the productivity of smallholder agriculture to reduce hunger and poverty

For smallholders to participate effectively in markets and to generate significant on-farm income, solving the water constraint is a necessary but insufficient condition. Raising productivity will require investments in transportation, communication, extension services, credit, capacity building, and education. New approaches to support information flows between farmers and markets are needed to encourage agricultural innovation.

Government budgets do not prioritize these issues, as they are often externally financed and not sustainable in the long run. Partnerships between governments, private sector or NGO service providers, civil society organizations, and community-based groups are crucial to help farmers make the transition. A related challenge is to set up targeted safety nets for farmers who are unable to adjust quickly enough as the transformation of agriculture to market-oriented production accelerates over the coming decades. Safety nets that can provide credible insurance against catastrophic asset loss and facilitate rapid recovery will be crucial, given the expected impacts of climate change.

Ensuring rural poor people's right to secure access to water represents a key challenge to water governance reform

Strengthening water governance

Recognizing that the root cause of many water problems related to poverty is poor water governance, there has been a wide call for reform (see chapter 5 on policies and institutions). Common elements in such reform initiatives are decentralized decisionmaking, often involving institutionalization of user participation, assignment of private property or extensive use rights to water, and greater reliance on market mechanisms to ensure the most cost-effective allocation and management of scarce water resources.

Ensuring rural poor people's right to secure access to water represents a key challenge to water governance reform. Currently, access to water, particularly for agriculture, tends to be based on informal or customary rights associated with ownership of land containing water springs or flows or based on social norms or relations with owners of land or local water committee members. If such forms of access are not recognized and accommodated in reforms of water governance, the rural poor stand to lose their access to water for agriculture (Bauer 1997; Pradhan and others 1997). Women in particular confront severe problems in accessing water. Because access often depends on land ownership, gender inequalities and discrimination in access to land and in livelihood opportunities in general often reproduce gender inequalities in water.

A second challenge related to water governance is to ensure poor rural men and women a voice in decisionmaking on the development, allocation, and management of water resources. In many places the response to this challenge has been to create water user boards that aim to represent all relevant stakeholders. However, experience has been disappointing. Stakeholder participation in the formulation and renegotiation of water policy, legal, and regulatory frameworks has been limited. The ways social and economic relations shape access to and management of water and their effects on interactions among stakeholder representatives are rarely clearly recognized and addressed. In this situation and within limited and often unclear mandates, water user boards tend to reproduce existing power inequities among stakeholders and thus have come to legitimize rather than challenge and contest these relations (Ravnborg forthcoming; Webster, Merrey, and de Lange 2003).

Strengthening the voices of the poor in decisions affecting their well-being

A prerequisite for strengthening water governance is to increase awareness of "water poverty" as a core component of poverty and to ensure that the rights of the poor are properly addressed. Smallholder farmers, particularly women, have been unable to voice their

economic interests in political forums (figure 4.6). The same is true for a large number of fishing and herding communities.

There are a large number of stakeholders in government agencies and the private sector with a keen interest in water allocation (including river flow management). As water becomes scarcer, the conflict over water allocation, rights, and entitlements at household, watershed, and basin levels is bound to intensify. One way to tackle this is to craft and support institutions and processes that have the ability to speak upward from the village level to higher levels, and to make the voices of the poor heard, as illustrated in box 4.1.

Smallholder farmers, particularly women, have been unable to voice their economic interests in political forums

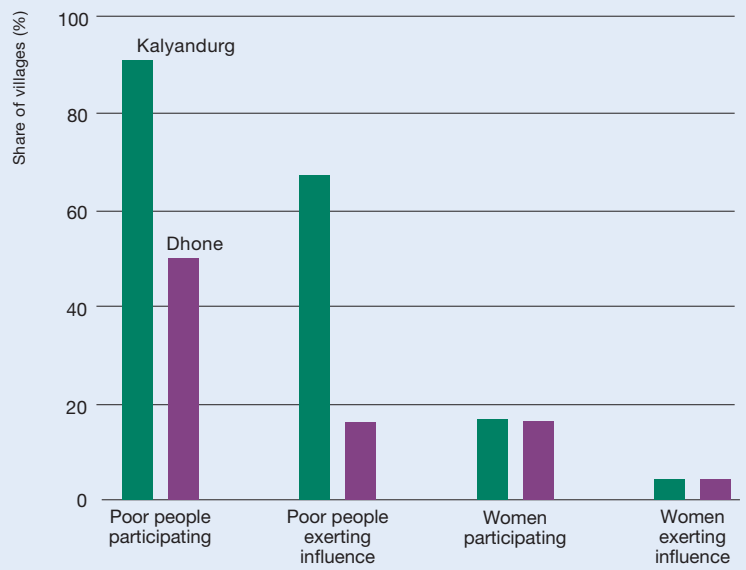
Having the right to voice opinions is not the same as having the power to set the agenda. Today, there are two mechanisms that allow for addressing water development in the context of poverty reduction: Poverty Reduction Strategy Papers (PRSPs) and integrated water resources management. However, achievements to date do not match their potential.

In the case of the PRSP processes prioritization of scarce financial resources often goes to more tangible sectors such as education and health and not to more contested sectors such as water resources, which often involve many stakeholders. As a result, water management actions are poorly represented in PRSPs (PEP 2002).

This challenge can be addressed through a three-pronged approach: first, recognize and protect the rights of the poor; second, prepare a transparent national water sector strategy with poor male and female farmers as a priority; and third, integrate the water strategy

figure **4.6** **Managing water—some people have a greater voice than others**

Influence and participation in water user associations by the poor and women in two subdistricts in Andhra Pradesh, India, 2000



Source: UNDP 2006.

box **4.1** **Improving livelihoods through better water management and institution building**

Cotahuasi is 2,600 meters above sea level in the Peruvian Andes. It is isolated and populated largely by indigenous people who suffer from poverty, illiteracy, and little access to basic social services. The area is recovering from years of terror and violence inflicted by the Shining Path guerrilla movement.

The NGO AEDES started working there in 1996 to implement the development program Local Agenda 21. Sustainable water management was identified as key to developing the area, which is in the Ocoña watershed. AEDES focused on improving incomes by capitalizing on people's knowledge of organic production and pest management. They revived and strengthened irrigator committees, improving irrigation techniques. Farmers' incomes have improved as AEDES located national and international markets for a niche crop, amaranth.

AEDES also began to facilitate roundtables, bringing together representatives of different government agencies, community groups, and the private sector to discuss a water management plan. In 2005 the watershed was declared a protected area, and plans call for development of ecotourism. AEDES has also developed a geographic information system–based database that facilitates development of a zoning plan and provides information to support local negotiation on the use of land and water. The database provides the roundtables with valuable input for their planning exercises and allows them to develop proposals that are acceptable to regional and even national decisionmakers. With the experience gained in Cotahuasi, AEDES is planning to scale up its activities to the other subbasins in the Ocoña watershed.

Source: Both ENDS and Gomukh 2005.

into national poverty reduction programs such as PRSPs (UNDP 2006). Over the past two years the World Bank (forthcoming) has assisted countries in Africa (Ethiopia, Tanzania), Latin America (Brazil, Honduras, Peru), Asia (China, India, Pakistan, the Philippines), and elsewhere (Azerbaijan, Iraq) to prepare such country water assistance strategies.

The ongoing debate on whether integrated water resources management contributes to poverty reduction or worsens poverty has not yet been resolved. Some argue that it can facilitate management of water resources and water services in ways that will help reduce poverty. Others strongly contest this claim (see chapters 5 on policy and institutions and 16 on river basins). In Africa, for example, the regulatory administrative water rights and registration systems introduced under the banner of the integrated water resources management agenda are biased against the poor and risk further eroding their limited water rights (Van Koppen and others 2004; Mumma 2005).

This water development agenda can fit the needs of the poor, unlike former interpretations of integrated water resources management as a blanket water agenda for everybody, including the poor. It offers an opportunity to reduce poverty by recognizing multiple-use systems approaches as appropriate in poor areas with backlogs in infrastructure development (GWP 2004). This recognition widens the interpretation of integrated water resources management in at least three aspects. It clearly includes water development. It acknowledges that water can be used for poverty alleviation and gender equity only if poor women and men get more and better access to water for both domestic and productive uses. And it recognizes that even if it becomes more expensive to develop water resources

because the easier resources have already been developed, this should not stifle efforts to develop new water resources to provide for the basic domestic and productive water needs of all.

Improving gender equality and recognizing changes in demography and livelihoods

In many cases water resource policies have proven detrimental to women's water rights and to the sustainable management and use of water resources

In many cases water resource policies and programs have proven detrimental to women's land and water rights and, therefore, to their sustainable management and use (photo 4.1). Interventions such as irrigation habitually exacerbate rather than redress the existing imbalance between men and women's ownership rights, division of labor, and incomes (Ahlers 2000; Boelens and Zwarteveen 2002; Chancellor 2000). Where women constitute a significant proportion—if not the majority—of farm decisionmakers, as in large parts of Southern and Eastern Africa and elsewhere, strengthening women's land and water rights and gender-sensitive targeting of credit and input provision, training, and market linkages are central to increasing agricultural productivity (Quisumbing 1996; Van Koppen 2002). Efforts to increase water productivity, whether through new microirrigation technologies or community management of multifunctional irrigation structures, need to be well targeted to women farmers.

Water policies and agricultural water management activities also need to take into account the impact of the HIV/AIDS pandemic and its disproportionate effects on women and girls. In Sub-Saharan Africa, the epicenter of the HIV/AIDS pandemic, households with sick members need more water, while the loss of agricultural labor and the shift to low-input crops and activities that demand less labor all affect local water management.

Photo by Olufunke Cofie

Photo 4.1 Woman transporting water in gourds

Improved agricultural water management and gender equality can create greater resilience among poor vulnerable households to withstand the poverty impacts of HIV/AIDS and other diseases. The financial burden of HIV/AIDS means that innovative cost-recovery measures are needed. Measures also need to take into account the loss of skilled people in the water sector (Ashton and Ramasar 2002). Inheritance rights to land and water need to be protected, especially where orphans and girls are ineligible to hold land or water rights and where water rights are customary rather than formal (Aliber and Walker 2006).

Poverty reduction programs that are formulated without due regard to ecosystem resilience will not achieve sustainable poverty alleviation objectives

Ending terrestrial and aquatic ecosystem degradation

Ecosystems provide a range of benefits to humanity, including food, timber, fuel, fibers, climate regulation, erosion control, and regulation of water flows and quality (see chapter 6 on ecosystems). Unsustainable land and water management decreases the capacity of ecosystems to provide these services and hits the poor the hardest, as a large proportion of poor people depend on wetlands and other common property resources for their livelihoods—the land and water sources that have been among the most degraded. Further loss of these valuable ecosystems will result in less water security and increased poverty. The capacity of ecosystems to generate ecosystem services has diminished in response to management of water for agriculture and the extension of agriculture into marginal and fragile lands. While water may be a limiting factor for agriculture, more serious will be the degradation of ecosystems that provide and regulate water, which will lead to decreasing natural water supply and quality.

Aquatic ecosystems—and inland fisheries that rely on the sustainability of these ecosystems—are facing unprecedented threats, including physical encroachment and loss, pollution, and overharvesting of resources. By far the most important threat comes from the changes in land and water management, which can alter the hydrological dynamics that have driven the patterns of seasonal and interannual production in these ecosystems over millennia (see chapter 12 on inland fisheries). There are many examples of rivers in developing countries where water flow has already been altered significantly by dams and irrigation schemes and where the associated riverine floodplains and other wetlands have been degraded. Hence, poverty reduction programs that are formulated without due regard to ecosystem resilience will not achieve sustainable poverty alleviation objectives.

Reducing the vulnerability of poor people to climate shocks and other hazards

The last decade has seen a dramatic increase in the number and intensity of water-related disasters and other hazards. Globally, between 1991 and 2000 more than 665,000 people died in 2,557 natural disasters, 90% of them from water-related events such as floods, typhoons, and hurricanes (UN–Water 2005, p. 12). Most victims were in developing countries. Such disasters and the vulnerability they inflict can undermine any effort to break out of poverty and can even cast more people into poverty when the basis of their livelihoods is destroyed by a cataclysm.

Climate change has both short- and long-term effects. Short-term climate variability and its extremes influence the range and frequency of shocks that society absorbs or adjusts

to, whereas longer term variability can lead to changes in the productive base of society, particularly in economies dependent on natural resources (Parry and others 1999).

The impacts of climate change penetrate all aspects of the environment, society, and economy so that other global trends influencing development reinforce the adverse effects of climate change to inflict greater harm on the poor. O'Brien and Leichenko (2000) note how exposure to climate change and globalization can produce a phenomenon they call "double exposure." Farmers who are already vulnerable to market fluctuations as a result of international trade will be double losers through losses in crops, livestock, or other agricultural assets from changes in weather patterns. These effects will be felt most acutely by poor farmers because they are less able to adapt to the changing context and respond to external shocks (Lambrou and Piana 2006). Analysis by Kurukulasuriya and others (2006) shows that climate change will hit agriculture hardest in Africa, a region already devastated by extreme poverty and episodes of famines. The post-disaster impact assessments in Sri Lanka show that the 2004 tsunami caused widespread destruction and contamination of coastal aquifers, destroyed open dug wells used for potable water supplies, increased groundwater salinity, and affected the long-term sustainability of the fragile agroecosystems, to the detriment mainly of poor coastal communities (Illangsekare and others 2006). The challenge is to define appropriate supportive institutional and policy frameworks that enable local adaptation and reduce risk and vulnerability at different scales (see Pannell and others 2006).

> An equitable pro-poor arrangement is to guarantee acceptable minimum quantities of water and land for all and to set rules for the few who want to claim any surplus

Reducing water poverty

The strategies for lifting most of the 800 million people who work on small farms out of poverty is necessarily multipronged. Broadly conceived it entails:

- Ensuring the right to secure access to water for the poor (securing water and developing appropriate technologies and financing options).
- Empowering people to use water better (raising water productivity).
- Improving governance of water resources.
- Supporting the diversification of livelihoods.

Such multifaceted strategies will require ensuring the right to secure access to water and a range of other complementary technologies, accompanied by dynamic policies and institutions that are responsive to the needs of the poor, as well as capacity building and support of pro-poor research. It is critical to create awareness among governments of the significance of water in the resource base and of the need to protect it not only as a strategy for sustainable economic development but as a critical measure for poverty reduction.

Ensuring the right to secure access to water for the poor

Securing water. Cremers, Ooijevaar, and Boelens (2005, p. 40) present security of access in terms of the possibility of materializing water use rights now and in the future and of avoiding or controlling the risks of unsustainable water management. To secure these rights it is important to consider the larger "bundle of rights" (water access and withdrawal rights, operational rights, decisionmaking rights) of which they are a part. Users can adopt strategies to secure rights. People often try to materialize their claims through rules, rights,

and regulations that originate from different and sometimes divergent rights systems and that best represent their interests. But it is also essential that higher level institutions such as the national law and water administration provide policies and mechanisms that increase security of access for users and address entitlement gaps of the poor.

The rising demand for limited water resources makes sharing and prioritizing unavoidable and puts the poor at greater risk. Local norms generally guarantee that everyone has access to water for drinking. In many African countries local norms also tend to support equitable access to water for small-scale productive uses and livelihoods. Individuals who take large quantities of water and thus deprive others generally encounter community resistance (Derham, Hellum, and Sithole 2005). However, formal water legislation and priority setting under scarcity can often only weakly protect the poor. Local regulations and solutions in water management tend to be overlooked by official policies and intervention strategies. An equitable pro-poor arrangement, as practiced for example in parts of India and Sri Lanka, is to guarantee acceptable minimum quantities of water or land for all and to set rules for the few who want to claim any surplus (Van Koppen, Parthasarathy, and Safiliou 2002). Equity here refers to both the distribution of water access rights and to control over water management.

There are many instances in Africa where poor people have lost vital livelihood systems because government planning diverted water used in informal irrigation systems to formal water uses

Investments or policies disrupting existing water access rules have an impact on livelihoods. For instance, informal irrigation systems, such as *dambos* in Southern Africa and *fadamas* in Nigeria, contribute to poverty reduction and food security. There are many instances in Africa where poor people have lost vital livelihood systems because government planning diverted water used in informal irrigation systems to formal water uses such as hydropower systems or medium- and large-scale irrigation systems.

An important way to increase the security of local water rights is to assign the rights to collectives rather than individuals (Boelens and Hoogendam 2002; Bruns and Meinzen-Dick 2000). Data from Chile, Ecuador, and Peru show that assigning water rights to individuals may create unstable situations, negatively affecting indigenous water rights and livelihoods (Bauer 1998; Brehm and Quiroz 1995). Communities can also compete for irrigation water, which often results in stretching the services beyond the planned capacity of the infrastructure (photo 4.2).

Although not recognized by formal legal frameworks in many places, rights to water are often claimed on the basis of land ownership. Owning land on which there is a spring, a stream, or an aquifer is a common mechanism for claiming a right to that water. Thus, where land distribution is skewed against the poor, water is also likely to be unevenly distributed. Adding to this, land with a water source tends to have a higher value than land without one, making land ownership–based rights to water even more inaccessible to the poor.

In the Nicaraguan hillsides approximately 60% of nonpoor households own land with a water source compared with about 15% of the poorest households (Ravnborg forthcoming). In Southwestern Tanzania, where land distribution within many communities was at least partially guided by social concerns to secure all households a right to land in the valley bottoms, almost 9 of 10 households have rights to traditionally irrigated (vinyungu) land, with no differences between nonpoor and the poorest households (Boesen and Ravnborg 1993).

Photo by David Molden

Photo 4.2 Bringing water to the fields

Access to water or water infrastructure may also be limited by access to financial resources, as is the case for most countries in Sub-Saharan Africa and South Asia (box 4.2). In South Asia's so-called poverty square, which comprises Bangladesh, eastern India, and Nepal's Terai, the gradual expansion of public and private tubewells during the 1960s and 1970s favored the elite, who had access to the necessary capital (Shah 2001; Shah and others 2000). Lack of access to capital may also limit the capacity of governments to provide the needed water infrastructure for the development of their citizens. Bilateral and multilateral investments in water infrastructure have diminished for many reasons; chief among them environmental pressure, poor performance, and lack of donor interest in agriculture (see chapter 2 on trends). Thus African countries are finding it increasingly difficult to secure funds to enable productive access to water resources for effective poverty reduction and food production.

Developing appropriate technologies and financing options. Small-scale localized water management systems are generally more suited to the needs of the poor. Examples of the successful development and marketing of such technologies are the treadle pump in Bangladesh during 1980s and the low-cost small-scale drip and sprinkler systems and water storage devices developed later.

- *Small-scale mechanized pumps.* In the 1980s the World Bank invested in a tubewell initiative in Bangladesh that made available subsidized diesel pump sets capable of irrigating 2–20 hectares. While these initiatives were successful in expanding irrigated acreage, they had a negative, or at best neutral, effect on poverty because they tilted access to irrigation toward larger, wealthier farmers. To facilitate the spread of the smaller technologies among small farmers and women, credit schemes were developed that allowed even women's groups to obtain loans and manage the pump sets for water sale (Van Koppen and Mahmud 1996).

box **4.2** | **Empowering rural women: creating local leaders**

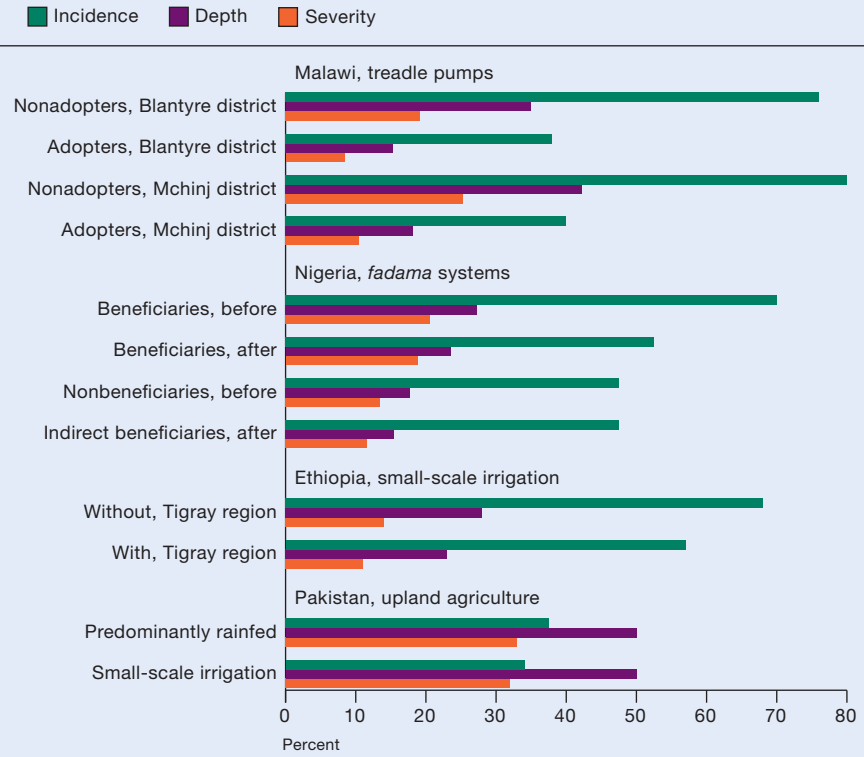
Alivelamma, age 28 and belonging to a Scheduled caste, is a resident of Jettigundlapalli Village, Chittor District, Andra Pradesh, India. She lives with her husband, two daughters, and a son. The family had 1.4 hectares of land that they were unable to cultivate because of a lack of water. She and her husband worked as agricultural laborers. From their meager seasonal earnings, they had to meet all their expenses. Frequently, they had to go to moneylenders. Alivelamma took her daughter out of school because the cost was too high and the daughter needed to look after the youngest sibling.

In 2001 Alivelamma joined a rural microcredit group. The group's good performance helped them get a loan of 8,000 rupees (Rs). After a series of small loans, Alivelamma and two other members got a grant of Rs 60,000 for a bore well. With her share of water, she irrigates 0.6 hectare and grows tomatoes. She also sells water to nearby farmers. The increase in family income has given Alivelamma the confidence to take an additional loan to construct a new house. Her children are going to school, and the family eats better. Alivelamma buys what she needs and no longer must rely on her husband for money. She also travels outside her village to meet with government officials, whereas before she never dared to leave her village or to exercise her political rights.

Source: DHAN Foundation 2003.

- *Treadle pumps.* In the late 1980s International Development Enterprise implemented a program to stimulate the rural mass marketing of treadle pumps, promoting the emergence of 75 private sector manufacturers, several thousand village dealers and well drillers, and a variety of marketing and promotional activities (Heierli and Polak 2000). Over a 15-year period some 1.5 million treadle pumps were purchased and installed by small farmers at an unsubsidized fair market price, putting 300,000 hectares under irrigation at a total investment cost of $49.5 million. The cost of irrigating the same farmland with a conventional dam and canal system would have been at least $1.5 billion. This treadle pump investment is generating $150 million a year in continuing net income for poor smallholders (Polak 2005; Polak and Yoder 2006; Sauder 1992). The Food and Agriculture Organization and many other organizations are now involved in treadle pump programs in Asia and Sub-Saharan Africa (Kay and Brabben 2000). These small-scale technologies enable poor people to take a major step on the pathway out of poverty (figure 4.7).

figure **4.7** | **Reducing poverty through access to microirrigation and markets**



Note: Data refer to selected sites in each country.
Source: Gichuki and Hanjra forthcoming.

- *Low-cost drip irrigation.* Low-cost drip systems have been made available to smallholder farmers through a private sector network of manufacturers, village dealers, and farmer-technicians who install a 1 acre drip system in two days for about $4. In addition to providing a reliable source of water, low-cost drip systems can improve crop quality, boost yield, and lower water use, leading to the cultivation of high-value marketable crops (Keller and others 2001).
- *Low-cost water storage.* In many semi-arid areas the bulk of annual rainfall occurs during a few monsoon months. Because irrigation water is either scarce or not available during dry months, when growing conditions are otherwise favorable and vegetable and fruit prices are at their highest, small-scale farmers are unable to compete in the market. Capturing and storing monsoon rainwater for future use are constrained by the high price of conventional water storage systems. Low-cost bagged water storage systems tailored to the needs of poor male and female farmers are particularly advantageous to poor farmers. Recent advances have lowered the costs of material, but the need for cheap on-farm water storage systems remains, particularly with the increasing variability in monsoon rainfall due to climate change (Polak and others 2004).
- *Informal irrigation systems.* Upland farming and hillside farming are most commonly equated with rainfed farming. Nevertheless, in many countries upland and hillside farmers have developed systems of informal irrigation ranging from drip irrigation constructed from water-filled plastic bottles placed to irrigate seedlings to more organizationally demanding systems of furrow irrigation in valley bottoms and along river beds to irrigate vegetables, green maize, and paddy. In most cases poor people are engaged in agricultural activities involving marginal-quality water (see chapter 11 on marginal-quality water). The use of marginal-quality water has mixed impacts on both irrigators and customers. While the use of such water can be economically attractive, the risks to the health of producers, consumers, and the environment need to be carefully managed through public policy interventions (Hussain and others 2001).

Informal irrigation systems are rarely adequately reflected in official statistics or recognized by policymakers and agricultural support services such as research and extension

Such informal irrigation systems are rarely adequately reflected in official statistics or recognized by policymakers and agricultural support services such as research and extension (photos 4.3 and 4.4). In Ghana informal irrigation around cities in the center of the country covers an estimated 40,000 hectares compared with 5,478 hectares covered by the 22 formal

Photo 4.3

Photo 4.4

Photos by Olufunke Cofie

Many farmers use different sources of water with a variety of technologies, which are often not officially recognized

schemes (Drechsel and others 2006). In mainland Tanzania an estimated 5% of cultivated land is irrigated, two-thirds of it under traditional irrigation initiated by farmers with no support by external agencies (FAO 2005). But even this statistic likely underestimates the importance of informal irrigation. A study of four hillside villages in Iringa District in Southwestern Tanzania found that 9 of 10 of rural households had land under informal irrigation (Boesen and Ravnborg 1993). In these villages informally irrigated land constitutes as much as 16% of cultivated land. In the Honduran and Nicaraguan hillsides 16%–39% of farming households have land on which there is a water source or that borders a stream. But these households lack access to the resources and technologies needed to make productive use of the water. In Miraflor and in the Condega District in the Nicaraguan hillsides only one-third of households with access to water have crops under some form of informal irrigation (Ravnborg 2002a, 2003).

Having the ability to water crops through such small-scale technologies and informal irrigation makes a tremendous difference to the livelihoods of farming households as it reduces the potentially negative impacts from dry spells during the rainy season and allows for the cultivation of water-demanding and often higher value crops such as vegetables (GWP 2003). Thus it reduces the vulnerability and increases the otherwise low returns associated with rainfed farming.

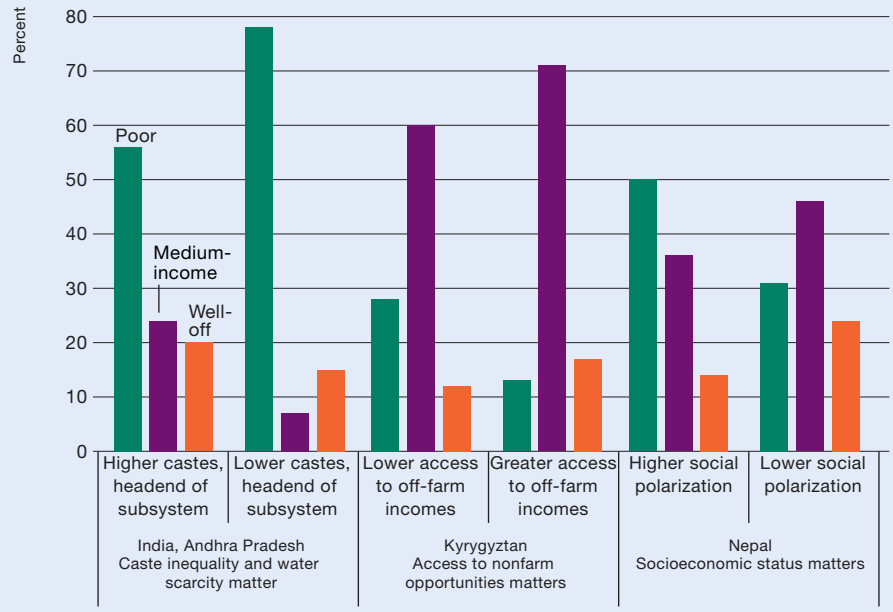
A promising pathway to using water more effectively for poverty reduction and gender equity is an approach that takes poor women's and men's multiple water needs as the starting point

Empowering people to use water better

Using water better means improving the productivity of agricultural water in both irrigated and rainfed systems, through multiple-use water system, integrated water resources planning, and targeted research. This will entail understanding local contexts and constraints, developing appropriate training, and building capacity to empower users to use water to maximize benefits and reduce negative impacts on the environment.

Improving productivity and equity in existing large-scale irrigation systems. Productivity is low in many old established irrigation systems in Africa and Asia, and pockets of poverty persist. Findings on irrigation sites in India, Kyrgyzstan, and Nepal illustrate that inequitable water distribution coexists with a range of socioeconomic conditions (figure 4.8). The common elements found across the cases studies are weaknesses and power imbalances in relationships, inadequately developed knowledge and skills, and disadvantaged access for poor and female irrigators (Mott MacDonald 2006; Howarth and others forthcoming). From extensive case studies in Asia, interventions that might improve poverty reduction can be categorized into technical and institutional interventions (Hussain 2005). Technical interventions include promoting water saving and conservation measures, enhancing diversification of agricultural enterprise, introducing high-value crops, rehabilitating infrastructure, integrating management of surface water and groundwater, developing water control structures, and improving drainage management. But to be effective, these technical interventions must be complemented by institutional interventions, such as developing relationships and accountability between water users, user associations, and service providers; building the capacity of system officials and water user association members through targeted training; and improving headend and tailend equity in water distribution (Mott MacDonald 2006; Howarth and others forthcoming).

figure **4.8** **A range of socioeconomic factors interact with irrigation equity in selected systems experiencing problems with water distribution**



Note: Well-being categories are based on local assessments by key informants and baseline survey.
Source: Mott MacDonald 2006.

Upgrading rainfed systems. Low-yielding rainfed systems in marginal areas hold the highest potential for productivity gains (see chapter 8 on rainfed agriculture). Because a large number of rural poor people depend on these systems for their livelihoods, upgrading these systems through soil water conservation, water harvesting, and supplemental irrigation can lift people out of poverty through productivity gains.

Recognizing multiple uses of water infrastructure. A promising pathway to using water more effectively for poverty reduction and gender equity is a multiple-use water services approach, which takes poor women's and men's multiple water needs as the starting point. This approach recognizes that when rural communities construct their own wells, village tanks, household storage, and other water infrastructure they typically do so for multiple uses: domestic purposes, sanitation, livestock, small-scale horticulture, cropping, fisheries and aquaculture, tree growing, beer making, and other small water-dependent businesses and ceremonial uses. For the poor, water is water whatever its designated purpose (photo 4.5). Communities also tap multiple conjunctive sources of water: rainfall, surface streams and lakes, wetlands, and groundwater. Multifunctionality, flexibility, and the tapping of conjunctive water sources enable poor people to accommodate for the range of water needs, seasonal variation, and the need to spread risks and cope with extreme events.

Photo by Paul Polak

Photo 4.5 Households often use water meant for drinking purposes for homestead irrigation

Multiple-use approaches are thought to be effective for poverty alleviation and gender equity for several reasons:

- By taking poor women's and men's multiple water needs as a starting point, multiple-use approaches meet a broad range of basic water needs and alleviate more dimensions of multifaceted poverty: they reduce drudgery and improve health and food security and increase income from livestock, fish, crops, and small businesses.
- Incremental capital costs are low compared with single-use approaches and represent good value for money in light of the considerably broader livelihood and scheme sustainability benefits derived.
- Having a water user institution that includes all water users, instead of having parallel irrigation committees, domestic water committees, and traditional structures governing the same water resources could be more effective and sustainable.
- Holistic water user associations are considerably more equitable if the multiple water needs of all are taken into consideration from the outset.
- The opportunities of multiple-use approaches for widening livelihood benefits and enhancing scheme sustainability and equity at low incremental costs are generic and can be implemented on the ground according to locally specific conditions.

Integrating livestock and small-scale fisheries and aquaculture in the water resources planning process. Livestock rearing, fishing, and small-scale aquaculture activities represent a significant share of farm production in most farming systems of the developing world and are a major source of cash income for households with small landholdings (Turpie and others 1999; Maltsoglou and Rapsomanikis 2005; Thornton and others 2002). Promoting

livestock production and integrating it into crop production systems are effective ways to target the rural poor; livestock income improves equity in favor of the poor more than crop incomes (Adams 1994). Similarly, integrated aquaculture-agriculture and inland artisanal fisheries and related activities such as small-scale fish processing and trading are usually operated by resource- and land-poor households (see chapter 12 on inland fisheries). In places where primarily women engage in livestock activities, targeting the livestock sector would also be a way of reaching rural women with income-generating activities.

Pro-poor research on low-cost and gender-suited technologies, crop improvements, and better agronomic and water management practices can contribute significantly to poverty reduction

Enhancing water productivity through targeted research. Pro-poor research on low-cost and gender-suited technologies, crop improvements, and better agronomic and water management practices can contribute significantly to poverty reduction. Crop research should focus on issues relevant to the circumstances of poor people in developing countries such as drought, rainfall failure, water logging, salinity, sodicity, pests and diseases, and soil nutrient deficiencies. The development of crop varieties tolerant of these biotic and abiotic stresses would improve the productivity of water (see chapter 7 on water productivity). There is also a great need for water research that locates water use as an embedded activity mediated through institutions, social relations, property rights, identity, and culture (Mosse 2003; Cleaver 2000; Mehta 2005). This can assist with more realistic proposals for how agricultural water management can reduce poverty and inequality.

Improving governance of water resources

Improved governance of water resources can potentially contribute to poverty reduction by enabling secure rights to water and related services for the poor. Water rights of poor people are often informal and insecure, and they are not always sanctioned by social norms. The institutions charged with protecting the rights are frequently inaccessible or unresponsive to the poor. Water entitlements of poor people are often encroached on, physically or volumetrically. This section highlights how water governance agendas have made irrigation water more accessible to smallholders.

Multiple actors: linking local users to management and decisionmaking processes. Developing sustainable water management and governance agendas requires the involvement of multiple actors (see chapter 5 on policies and institutions). NGOs can play a role in training and capacity building by mediating between stakeholders and empowering local populations to identify their problems in a systems context, to analyze causes and effects, to assess options, to arrive at well informed decisions, and even to assert their claims to unused land and water. NGOs working on water management have accumulated a wealth of experience on local strategies for poverty reduction through sustainable water management (Both ENDS and Gomukh 2005).

Supporting the diversification of livelihoods

Most poor farmers engage in several activities in addition to agriculture to increase their incomes, manage risks, and cope with uncertainty. Diversifying income sources and even exiting from agriculture are seen by many as viable strategies for escaping poverty (Dixon and Gulliver 2001) and indirectly reducing the pressure over local water resources when

these are limited. In many countries income sources other than agriculture already constitute a substantial proportion of rural household income. In India more than a third of rural households derive their income from manufacturing and services. Poverty reduction efforts need to link these microrealities—expanding the asset base and the productivity of assets—with enabling macro-level policies. Investments in education and training programs and infrastructure are crucial. The private sector, governments, NGOs, research institutes, and aid agencies all have a role to play in this. The development of the rural nonfarm sector must be seen as a complement to and not a substitute for agriculturally led poverty reduction efforts.

Linking farmers to input and output markets. Agricultural water management and other production technologies and services are more effective when they enable smallholders to take advantage of market opportunities (Maltsoglou and Rapsomanikis 2005). Agricultural water management interventions are a strategic entry point for addressing a range of market constraints.

The income-generating potential of agricultural water management is directly related to the degree to which smallholders are integrated with input and output markets. Impacts are greatest when small farmers can access a range of complementary goods and services for the production and marketing of crops. Furthermore, when these goods and services are aligned along specific commodity value chains, a synergistic effect is created. Thus agricultural water management interventions are most effective where market linkages already exist or could be created.

The income-generating potential of agricultural water management is directly related to the degree to which smallholders are integrated with input and output markets

The increasing concentration of global agribusiness supply chains means that small farmers must find ways to link up commercially with much larger players. Otherwise, they risk being squeezed out of the fastest growing domestic and export markets, which are increasingly controlled by supermarkets and agribusiness firms (Reardon and others 2003).Whether the smallholders are raising labor-intensive cash crops or livestock or fish, generating new income depends on removing constraints in access to markets where they sell their products (photo 4.6).

Supermarkets in both developed and developing countries are playing an increasingly dominant role in markets for fruits, vegetables, and other high-value crops that can be grown advantageously by many smallholders (Reardon and others 2003). To gain access to supermarket buyers, smallholders may need training to meet new quality standards. To meet market volume requirements, smallholders need stronger farmer organizations and mechanisms to aggregate their production. Bundling products and services for small-scale farmers in a vertically integrated fashion could be a key strategy in catalyzing the participation of growing numbers of poor rural producers in emerging high-value agricultural commodity markets.

Water markets can enhance poor people's access to water. As the price of the cheapest diesel pump in Bangladesh dropped over the years from $500 to $160, millions of smallholders increased their disposable income by installing treadle pumps and hundreds of thousands of smallholders in Bangladesh and eastern India started selling excess water to their neighbors. The water markets this created have expanded smallholder access to affordable irrigation water

Photo by David Molden

Photo 4.6 Smallholder irrigated agricultural products are often perishable, requiring improvements in marketing systems

(Shah 2001). Twenty years ago villagers in Bangladesh reported that just 30% of small farmers in the village had access to affordable irrigation water. Two years ago that share had risen to between 70% and 100% (Nanes, Calavito, and Polak 2003). Thus, under certain circumstances, adaptive private agents' market responses can make up for failed public efforts.

Promoting crop diversification. Crop diversification is a key to the livelihood strategies of poor people, but smallholders face significant constraints to diversifying their enterprises. For instance, despite the high demand for fruits and vegetables poor farmers are not benefiting much from the production of economically more rewarding cash (export) crops, mainly because their subsistence orientation has kept them specializing in staple crops. For instance, in Kenya, Tanzania, and Uganda, where agricultural prices and trade have been liberalized, producers of export crops tend to be better off than producers of food crops (Peacock 2005). In Kenya 47% of subsistence farmers are below the poverty line, compared with 31% of cash-crop farmers. In Malawi the income of smallholder burley tobacco growers is more than double that of food crop growers in the poorest regions (Peacock 2005).

While real concerns have been raised about the impact of cash-crop production on nutrition, cash-crop producers are better off overall than subsistence or food crop producers. Thus, smallholder farmers should be supported to produce and market crops and other produce for which there is increasing demand and which therefore can generate an enhanced income. Strengthening farmer organizations, collection centers, and access to finance and knowledge will be crucial if poor farmers are to benefit. Efficient infrastructure networks will also be needed.

There are also emerging opportunities for improving economic water productivity and reducing poverty. These include rural-based production and processing, fresh fruits and vegetables, and bioenergy crops. Donors, governments, and the private sector should do more to foster innovation, including supporting value chain arrangements for niche products.

The way forward

Clearly, increasing agricultural water productivity can play an important role in reducing poverty and vulnerability. A mix of small-scale technologies and water resources infrastructure designed from a multiple-use perspective can maximize benefits per unit of water for poor women and men. These efforts need to be combined with greater access to assets (land, water, working capital, human capital), markets, information, and services for poor people, particularly poor women. More priority needs to be given to equity and poverty reduction in water management projects and scaling up successful local innovations. Appropriate legal frameworks and functioning institutions that enable a wide ranging of stakeholders to share information and learn from successes and failures are critical for managing water in a way that ensures environmental sustainability and protects, promotes, and enhances poor people's rights, assets, and freedoms.

Reviewers

Chapter review editor: Jan Lundqvist.
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Notes

The title of this chapter is inspired by a quotation attributed to a farmer from the American West: "Water flows uphill towards money." We think that this is generally the unfortunate truth in too many countries today and want to see that water also flows to the poor.

1. This statement is made in full awareness of the contested nature of human rights declarations, of critiques of universalism and the rights based approach to development, and of the need to situate rights-based discourses in local contexts. However, water is fundamental, and many rights such as the right to life and food cannot be realized without the right to water. That human rights are necessary for combating poverty and ensuring sustainable development is reflected in the Millennium Declaration, the Copenhagen Declaration, the Vienna Declaration, and the work of the UN General Assembly. Advancing a right to water cannot be divorced from the important role that healthy ecosystems play in ensuring an adequate quantity and quality of freshwater for basic human needs, sustainable social and economic development, and poverty reduction.

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