Water Management across Scales in the São Francisco River Basin:

Policy Options and Poverty Consequences

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An interdisciplinary collaborative project of the University of California, Davis and the Empresa Brasileira de Pesquisa Agropecuária

Embrapa

The Future of Small-Scale Irrigation: An Example of On-Farm Costs and Benefits

Delivering water to smallholders can be a critical first step in achieving the ultimate goals of increasing incomes, improving food security, and reducing poverty. But often it is only that, a first step. To effectively use water farmers generally need to make on-farm investments to store and move water to crops. Preparing to do so entails up-front costs and the management of water is never free – at a minimum some labor is required. This research brief examines the costs of establishing and managing small-scale irrigation systems in the context of a small catchment area of the São Francisco River Basin.

Establishment Costs

In most cases, small-scale irrigation schemes entail some establishment costs. These cost involve not only out-of-pocket expenses to purchase material and to hire labor, but also should include the time dedicated by family members. Three types of establishment costs are usually encountered.

First, many surface water irrigation systems require some on-farm storage, since the flows onto farms from central canals or other public conveyance systems are usually not sufficient or timely enough to meet irrigation needs. Such on-farm storage usually requires labor to establish and some purchased inputs (e.g., plastic sheeting to reduce water seepage and fencing materials), and requires farmers to give up some cropland for reservoir construction. Figure 1 shows a typical on-farm water storage facility in Brazil.

Figure 1. On-Farm Water Storage in Brazil

Farmers considering irrigation must also have the means to move water from one place to another on their farms. This generally requires investments in pumps, electrical hookups, etc., and the skilled labor required to install them. Figure 2 shows such a pumping system being used to supply water to a small-scale tomato production system; it is simple and effective, but not cheap to purchase and install.

A third establishment costs involves outlays for water delivery which include pipes of different types and lengths, fittings to connect them, and labor needed to set the system up. Figure 3 shows two types of pipes used in a passion fruit/lime plot; large blue pipes (right) transport water under

Figure 2. Pumps to Move Water on Farms

pressure to feed micro-sprinklers that irrigate the lime trees and the more flexible black pipes (center) are part of the drip irrigation system for establishing passion fruit vines.

These three types of establishment costs can be quite high. The SFRB research team collected information on irrigation establishment costs for three types of lime production systems in the Buriti Vermelho sub-catchment area located outside of Brasilia; dry-farmed limes, limes irrigated using

Figure 3. Irrigation Pipes of Different Types in Brazil

Table 1. Establishment Costs for Alternative Lime Production Systems (Current $U.S.)

Irrigation System	On-Farm Storage	Pumping Systems	Water Delivery
Dry Farming	0	0	0
Flood Irrigation	151	1,936	22
Micro-Sprinkler Irrigation	151	1,936	3,167

flood irrigation techniques, and limes irrigated using micro-sprinklers. Table 1 summarizes the establishment costs associated with each. As one would expect, dry farming requires few investments in water management. Both flood irrigation and micro-sprinkler systems require roughly similar investments in on-farm water storage and on-farm water conveyance, but the micro-sprinkler system is the most expensive to establish.

Operational Costs

Once the on-farm storage and conveyance systems are established, using irrigation systems requires electricity and labor, sometimes hired labor. Moreover, irrigation often leads to changes in crop mix or production technology that require farmers to face additional operational expenses. For example, Figure 4 shows female laborers removing blemished grapes from a table grape production system using micro-sprinklers. Such outlays are required to achieve product quality acceptable for international markets, and hence need to be considered as part of the costs of producing this irrigated crop.

Returns to Land, Water, and Family Labor

Table 2 summarizes the profitability of the selected lime production systems in terms of the returns to land, water, and family labor. Our measure of economic performance is net present value – the discounted stream of benefits minus costs (including establishment costs) over the lifetime of the lime orchard (12 years). The flood irrigation system is the most profitable of the three in terms of overall returns and returns to land. However, the returns to labor are the highest for the micro-sprinkler system, since very little labor is required to manage irrigation.

Conclusions

Providing water to smallholders can dramatically increase yields and allow for changes in crop mix, and both of these can help reduce rural poverty. But delivering water to farmers' doorsteps is generally not enough to achieve desired increases in productivity and profitability. To secure these objectives, farmers must invest to store and move water on their farms.

But these investments can be costly. Indeed, some investments may be beyond the reach of resource-poor smallholders, implying that short-term or medium-term credit options be available. The good news is that many on-farm investments in water storage and conveyance will pay off; the bad news is that credit markets too often fail to provide loans to facilitate them.

Table 2. Returns to Land, Water, and Family Labor

Irrigation System	Overall Returns (NPV)	Returns to Land (NPV/ha/yr)	Returns to Water (NPV/m^3)	Returns to Family Labor (NPV/person-day)
Dry Farming	8,943	373	N/A	35
Flood Irrigation	32,970	1,374	0.00000013	47
Micro-Sprinkler Irrigation	27,168	1,132	0.00000036	98

Figure 4. Cleaning Table Grape Clusters in Brazil

This research brief was prepared as input into the CPFW's International Forum on Water and Food, Vientiane, Lao PDR, November 12 – 17, 2006.

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CGIAR Challenge Program on WATER & FOOD

This research program is part of the CGIAR Challenge Program on Water & Food and is supported by the International Water Management Institute, the Brazilian Enterprise for Agricultural Research (Embrapa), and the Department of Land, Air and Water Resources, the Department of Agricultural and Resource Economics, and the Center for Natural Resources Policy Analysis, all at the University of California, Davis. The views expressed in this research brief need not reflect those of the sponsors.