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WATER PRICING AS A TOOL FOR INTEGRATED WATER RESOURCE MANAGEMENT: A SYNTHESIS OF KEY ISSUES FOR RURAL WEST AFRICA

By

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BACKGROUND: Water insecurity in West Africa is an obstacle to economic development and to food and health security. Ineffective water resource management has resulted in excessive or inappropriate government expenditure, early deterioration of infrastructure, wasted community labor spent hauling water, community health and nutrition problems from poor water quality or inaccessible supply, intersectoral and regional conflict, water wasted to evaporation, limited cropping cycles, soil and water degradation, and under-investment from the private sector. Many of these problems arise because prices charged for water bear little relation to the costs of its extraction and distribution. Appropriate water pricing strategies are critical to building a viable and sustainable water security policy in West Africa and in the sub-region.

This synthesis provides an overview of: (1) the objectives of water pricing as a tool for rural water resource management; (2) the characteristics of different water pricing strategies; and (3) some requirements for, and economic constraints to, the implementation of water pricing policies in rural West Africa.

OBJECTIVES: Water pricing strategies or policies can be used as tools to meet various objectives: (1) sustainable cost recovery, which increases the financial sustainability of water services by generating the resources needed to maintain water extraction and distribution systems; (2) demand management, which encourages users to invest in water conservation efforts, assuming that users have the necessary knowledge and resources to respond to a price-based conservation incentive; (3) allocative efficiency, which directs water to its highest value use. This is most pertinent where farmers can choose among crops of different value and that require different amounts of water; and (4) income distribution goals, which can be addressed in a limited manner depending on the design of the pricing structure. Cross-subsidizing consumption or use by the poorest and guaranteeing all users with a minimum amount of water necessary for basic needs at reduced or no charge can also have important implications for food and health security.

The objectives listed above are not mutually exclusive. A water pricing policy may strive to meet different combinations of objectives, depending on a region's development goals and needs. For example, regions with irrigated cash crops may have the resources to emphasize cost-recovery and income distribution goals simultaneously. Financial benefits from water investments could be reinvested into maintaining public water services used by cash croppers as well as those for community household needs or subsistence farmers.

Pricing for allocative efficiency must account for the full economic value of water in various uses. It is important to distinguish between the financial value of water services as a private good and the economic value of water services, which also encompasses water's value to the broader society such as in supporting food security and preventing disease and ecological destruction. In some cases, the economic value of water for subsistence production or for ecological services may be greater than in its financial value in cash crop production; this poses a challenge for policy makers striving to meet cost-recovery objectives. Furthermore, efficiency is not a static outcome. Rather, as rules and conditions change, the "efficient" outcome also changes dynamically.

The "correct" approach to pricing water varies from situation to situation. Policy planners must consider certain variable factors when designing water pricing strategies for any given region. These variables include: (a) the water supply (water quality, accessibility of water - depth and distance to site of use, variability by season or year, dependence on upstream water use practices); (b) distribution systems (different systems have different infra-structure and human resource management requirements; community management may suffice for some systems, where others may require the continual support from technical professionals); and (c) user and management demographics and organization (ethnic diversity, existence of multiple competing users, cash/credit and labor availability or ability to pay, history of cooperative management or corruption).

WATER PRICING STRATEGIES: A water pricing strategy must address (1) pricing structures, and (2) price levels. Pricing structures can be subdivided into two main categories – volumetric pricing and non-volumetric pricing. The relationship between the objectives of water pricing and the pricing structures listed below is summarized in Table 1. Price levels may vary by season, year, output market prices, system costs, or simply political considerations. The following discussion on pricing structures addresses water markets, participatory resource management, and the constraints of poverty and limited managerial capacity.

Volumetric Pricing. Volumetric pricing is theoretically necessary for (but does not guarantee) water pricing efficiency. Charges are based on volume of water consumed as measured by the actual volume or by minutes of flow. Rates may be accompanied by a fixed flat fee for access to the system in addition to the per-unit fees based on quantity used. (see two-part tariff below).

Tiered pricing may be either decreasing or increasing block rates that vary by amount of water used.

In decreasing block pricing, the first units purchased are the most expensive, and rates fall as consumption increases. This approach is widely criticized for discouraging conservation but may reflect economies of scale in provision of water. (A key empirical issue for pricing policy is the extent to which such economies of scale exist in a given water system.)

Increasing block pricing represents a cross-subsidy in which large-scale users subsidize smaller-quantity users to some degree. For irrigation, the progressive nature of increasing block pricing may have income distribution benefits where land holdings are highly concentrated. For households, the distributional effects may be negative where family size and household poverty are positively correlated. This policy also promotes demand management by functioning as an economic incentive to conserve water.

A two-part tariff combines a fixed fee for access to service plus a marginal price for each additional unit consumed. The marginal price for additional units may be constant, increasing, or decreasing. Two-part pricing is conceptually the efficient way to price water when its provision involves both significant fixed costs as well as variable costs. It is also useful when growers combine irrigation with rain-fed water use. Without the fixed fee, basic maintenance costs of operating irrigation systems would not be covered in rainy years. The resulting deterioration would limit their performance in dry years (Johansson 1999).

The investment required for conducting volumetric metering and billing is prohibitive in most cases, particularly where there are many smallholders or systems that cover large areas with many dispersed users. As a result, volumetric pricing is limited to areas with significant investment in irrigation infrastructure and the organizational capacity for variable billing.

Non-Volumetric Pricing. The alternative to volumetric pricing is non-volumetric pricing, where water is billed in proportion to something other than

Table 1. Matrix of Pricing Structures' Potential for Improving Efficiency, Income Distribution, and Demand Management

	Volumetric		**Non-Volumetric**			
Pricing Structures	**Tiered: Increasing/ Decreasing Block**	**Two-Part**	**Propor-tional to Output**	**Propor-tional to Input Use**	**Per Hectare**	**Betterment Levy**
Effect on Income distribution[1]	Possible negative or positive impacts for both irrigation and household use	None	None	None	None	Potentially positive
Demand Management Tool	Relatively good	Relatively good	Relatively good	Good	None	None
Short or Long-run Efficiency	Short-run	Long-run	Short-run	Relatively Complicated	Neither	Neither
Efficiency Achieved[2]	First Best	First Best	Second-best	Relatively Complicated	None	Complicated
Implementation	Relatively complicated	Relatively complicated	Easiest	Easy	Relatively easy	Political advantages & disadvantages

Adapted from Dinar, 1995.

[1] Income dispersion is used as a measure of income distribution, measured by income variance.

[2] Efficiency scores may change after monitoring and enforcement costs are included. Per-unit pricing (units may be measured in hectares, inputs or outputs), has lowest agency transaction costs of the ranked schemes.

the volume of water used (e.g., area irrigated or weight of crop produced), which may be more feasible to measure. In area-based pricing, demand farmers' water costs are fixed regardless of quantity of water consumed, precluding the use of price as an incentive for conservation through investment in conservation practices. This can result in under-investment in conservation technology, land and water degradation from excessive water use, and over-extraction of surface and ground water at the expense of downstream and neighboring users.

Per-hectare pricing has the benefit of low monitoring costs – explaining its popularity in spite of its efficiency drawbacks. With respect to cost-recovery objectives, cost savings from reduced monitoring requirements may outweigh gains in efficiency or conservation that result from volumetric pricing (Dinar 1995).

Input and output pricing assesses taxes or fees based on units of inputs other than land and water (fertilizer, seed, etc.) or based on output produced (e.g., rice, cotton, or onions), under the assumption that these values roughly indicate levels of water consumption (Onjala 2001). This approach may reduce monitoring and enforcement costs where input and output markets are sufficiently organized for the collection of tax revenues exacted at the time of purchase or sale of inputs or outputs. Conservation incentives are largely divorced from water prices in this approach as well.

A betterment levy sets a price per hectare based on the estimated increased value of land resulting from the provision of irrigation services. A change in land value would be influenced by the land quality and by the market potential of the crop to be irrigated. If the betterment levy is assessed on the basis of the crops actually grown rather than on the basis of the highest-value crops that potentially could be grown on the land, this approach to water pricing could be useful in encouraging cultivation of less profitable staple or subsistence food crops rather than or along side export cash crop production. Such a policy could also serve temporary food security or other planning objectives. The approach would have positive distributional implications for those farmers on less arable plots who face lower profit margins from their crops.

Depending on how it is designed, the betterment levy could imply a level of direct or cross-subsidization that may not be politically or financially sustainable in the long run. In theory, the betterment levy, if set at 100% of the increase in the land value resulting from irrigation, fully extracts the economic rent due to increased access to water. In practice, less than 100% of this rent is extracted. But by charging different prices to different users depending on the value of their irrigated output, the betterment levy is allocatively inefficient – water is not allocated to its highest cash value use. Thus, this pricing scheme would only have positive economic potential where other market failures need to be mitigated (e.g., lack of access of the poor to enough income to buy an adequate diet). It may be best considered as a temporary policy tool that can be used in transitional periods while attempting to resolve other constraints that limit the market's ability to reflect full economic value in prices.

After years of price experimentation, the *Office du Niger* (ON) in Mali has found some success in using per-unit pricing and betterment levies to address both cost recovery and distributional goals. Rates are set according to the three classes of land value (rate differentials are determined by projected rice yields) and also vary by type of crop produced (rice in the wet season, vegetables in the dry season). In order to meet the marginal cost-recovery goals (for operations and maintenance costs only), rates vary with costs. This arrangement has been successful because of farmer participation in the process of setting rate structures and levels (Aw and Diemer, forthcoming).

Setting Price Levels. In theory, price levels should be set to recover financial and economic costs. For full economic cost recovery, prices need to cover fixed costs of infrastructure and marginal costs of system operation and maintenance (O&M), *plus* any costs borne by others due to water extraction, use, and drainage (externalities such as polluted or reduced downstream flows that detract from others' ability to produce agriculture or for household needs). In practice, prices may reflect the seasonality of supply and demand, supply scarcity, externalities, reliability of services, and political objectives.

Where technology and management are appropriate, increased yields from water investments should always allow users to meet close to 100% of O&M costs (Molden 2003). In reality, however, developed and developing countries generally set water prices far below the level needed to recover even O&M costs, creating financial burdens on the state or resulting in under-investment in O&M, infrastructure, and the management of ecological services.

Many states have regulatory bodies established to monitor when and which water uses impose negative externalities on the environment or on other users and should incorporate those costs into the price of water. Accountability of these regulatory bodies is reinforced when strong users' associations exist for both upstream and downstream users.

Where poverty is a problem and when input and output prices vary greatly, maintaining cash-based full economic cost recovery fees may be politically and financially inappropriate. Farmers may not have the cash to pay fees. Applying user fees to compensate users who suffer externalities may not be within administrative capacity. Moreover, if water prices increase without corresponding yield or income increases, the cost of water will be reflected in the price of food and/or deteriorated health of the population, which will disproportionately hurt the poor.

If cash constraints are due to liquidity problems, improving access to credit may be an appropriate solution. If the cost of water use is greater than the marginal revenues it produces, it may be necessary to consider investing in more profitable crops. Where other systemic constraints may limit either crop choice or cash returns on output, water-use fees may involve in-kind payments such as labor contributions or harvest shares. In some areas, traditional community systems for sharing community costs and work burdens may already be practiced. In such cases, it is important for the government to provide the technological or infrastructural support, but not necessarily to re-organize the traditional cost-sharing system (Molden 2003).

Water markets and participatory irrigation management (PIM) are two approaches to reducing some of the political obstacles to raising price levels to recover O&M costs. In the example of the ON above, PIM has been instrumental to a decade of near 100% O&M cost rate recovery. When reformers sought cost-recovery pricing, farmers insisted that rates be tied to service guarantees including delivery timing and quality and quantity standards necessary for profitable harvests (Aw and Diemer, forthcoming).

PIM also contributes to sustainable water pricing policy if farmers can contribute to management decisions that improve the fit between user needs, management capacity, and technology choice. User participation can also reduce corruption; even if the participation is limited to the users' financial contributions, users gain some element of leverage in demanding service quality and consistency.

In PIM, it is important to ensure that the actual decision-makers and not just the landholders are participating in the decision-making process. This becomes an issue when there are many absentee landowners, if land users such as livestock herders do not own the land they use, or if women are primary water use decision-makers yet are excluded from the water management decision-making process for lack of land title, such as in bas-fond rice production (Van Koppen 1998).

Water markets offer the benefit of eliminating some of the politics of setting or adjusting water prices. This allows prices to reflect dynamic changes in supply and demand over time, rather than just centralized government decisions (Easter 1998). Water markets are based on users' ability to use, sell, or lease water that is allocated to them by formally or traditionally defined water rights institutions. One can imagine "waterholders" as similar to landholders with land property rights. The market value of water serves as an incentive to invest in efficiency-improving practices like infrastructure repair.

Markets encourage financial efficiency by allocating water to its highest value use, and they give farmers an asset that they can use to generate income by leasing unused water rights in the event of being unable to produce for a season or when drought causes the value of water to increase (Griffin 1998). An initial equitable distribution of rights in water markets is one factor that can help prevent the accumulation of water rights by the wealthiest bidders without due compensation to other users (Griffin 1998).

Water markets can be defined within an irrigation system, within a watershed, or within an entire river basin, depending on the organizational support and the ability to link one person's use to another person's non use of the same water. The larger the scale of the market, the more crucial the role of a governance organization in water market management for facilitating transactions, improving access to information and for mitigating negative external impacts on nonmarket water users and on the environment within the market (Livingston 1998).

At the river basin level, where regional organizations like the OMVS have allocated stream flows of the Senegalese River by country, water markets could encourage countries to invest in conservation by reducing losses due to evaporation or to virtual water export through water-thirsty export crops and thereby increasing return flows (returning diverted water back to the river directly or through groundwater seepage) in exchange for selling foregone water rights to the highest bidder among the other member states. These organizations also bear the responsibility for protecting adequate minimum flows for ecological services and fisheries.

CONSIDERATIONS AND CONSTRAINTS: Pricing water can transform users into investors with increased power to hold service providers accountable to service quality. In rural West Africa, pricing policies must address both (1) water users who do not have the cash resources to purchase water for their basic household production needs and (2) limited management, implementation, and enforcement capacities.

Subsidizing the search for and distribution of appropriate technologies with low initial investment and O&M costs for cash-poor regions is an important role for the state. The state may need to intervene to protect use and non-use ecological values or resolve conflict among competing users. Also, poorly defined land distribution and titling institutions may be serious obstacles to designing and implementing a feasible water pricing strategy.

Advocates of investment in small-scale irrigation and community water resource development tout a long list of economic advantages relevant to pricing, including low equipment and O&M costs which allow for a more user demand-driven rather than government subsidy-dependent market (Aeschliman 2001). Low initial investment costs and low O&M costs may be better met by in-kind payments of labor hours or low fees that better match users' ability to pay and communities' ability to monitor and enforce contributions.

CONCLUSIONS: Water pricing is a tool that can help advance the objectives of water resource development and management, increasing efficiency, income redistribution, reducing financial burdens on the government, and encouraging conservation. The extent to which these goals can be achieved without making other users worse off will depend greatly on the design of the water pricing strategy, the approach to setting the price levels, the degree of attention paid to competing uses and non-use values, the initial endowment of water use rights, and the recognition of constraints based on users' ability to pay cash fees.

REFERENCES

Aeschliman, C. 2001. Reflections on Irrigation Finance in Africa. Paper presented at the Private Irrigation in Sub-Sahara Africa: Regional Seminar on Private Sector Participation and Irrigation Expansion. 1-5 October. Accra, Ghana.

Aw, D., and G. Diemer. Forthcoming. *Reforming the Office du Niger in Mali: Fostering Partnership between Farmers, Irrigation Agency and Government 1978-2000.* World Bank Technical Paper. Washington, D.C.: The World Bank.

Dinar, A., and T. Yacov. 1995. *Efficiency and Equity Consideration in Pricing and Allocating Irrigation Water.* Policy Research Working Paper No. 1460. Washington, D.C.: The World Bank.

Easter, W. K. 1998. Water Markets: Transaction Costs and Institutional Options. In *Markets for Water: Potential and Performance*, ed. K. William Easter, Mark W. Rosegrant, and Ariel Dinar. Boston: Kluwer Academic Publishers.

Johansson, R. C. 2000. *Pricing Irrigation Water: A Literature Survey*. Policy Research Working Paper No. 2449. Washington, D.C.: The World Bank.

Livingston, M. L. 1998. Institutional Requisites for Efficient Water Markets. In *Markets for Water: Potential and Performance*, ed. K. William Easter, Mark W. Rosegrant, and Ariel Dinar. Boston: Kluwer Academic Publishers.

Davia Moulden. Personal converstaion at the Stockholm International Water Institute Symposium.

Onjala, J. 2001. *Water Pricing Options in Kenya: Cases of Mwea and West Kano Irrigation Schemes*. CDR Working Paper No. 01.9. Copenhagen: Centre for Development Research.

Van Koppen, B. 2002. Gender Analysis for Improved Sahara Africa. In *Private Sector Participation in Irrigation Expansion in Sub-Saharan Africa,* ed. Sally and Abernethy. Presented at FAO-IWMI-CT Regional Seminar, 22-26 October, 2001. Accra, Ghana.

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