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NOTES

Investing In the Reuse of Treated Wastewater

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Of the projected 1 billion growth in global population by 2015, 88 percent will take place in cities, nearly all of it in developing countries (UNDP 1998). Investments in urban water supply and sewerage coverage are rising, as shown in Figure 1. However, as shown in Table 1, adequate treatment for agricultural reuse with acceptable risk mitigation for human health and the environment will require further investment (World Bank and Swiss Development Corporation 2001). While this Investment Note addresses reuse after treatment, it is critical to ensure that investments in treatment appropriate for reuse schemes will be made. Urban wastewater is well suited to agricultural reuse and landscaping because of the reliability of supply, proximity to urban markets, and its nutrient content (depending on the treatment technology). To have an impact on scarcity, reuse of wastewater must substitute for, not add to, existing uses of higher-quality water.

Moreover, reuse of treated wastewater often disproportionately benefits the poor. It must be combined with strategies to prevent or mitigate health risks from pathogens, heavy metals, pesticides, and endocrine disrupters, and environmental damage from heavy metals and salinity. Long-term institutional coordination among urban, agricultural, and environmental authorities and end users is a requirement for water reuse investments to pay off. This note outlines technological and management interventions suitable for World Bank lending.

Potential Areas of Investment

Water reuse has become part of integrated water resources management policy in several economies facing acute physical water scarcity, including Tunisia, Jordan, the West Bank and Gaza, and Israel (Box 1). In other countries (such as Australia and the United States) beneficial reuse has been practiced for decades. In situations where the investment costs to develop new freshwater resources are high, water reuse should be given priority consideration. Owing to water quality and associated risk considerations, agricultural reuse of treated wastewater is more feasible than potable reuse (although direct potable reuse is now practiced in Singapore). Reuse through surface irrigation, particularly drip, but also controlled furrow irrigation, appears to present less risk of contaminant transmission than does groundwater recharge and recovery, although Israel, the United States, and Australia are gaining experience with safe injection and recovery, soil-aquifer treatment, and related groundwater-based technologies. Landscaping uses with suitable controls over contaminant transmission to the public represent an important investment opportunity, but benefits and cost recovery may be limited to specific high-value uses, such as golf courses.

POTENTIAL BENEFITS

If reuse substitutes for an existing use, freshwater is saved. Finding new uses for treated wastewater may generate additional economic benefits but does not translate into water savings. Because of water competition in water-scarce situations, farmers' livelihoods are often threatened, as cuts in allocation come at the expense of the agricultural uses. Water reuse with some tenure security for farmers can result in signifi-

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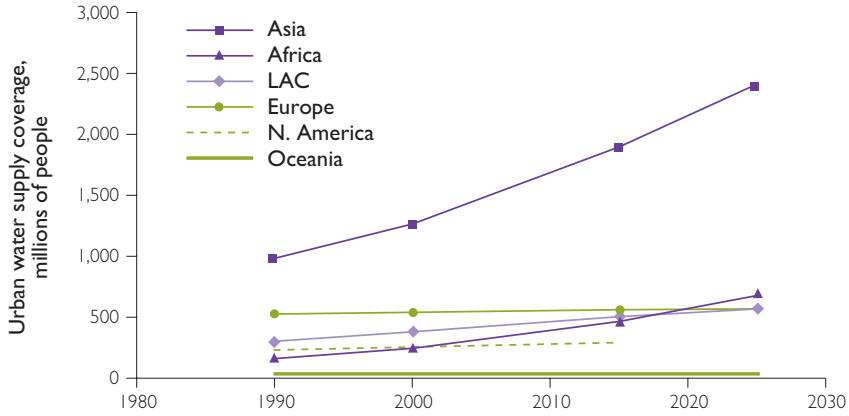
cant economic benefits. Environmental quality is often an important benefit of reuse programs because poor-quality water is used in agriculture instead of being discharged into cleaner surface water bodies or groundwater. Finally, water reuse may reduce the investment costs of developing new resources for agriculture or other uses for which it is substituted.

Figure 1: Urban Water Supply Growth, 1980—2015



Source: UNDP 1998.

Based on international experience, it is increasingly apparent that economic win-win solutions are not easy. Instead, potential Bank investments in the water sector need to address alternatives and consider the economic tradeoffs, for example:

- Should a sea outfall be built to discharge wastewater from a coastal city, if permitted by national and regional regulations and treaties, or should wastewater be reused, possibly incurring much higher costs for the treatment, storage, and especially the transfer of reclaimed water?
- Should a reservoir for reclaimed water be built to increase its availability during the irrigation season or should treated water be discharged during the wet season?
- Are more expensive treatment and unrestricted irrigation preferable to simpler treatment and crop restrictions?

POLICY AND IMPLEMENTATION

Planned reuse is not just about treatment; it requires an integrated approach. Where the Bank lends for wastewater treatment, the planned reuse of effluent should be integrated into the decision to invest in intensive (for example, activated sludge) or extensive (for example, stabilization ponds) technologies, or centralized versus decentralized systems.

Because collection and treatment of wastewater are usually under the jurisdiction of a different sector (such as urban water supply and sanitation) from the reuse sectors (such as agriculture and municipalities), intersectoral coordination in planning and management is extremely important. The World Bank Country Water Assistance Strategies offer an opportunity to ensure such coordination. On the demand side, users should be involved in planning and monitoring the quality of the supplied effluent. Effective advisory/extension services are also extremely important.

Table 1: Water Treatment Gaps

Region	Percentage of sewered population in large cities	Percentage of sewered wastewater that is treated to secondary level
Africa	18	0
Asia	45	35
Latin America and the Caribbean	35	24
Oceania	15	Not reported
North America	96	90
Europe	92	66

Source: WHO and UNICEF 2000.

Box 1: Tunisia: Water Reuse

Tunisia, with per capita freshwater availability of about 450 cubic meters a year, is recognized as a leader in the area of treated wastewater reuse. From 1996 to 2030, the share of treated wastewater as a percentage of total available water resources is projected to more than double from 4.4 percent to 10.9 percent. Despite strong institutional support, including the 2002 consolidation of the Ministry of Agriculture, Environment, and Water Resources to oversee integrated water management and water reuse, only 18 percent of reclaimed water is currently used. Treated wastewater use has faced several constraints—social acceptance, salinity levels too high for some crops, restrictive regulations, and volumetric pricing in the range of US$0.02 to $0.05 per cubic meter (between 50 percent and 95 percent of the cost of freshwater for irrigation)— and these have limited its full potential for development. Through its carefully phased approach to treated wastewater use and the concomitant development of a regulatory framework prohibiting untreated wastewater use, Tunisia has significantly mitigated environmental and public health risks associated with the practice elsewhere in the world.

Source: Authors.

Key to the success of planned strategic reuse programs are a coherent legal and institutional framework with formal mechanisms to coordinate the actions of multiple government authorities; policies to reduce waste loads through application of the "polluter pays" principle; appropriate practices for wastewater use through crop choice, landscaping, and the like; public awareness campaigns to establish social acceptability for reuse; and consistent government commitment over the long term.

The private sector can play an important role in promoting treated wastewater reuse. It would be even more attractive for the private sector to invest in wastewater treatment when markets for the treated effluent exist. This arrangement requires policies and regulations that allow the private sector to function and provide reliable services. For example, in Australia, the private sector, under a contract to the city government, constructed a treatment plant and pipeline (the "Virginia pipeline scheme") to transport treated wastewater to farms for irrigation at an agreed tariff. This commercial solution was successful, and the private investor considered further investment to expand the treatment plant to serve other irrigated areas.

LESSONS LEARNED

Based on international best practices, the following should be borne in mind when developing wastewater investment plans.

- Wastewater treatment must result in water quality that is suitable for the particular reuse application—for example, nutrient removal may be counterproductive unless enrichment or eutrophication of surface or coastal waters is a risk.
- Guidelines linked to reuse must adequately protect human health. The international standard WHO guidelines (WHO 1989) are being revised, based on the Stockholm Framework encouraging flexible, stepwise implementation of guidelines that consider other sources of risk.
- Source control of contaminants is a must, particularly for industrial wastewater; otherwise reuse programs will be unsustainable.
- Cultural values play an important part in the acceptability of water reuse, particularly where religious views on ritual purity are highly articulated, for example in Islam and Hinduism.
- Sustained, long-term public awareness campaigns among the reuse target group (such as farmers or urban landscaping authorities) are needed for acceptance of water reuse.
- Irrigation methods must be suitable for the type of reclaimed water (high suspended, dissolved solids). Where possible, highwater-productivity drip irrigation should be encouraged. Sprinklers can lead to airborne transmission of viruses and other contaminants. It should be stressed that to save water, reuse must substitute for an existing use.
- Crop restrictions applied sensibly may be essential, particularly in view of increased phytosanitary controls required in export agriculture.
- Institutional coordination is essential among various government authorities, civil society, and farmer associations of water user groups.

POSSIBLE INVESTMENT OPPORTUNITIES

Examples of sound investments in treated wastewater use include the following:

- Water swaps as a substitute for existing uses of (raw or potable) water for reclaimed water
- Rehabilitation of wastewater treatment plants
- Construction of new wastewater treatment plants using appropriate technologies
- Sewer systems that separate municipal from industrial wastewater
- Surface storage reservoirs for reclaimed water
- Pilot projects on separate reuse of urine and feces through decentralized systems (ecological sanitation) in small towns and periurban areas.

RECOMMENDATIONS FOR PRACTITIONERS

Recommendations for countries experienced in reuse are different from those for countries just embarking on reuse. Comprehensive recommendations include the following:

- Support for master plans that integrate reuse in the planning and design of sanitation projects and that build it into agricultural programs
- National reviews of reuse policies, including multi-stakeholder workshops
- Creation of interdepartmental working groups at the national and/or local levels
- Awareness building on health and environmental risks for farmers using untreated wastewater or reclaimed water
- Development of economic and environmental models to support decision making about reuse investments and policies, including policies on subsidies
- Promotion of regional exchange of experiences through professional networks
- Support for research on reuse technology and biophysical sustainability, on institutional arrangements for reuse as part of master planning, on factors that enhance or inhibit social acceptability, and on farmers' and users' innovations with water reuse.

For countries embarking on reuse, the following apply:

- Introduction of appropriate national reuse standards
- Introduction of appropriate crop restrictions.

And for countries that have made progress in reuse, the following apply:

- Formal arrangements between farmers and utilities specifying mutual rights and responsibilities
- Design of tariffs for reclaimed water.

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