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THE WORLD STEPS UP TO THE WATER QUALITY CHALLENGE:

COMMUNITIES AND GOVERNMENTS FIND SOLUTIONS

AFRICA:

Nairobi River, Nairobi, Kenya: Water-quality Improvement
The Nairobi River Basin Project arose from an effort by UNEP to address environmental problems in Nairobi, Kenya, with a focus on restoring and improving water quality of the river system through Nairobi. The project included several component efforts, addressing topics such as pollution, waste management, community participation and awareness, capacity-building, and legislation (Nairobi River Basin Project Phase II report).

Hartbeespoort Dam, North West Province, South Africa: Pollution Control
South Africa's Hartbeespoort Dam provides water resources ranging from farm irrigation to industrial process water and domestic drinking water in urban areas, from recreational uses to supporting extensive urban development along the shoreline. Excessive nutrient loads, originating largely as point source discharges from wastewater treatment works into the Jukskei River, have resulted in the reservoir being hypertrophic for many years. The large phosphorus loads discharged into the dam have supported blue-green algae blooms, since the early-1970s, with (1) tastes and odors in potable waters; (2) blue-green algal toxins within the lake and treated waters from the lake; (3) impaired recreational and aesthetic uses; and (4) decreased revenue from lake-related commercial activities and residential sales.

To address these issues, Government Notice 1567 of 1980 prescribed a phosphorus standard for effluent discharges; implementation was delayed until 1985, when it was decided to implement it only certain rivers, which contain five of the top ten water impoundments identified as the highest priorities in terms of eutrophication. An informal receiving-water quality objective for phosphorus was introduced in 1988 for reservoirs in sensitive catchments, including Hartbeespoort Dam. Nine wastewater treatment plants currently discharge more than 8 million m3 of treated effluent on a monthly basis into tributary streams draining to Hartbeespoort Dam (approximately 40% of the total water load to the reservoir).

Implementation of the standard coincided with the recovery of the reservoir, following the extensive drought conditions experienced between 1981-1982 and 1987-1988, and refilling it resulted in further dilution of the extremely high phosphorus levels observed in the waterbody, reducing in-lake phosphate-phosphorus concentration. But it was suggested in 1985 that simply setting an effluent concentration limit, rather than a limitation based on a total load, would have little beneficial impact. Improvements had been short-lived, with a return of extensive blue-green algae blooms during 2000, 2001, and 2003.A public meeting was held by the Hartbeespoort Dam community and they formed the Hartbeespoort Water Action Group (HWAG) charged with seeking short-term and longer-term solutions to the algal-blooms problem. HWAG realized a permanent solution would have to be found to address the causes of the algae problems. The interventions are centered on a three-pronged strategy, including (1) continuing to reduce the external phosphorus load to the reservoir; (2) managing in-lake nutrient availability; and (3) relaxing impaired food web structures that no longer support or provide a natural resilience to the eutrophication process. These longer-term efforts have been done in partnership with the appropriate governmental authorities at the national and provincial levels.

For more information: Hartbeespoort Dam (South Africa), contributed by Jeffrey Thornton and W.R. Harding, International Environmental Management Services Ltd, Waukesha, Wisconsin, USA

ASIA:

Ganges River, Varanasi, India: Water-quality Monitoring and Education

India's sacred river, the Ganges, supports over 400 million people, and for many, is an important symbol of purity. But as it travels along its 1,500-mile journey through India, over 1.4 billion liters of untreated waste water are dumped into it each day. Swatcha Ganga Research Campaign, a lab established in 1992, monitors the river water quality in Varanasi. Since then more than 30,000 tests have been conducted. Lab is a public watchdog, highlighting the public health and ecological impacts of sewage on river water quality. Sankat Mochan Foundation (SMF) has worked to clean the Ganges for 25 years, working with other organizations and the community to help shape and accelerate the new Ganga Action Plan, a revitalized government effort to finance the cleanup. Efforts involve working to generate change by engaging the community in training sessions, informing the media, and advocating with elected officials. These trainings have helped bring about progress in cleaning up the Ganges: the national government is moving forward on a new clean-up plan, is working to implement some of the alternative wastewater treatment technologies featured in the trainings, and has requested that Dr. Bailey Green and the Sankat Mochan Foundation create a detailed project plan for an alternative wastewater treatment system.

For more information: http://sankatmochan.tripod.com/index.htm
Sankat Mochan Foundation; +91(542)313884; vbmishra@altavista.net

Iraq: Marshlands Restoration and Management

The key water quality problems faced in the Iraqi Marshlands included polluted water discharge from upstream areas, salinity, and lack of wastewater management in the marshland communities. To address the water quality problems, the United Nations Environment Programme (UNEP) implemented several initiatives on a pilot scale, including: (1) natural wetland system management and monitoring to assess the potential for water quality improvement and wetland rehabilitation; (2) reverse osmosis treatment of highly saline water to provide safe drinking water in six communities; (3) solar stills for household treatment of marshland water for potable use; and (4) constructed wetland installation for wastewater management in one community. These pilot-scale interventions provided immediate relief in some areas, and also generated the data and experience needed in Iraq to continue with their management and potential replication. The need for longer-term management and monitoring was highlighted, especially for wetland management initiatives for water quality improvement.

For further information, see the project completion report at: http://marshlands.unep.or.jp/.

SOUTH AMERICA:

Medellin, Colombia: Integrated Urban Water Management

There is a large urbanized population in the Metropolitan Area of Medellín (MAM) of 3.3 million, many of whom live on the slopes of the Aburrá-Medellín Valley where Medellín is situated and highly prone to landslides and stormwater erosion. For many years leading up to the early 1990's, Medellín had been growing rapidly, and this led to an increase in municipal runoff, with domestic effluents compounded with growing industrial effluents and upstream agriculture activity. This increased toxic runoff into the Medellín River to the level that required immediate and drastic measures to recuperate the river. At the same time, Medellín was lacking in urban water management (e.g. wastewater and stormwater treatment, water quality, drainage, and institutional capacity). In order to confront the deteriorating sanitary and environmental conditions, as well as their adverse effects on residents' health and well-being, the Medellín River Sanitation Program was approved in the 1980's, and the subsequent integrated urban water management (IUWM) that developed there is considered to be an overall success, with sound urban water management carried out by a set of technically strong institutions with financial independence and lack of political interference. It is a good example of how a large metropolitan area with moderate income disparity can adequately operate and

maintain quality water supply to its many citizens. River clean-up and new infrastructure of treatment plant, aqueducts, wastewater collectors, new conveyance pipes to bring portable water to residents were the primary targets.

Source, and for more information:
http://en.wikipedia.org/wiki/Integrated_urban_water_management_in_Medell%C3%ADn,_Colombia

Eastern Antioquia, Colombia: Regulations/incentives or pollution prevention
The region of Eastern Antioquia in Colombia has had success with incentive-based water pollution regulation. Water bodies in Colombia have been polluted heavily by untreated industrial and agricultural waste, contributing to a high incidence of water-related disease. To address this, the Eastern Antioquia began to close factories and implement fines in 1995. However, many factories were able to find ways to avoid the regulations, and in 1997 this law was replaced with an incentive-based approach to meeting water quality standards, by charging polluters per unit of biological oxygen demand and total suspended solids discharged. Pollution charges start low for each polluter, and ramp up every 6 months if pollution continues, creating an incentive to reduce discharges and purchase wastewater treatment technologies (Kraemer et al. 2001). Charges are paid to local authorities, giving them incentive and resources to enforce the law. In the first five years, organic waste was reduced by 27%, and suspended solids were reduced by 45% (Blackman 2006).

For more Information:
Kraemer, R. Andreas, Keya Choudhury and Eleftheria Kampa. (2001).PROTECTINGWATER RESOURCES POLLUTION PREVENTION: Thematic Background Paper. Prepared for the International conference on Freshwater, Bonn 2001. Retrieved January 28, 2010 from http://www.cepis.ops-oms.org/bvsarg/i/fulltext/pollution/pollution.pdf.

Blackman, Allen. (2006). How well has Colombia's wastewater discharge fee worked and why? In: Economic incentives to control water pollution in developing countries. *Resources Magazine*, Resources for the Future. Retrieved January 28, 2010 from http://www.rff.org/rff/Documents/RFF-Resources-161_EconomicIncentives.pdf.

Nicaragua: Programa Campesino a Campesino, best practices, education
In 1987, the National Union of Farmers and Ranchers (UNAG) in Nicaragua founded the Programa Campesino a Campesino (PCaC), an innovative effort to promote best agricultural practices through peer-to-peer education. Today, producers from 817 communities are benefitting from the PCaC methodology where the producers share their knowledge and experiences with one another. In the Masaya region, they have documented a 90 percent decrease in the use of chemical fertilizers and increases in annual and perennial crop yields in conjunction with the PCaC practices of crop rotation, incorporating plant residues into the soil, using natural barriers to combat erosion, reforestation and cover crops, and spreading manure, rather than synthetic fertilizers—all of which have positive impacts water-quality from reduced agricultural runoff and runoff that carries fewer contaminants into water bodies. The practices proposed focus on local resources and conditions. In particular, the program seeks to encourage active participation by rural communities and the transfer of knowhow around organic agricultural production, sequential agro-forestry, agricultural diversification, and environmental health through implementing simple, inexpensive, and effective practices (IFAP 2005).

For more information: International Federation of Agricultural Producers (IFAP). (2005). Good Practices in Agricultural Water Management: Case Studies from Farmers Worldwide. Background Paper No. 3. DESA/DSD/2005/3

EUROPE:

Danube River Clean-up
The Danube River, located in Central Europe and shared by 18 countries, has been badly polluted by industrial and other wastes. An assessment of the river in 1999 found that it contained hazardous substances, microbial contamination, and high nutrient loads which led to eutrophication (Vousden 2007), and identified 130 major industrial polluters in 11 countries (IW LEARN TEST). To address this pollution, the United Nations Industrial Development Organization (UNIDO) started a Transfer of Environmentally Sound Technologies (TEST) project on the river in 2001. The TEST program aims to build capacity in industrial

service institutions to identify the least costly method for complying with environmental regulations through mechanisms such as cleaner production, environmental management systems and accounting, and selection of environmentally sound technology (UNIDO TEST).

The project on the Danube River was intended to demonstrate that environmental targets can be met while maintaining or even improving economic productivity and competitiveness, and to bring the selected industrial polluters into compliance with both European Union Accession and the Danube River Protection Convention requirements. More than 90 employees were trained to use the TEST approach, and over 230 cleaner production measures were implemented (UNIDO TEST). The project was largely a success, not only reducing water pollution, but resulting in a number of benefits to the companies, including reduced fines; reduction in costs associated with wastes (including through the recycling of wastes); better product quality; and marketing opportunities (Vousden 2007).

Vousden, David. (2007). Building Successful Technological and Financial Partnerships with the Private Sector to Reduce Pollutant Loading. In: *International Water Experience Notes*. Retrieved January 28, 2010 from http://waterwiki.net/images/e/ef/Expnote_danubetest_privatesector.pdf.

International Waters Learning Exchange and Resource Network. (IW LEARN). (2010). Transfer of Environmentally-sound Technology (TEST) to Reduce Transboundary Pollution in the Danube River Basin. Retrieved January 28, 2010 from http://www.iwlearn.net/iw-projects/Msp_112799491541.

Netherlands: Polluter-pays Regulations

During the 1960's in the Netherlands, water pollution loads, particularly organic pollutants, were becoming serious enough to interfere with the water's use for drinking water, recreation, and agriculture. In 1970, the Netherlands implemented the Pollution of Surface Waters Act, a pollution fine system that has been very successful in reducing water pollution. The system is based around the recognition that water needs to be clean enough not only for human uses (drinking water, agriculture, industry), but also for aquatic ecosystems (Van Erkelens and Olman 1996). These regulations are at the national level, but water management is the responsibility of provincial governments. All of these 12 governments in the Netherlands have delegated water management responsibilities to Water Boards.

Water-quality regulations in the Netherlands rely on licensing and charging both direct and indirect sources of biochemical oxygen demand and heavy metals. Licenses are granted by Water Boards to companies and households that discharge effluents directly to waters. Fine levels are based on the goal of providing full cost recovery of sewage treatment. While the Netherlands is not the only country which has levied fines on polluters, their system has been particularly successful for a number of reasons. First, fines are based on volume of pollution discharged, incentivizing as little discharge of pollutants as possible (Elkins 1999). Fines are also substantial enough to discourage pollution, and have increased over time. There are also organizational reasons for success: polluters and the Water Board have direct interactions, and requirements are laid out clearly. Finally, revenue raised is used to finance wastewater treatment facilities, which further improve water quality (Van Erkelens and Olman 1996). Dramatic water-quality improvements were attained in nearly all regions of the country. For example, in the first 25 years of implementation, discharges of oxygen-binding substances dropped 80 percent (Van Erkelens and Olman 1996).

For more information: Van Erkelens, P. and M. Olman. (1996). The Pollution of Surface Waters Act in the Netherlands: A story of successful enforcement. Fourth International Conference on Environmental Compliance and Enforcement, Chiang Mai, Thailand, April 22-26, 1996. Retrieved December 10, 2009 from http://www.inece.org/4thvol2/vanerkle.pdf.

Elkins, P. (1999). European environmental taxes and charges: recent experience, issues and trends. *Ecological Economics*, 31(1): 39–62.

North America:

New York City, United States: Source Protection

New York City has the largest unfiltered surface water supply in the world, fed by runoff from the nearby Catskills Mountains. An essential part of New York City's water supply is source water protection. In the

1990s, upgrades to New York City's water system were necessary to continue to supply a growing population with high-quality drinking water. The first option considered was the construction of a water filtration plant at a cost of approximately $US6 billion, with annual operating costs of $150 million. Because of the high cost of the filtration plant, the New York Department of the Environment decided to take a different approach. For far less money, the Department launched a watershed protection program in drinking water source regions which included enactment of regulations governing activities in the watershed (especially septic system siting); innovative planning initiatives; development and funding of best management practices for farms; and land acquisition.

For more information: United States Environmental Protection Agency (US EPA). (2009b). Hudson River PCBs: Background and Site Information. Retrieved February 5, 2010 from http://www.epa.gov/hudson/background.htm.

Cuyahoga River, Northern Ohio, United States: Pollution Clean-up

The Cuyahoga, a relatively small river in northern Ohio, U.S.A., carries great historic and symbolic importance as it flows from its headwaters some 160 km, through the cities of Akron and Cleveland, to discharge into Lake Erie. For more than one hundred years, it received un- and under-treated industrial and domestic wastes, at times including those from rendering plants, steel mills, and chemical plants, leaving the river a lifeless, toxic sewer. The oily sludge floating atop the river reportedly caught fire for the first time in 1868. Another fire in 1912 spread and killed five dockworkers; a major fire in 1952 caused a reported US$ 12 million (2009) in damages. On June 22, 1969, the river again caught fire, for at least the ninth time in a century. This time, however, the event was captured on national television and led to calls for major reform of U.S. water-quality laws. The municipal and state governments contested jurisdiction and authority, but new national attention on this and other water pollution disasters pressured the federal government to enact sweeping new legislation and centralize authority. In 1970, the new Environmental Protection Agency (EPA) was formed. In 1972, the federal Clean Water Act was enacted, requiring that waterways should become "fishable and swimmable."

By a two-to-one margin, voters in Cleveland approved a large bond issue in late 1968 to build a wastewater treatment plant, new sewer lines, and to improve existing facilities, vastly expanding the city's capacity to treat effluent and capture stormwater flows. In the past 40 years, local industries and the regional wastewater utility have spent US$ 3.5 billion to control and reduce water pollution. EPA enforcement of new laws decreased dumping of raw wastes into the river. Forty years later, the Cuyahoga supports more than 60 species of fish and birds and mammals have returned to the river's banks, and the quality of Lake Erie (which receives Cuyahoga River flows) is also vastly improved (Time 1969, Maag 2009, Rose 2009).

For more information: Time. (1969, August 1). "Environment: The Cities: The Price of Optimism." Time. Retrieved December 16, 2009 from http://www.time.com/time/magazine/article/0,9171,901182,00.html.

Maag, C. (2009, June 21). "From the Ashes of '69, a River Reborn." The New York Times. Retrieved December 16, 2009 from http://www.nytimes.com/2009/06/21/us/21river.html.

GLOBAL:

Stockholm Convention: International Water-Quality Agreement

While there are no enforceable international standards for water quality, there are guidelines developed by the World Health Organization and several international agreements regarding specific water-quality issues, e.g., persistent organic pollutants (POPs). POPs are chemical substances like PCB and DDT that persist in the environment and bioaccumulate through the food web. There is evidence of long-range transport of these substances to regions where they have never been used or produced and with the consequent threats they pose to the environment of the whole globe, the international community has now, at several occasions, called for urgent global actions to reduce and eliminate releases of these chemicals (UNEP POPs).

In 2000, after much urging from the United Nations Environment Programme, an intergovernmental negotiating committee reached an agreement on reducing and controlling the discharge of POPs as an international measure with binding force. The draft convention initially targeted 12 substances: aldrin (insecticide); dieldrin (insecticide); endrin (insecticide); chlordane (insecticide); heptachlor (insecticide);

toxaphene (insecticide); mirex (insecticide, fire-resistant material); hexachlorobenzene (fungicide); PCB (insulation oil, heat carrier); DDT (insecticide); dioxins; and furans. The convention entered into force in 2004 with ratification by an initial 128 parties and 151 signatories. Signatories agree to outlaw nine of the dirty dozen chemicals, limit the use of DDT to malaria control, and curtail inadvertent production of dioxins and furans. Parties to the convention have agreed to a process by which chemicals can be reviewed and added if they meet certain criteria for persistence and transboundary threat. Nine new chemicals were added in 2009. As of January 2010, there are 169 parties to the Convention, representing the vast majority of countries.

For more information: United Nations Environment Programme (UNEP). Chemical Persistent Organic Pollutants (POPs). Retrieved December 16, 2009 http://www.chem.unep.ch/POPs/default.htm.