

SUCCESS STORIES **25**



ASSESSMENT OF ENVIRONMENTAL FLOWS FOR RIVER HEALTH

Based on years of research, the assessment of environmental flows (or E-flows) has begun to take on a strategic role in the efforts of developing countries to keep their rivers healthy. With support from the International Water Management Institute (IWMI) and its partners, countries are using E-flow calculators to plan the management of water resources in major river basins and to report more accurately on progress toward water-related targets of the United Nations Sustainable Development Goals (SDGs).

DEFINING

RIVER HEALTH

Environmental flows – known as E-flows – describe the quantity, quality and timing of the water flows needed to sustain freshwater ecosystems as well as the benefits they provide, such as freshwater, fish, flood control and climate change mitigation. Many people in developing countries directly depend on such ecosystem services for their livelihoods and well-being, and the overuse of water and continuing degradation of aquatic ecosystems puts them at risk. This calls for water management plans that are based on a clear understanding of environmental flows.

“Scientists use a variety of methods to define the E-flows needed to maintain healthy rivers,” says Chris Dickens, principal researcher, IWMI. “These range from simple desktop methods to approaches that require teams of experts and a year-long survey of the ecosystem. E-flows have many dimensions and their assessment requires both technical and social lenses.”

EARLY ADVANCES

IWMI has steadily improved the determination of E-flows over the last 15 years, in the process considering the full spectrum of scientific approaches. In 2004, the Institute published its first assessment of the E-flow requirements of the world’s river basins, which included a wealth of data on the withdrawal of surface water and groundwater at the global, regional and subregional levels.

In a 2007 project, IWMI partnered with World Wide Fund for Nature-India (WWF-India) on the country’s first-ever holistic E-flows assessment. The high-profile project chose the iconic Ganges River and employed the Building Block Methodology, which determines the flow regime of a river by segregating it into distinct components that can be described in terms of timing, duration, frequency and magnitude (O’Keeffe et al. 2012).

In addition to taking into account ecological water requirements, the project examined livelihood, spiritual and cultural needs, including the volume of water required for ritual purifications. This was the first time that “spiritual flows” were included in E-flow assessments. The Indian government subsequently incorporated E-flows into the aims and objectives of the National Mission for Clean Ganga (NMCG), the implementation arm of the National Ganga River Basin Authority (Lokgariwar et al. 2014; Smakthtin and Bharati 2016).

E-FLOWS ASSESSMENT OF THE GANGES

“The aims and objectives of NMCG (are) to accomplish the mandate of National Ganga River Basin Authority (NGRBA):

1. To ensure effective abatement of pollution and rejuvenation of the river Ganga by adopting a river basin approach to promote inter-sectoral co-ordination for comprehensive planning and management and
2. To maintain minimum ecological flows in the river Ganga with the aim of ensuring water quality and environmentally sustainable development.”

Source: NMCG website (https://nmcg.nic.in/aims_obj.aspx).



Worshippers take a “holy dip” in the Ganges River at Varanasi, India, one of the most sacred sites for the Hindus.

E-FLOW CALCULATORS

APPLICABLE ANYWHERE IN THE WORLD

Building on early successes, IWMI researchers have developed online E-flow calculators, a family of software for rapid, desktop assessment anywhere in the world. These online calculators enable users to establish an E-flows baseline, which then provides them with an understanding of how much water remains in the system for supply and use. This is important for countries that are intent on improving water management but lack the capacity to define E-flows on their own. While the calculator estimates E-flows at a relatively basic level, it does provide information that governments can use for scoping studies and preliminary planning.

More recently, the IWMI E-flow calculators have been adapted for specific river basins and countries. For example, under a project to promote sustainable water resources development in western Nepal, researchers have collected macroinvertebrate samples and conducted social surveys to add both ecological and sociocultural data to the original IWMI E-flow calculators. The country's Department of Water Resources and Irrigation requested the E-flow requirements generated through IWMI studies to

support the development of Nepal's National Irrigation Master Plan.

"IWMI has also played a major role in building capacity and awareness in Nepal around the concept and methods of calculating E-flows by organizing workshops and training courses as well as developing university curricula for national universities," says Luna Bharati, IWMI principal researcher.

E-flow calculators also provide countries with the information they need to support achievement of the SDGs, especially Goal 6 (Ensure availability and sustainable management of water and sanitation for all). The information is particularly important for monitoring SDG indicator 6.4.2, which tracks how much freshwater is withdrawn by economic activities, compared to the total renewable freshwater resources available. As custodian for Goal 6, the Food and Agriculture Organization of the United Nations (FAO) is using the E-flow calculators to provide estimates to every country in support of their national reporting on the SDGs. FAO has just released guidelines on estimating E-flows, prepared jointly with IWMI, to support a global data drive (FAO 2019).

A POWERFUL NEW TOOL

PROBFLO is a powerful new tool for estimating environmental flows. Developed by IWMI in partnership with South African universities, PROBFLO examines the dynamic relationships between the various drivers of change in the ecosystem, particularly water flow variables, and the response of ecosystem variables, such as vegetation, fish, invertebrates, mammals and birds. Any significant flow reduction will change these components and diminish the ecosystem services available to local communities, thus undermining their livelihoods. The approach also considers the risks of increased waterborne illnesses (e.g., malaria, bilharzia, river blindness and dysentery) in areas affected by reduced flows. Probabilistic graphical modeling tools (Bayesian Networks, also known as belief or causal

networks) are used to calculate the socio-ecological consequences of altered flows on future scenarios and are thus used to determine the E-flows needed to protect the ecosystem and maintain its benefits at a sustainable level.

The PROBFLO method has been applied in the Nile Basin, where it was used during the development of the strategy and framework for E-flow assessments under the Nile Basin Initiative (to which IWMI staff contributed) (O'Brien et al. 2016). More recently, PROBFLO was used in the Inner Niger Delta, resulting in the development of recommendations on flow requirements to support the livelihoods of more than 1.5 million people who depend on the Delta's flooding cycle (Dickens et al. n.d.).

REFERENCES

Dickens, C. et al. n.d. *E-flows for the Upper Niger River and Inter Niger Delta: synthesis report*. Unpublished.

FAO (Food and Agriculture Organization of the United Nations). 2019. *Incorporating environmental flows into "water stress" indicator 6.4.2 - Guidelines for a minimum standard*. Rome: FAO.

Lokgariwar, C.; Chopra, R.; Smakhtin, V.; Bharati, L.; O'Keeffe, J. 2014. Including cultural water requirements in environmental flow assessment: An example from the upper Ganga river, India. *Water International* 39(1): 81-96.

O'Brien, G.C.; Dickens, C.; Seid, A.; Alarabawy, M.; Bubmann, S.; Petersen, G. 2016. *NBI Guidance document on environmental flows*. Prepared by HYDROC GmbH on behalf of the Nile Basin Initiative and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

O'Keeffe, J.; Kaushal, N.; Bharati, L.; Smakhtin, V. 2012. *Assessment of environmental flows for the Upper Ganga Basin*. Project report of the environmental flows assessment done under the Living Ganga Program. New Delhi, India: World Wide Fund for Nature - India (WWF-India). 161p.

Smakhtin, V.; Bharati, L. 2016. Environmental flows: Keeping the basin rivers alive. In: *The Ganges River Basin: Status and challenges in water, environment and livelihoods*, (eds.) Bharati, L.; Sharma, B.R.; Smakhtin, V. Oxon, UK: Routledge - Earthscan. Pp. 175-187. (Earthscan Series on Major River Basins of the World).

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ABOUT IWMI

The International Water Management Institute (IWMI) is a non-profit, scientific research organization focusing on the sustainable use of water and land resources in developing countries. IWMI works in partnership with governments, civil society and the private sector to develop scalable agricultural water management solutions that have a real impact on poverty reduction, food security and ecosystem health. Headquartered in Colombo, Sri Lanka, with regional offices across Asia and Africa, IWMI is a CGIAR Research Center and leads the CGIAR Research Program on Water, Land and Ecosystems (WLE). www.iwmi.org

FOR MORE INFORMATION, CONTACT:

Chris Dickens, Principal Researcher (c.dickens@cgiar.org)

Luna Bharati, Principal Researcher (l.bharati@cgiar.org)



RESEARCH
PROGRAM ON
Water, Land and
Ecosystems

Postal Address: P O Box 2075 | Colombo | Sri Lanka
Location: 127 Sunil Mawatha | Pelawatta | Battaramulla
Sri Lanka | T: +94 11 2880000 | F: +94 11 2786854
E: iwmi@cgiar.org | www.iwmi.org

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