



*Background Paper for the International Workshop*  
**Environmental Flow Assessments and Implementation for India**  
Exchanging Indian, European and International Experiences  
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### **Rivers under Pressure**

Water is a key resource for the sustenance of life for humans, animals and plants alike. Around the globe, the demand for water is increasing due to population growth, rapid urbanization and industrialization. In this regard, rivers – one of the world’s most essential sources of freshwater – and their ecosystems are under immense pressures due to diversion and abstraction of waters for human uses.

### **The Indian Context**

Indian rivers are a critical natural resource, crucial for human well-being. The Ganga River, for example, supports a population of almost 500 million people by providing a multitude of domestic, agricultural, industrial, and power generation uses, and it also serves for recreational, livelihood and spiritual purposes.

River flows in India show a highly skewed seasonal discharge pattern resulting from the influence of the monsoon season. Most of the annual rainfall and about 80% of the total annual river runoff occurs within the months of June to September.

In order to support an agrarian society, water resources development targeted the storage and diversion of river flows from an early time onwards. In particular, the last two centuries saw the construction of many irrigation dams throughout India, contributing to the fact that India has one of the highest numbers of irrigation dams of any country worldwide. Sixty percent of India’s population directly depends upon farming. Unsurprisingly, agriculture nowadays accounts for around 80% of the entire consumptive water abstractions in India, however, water is also routed to domestic and industrial uses. Furthermore, water is diverted from many rivers for hydropower generation (non-consumptive use). Although the expansion of hydropower facilities is still low when compared to irrigation projects, it is expected to significantly increase in the next decades as India aims to expand its energy generation capacity.

### **Effects of Dams and Water Diversion**

To satisfy the growing water demand, progressively more and more dams are constructed, and water is being taken to off-stream uses. Combined with extensive groundwater uptake (India has one of the greatest groundwater uses of any country), these hydrological changes

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lead to streamflow depletion and water table lowering. In particular, during the lean (dry) season there are increasing reductions and depletions in the river flow. In extreme cases, some river reaches even fall completely dry during parts of the lean season, which leads to local habitat loss and disrupted longitudinal connectivity. Besides, dams and related effects can also disconnect links between the river and groundwater (vertical fragmentation) and between the river and its floodplains (horizontal fragmentation), adversely affecting the river ecosystem as well ecosystem services to humans, such as rich (inland) fisheries.

Furthermore, Indian rivers, and most notably the Ganga river, are worshipped and closely tied to Indian culture and festivals. Aside from social rituals such as marriage and cremation, river waters are also essential for spiritual reasons. For example, during religious festivities such as Kumbh, millions of Pilgrims gather on the river banks for cleansing rituals. Not only does bathing require a sufficient water depth but also the adequate water quality – both aims need to be tackled and ensured.

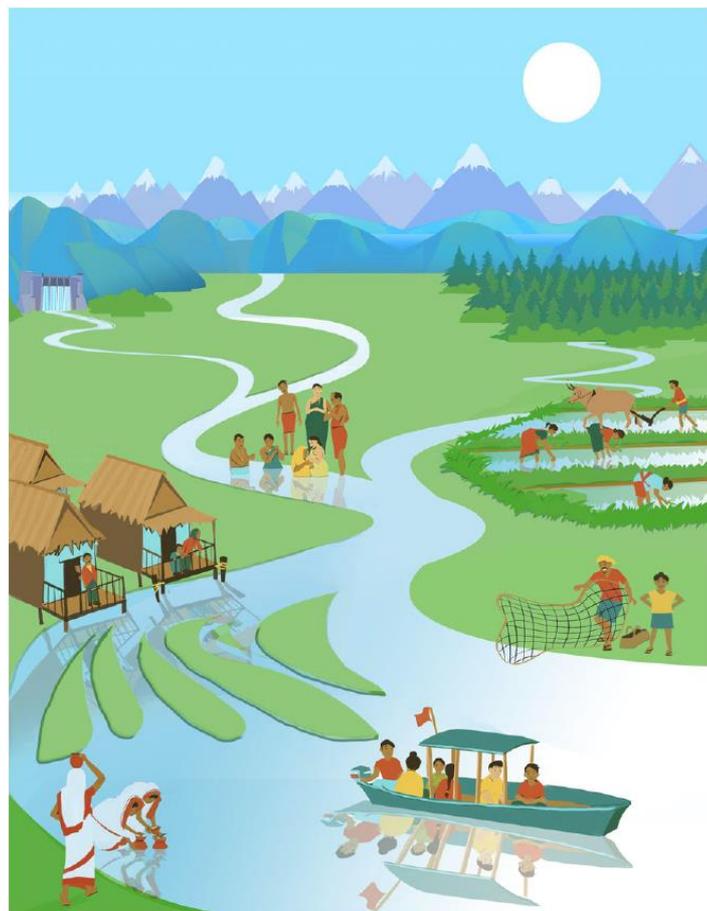


Figure: Water flows are the river's master variable, arranging patterns and processes of the physical and biological environment. Furthermore, aside from maintaining ecologically healthy river-floodplain systems, river flows are also linked to livelihood, identity, sense of place, religious beliefs and ceremonies, language systems, or educational practices (Image source: Anderson et al., 2019, WIREs Water, e1381. doi.org/10.1002/wat2.1381).

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## Environmental Flows in India

The consideration that certain environmental flows (e-flows) should remain in the river for maintaining aquatic ecosystems gave rise to research and development on e-flows assessments in India, which started about two decades ago. First e-flows were mostly prescribed as percentages of dry season flows. Later, researchers and practitioners not only used hydrological methods for e-flows determination but also methods incorporating habitat requirements of aquatic species. Efforts have been made to identify the flow related needs of native species such as Golden Mahseer or Gangetic Dolphin to suggest the e-flows allocation. Yet, data on flow-ecology relationships are still scarce. In the meantime, water resources management often suggests percentages of seasonal flows until better estimates are feasible.

The need to ensure adequate water flows for the environment is increasingly advocated at the political level. In 2012, the government of India recognized that *“water is essential for sustenance of ecosystems, and therefore, minimum ecological needs should be given due consideration”* (see National Water Policy). Also, the Ganga River Basin Management Plan (2011) and more recently, the Ganga Notification of 2016 underline the need to assess and release e-flows for ecological purposes.

Currently, a growing number of organizations and people are involved in research and development of e-flows assessment in India. Although the database of properties and requirements of aquatic ecosystems is poor, there are many efforts underway to collect integral data in order to enhance the understanding of flow-ecology relationships. Moreover, current assessment and implementation projects attempt to better involve stakeholders in their decisions through conferences, public hearings or other means such as social media.

## This International Workshop

As stated above, it is increasingly recognized that the goal of attaining healthy river ecosystems can best and most sustainably be reached by integrated environmental management.

India, the European Union through the India-EU Water Partnership (IEWP) as well as the Indo-German Cooperation with its project “Support to Ganga Rejuvenation” (SGR) endeavor to encourage and promote cooperation in the water sector, which brings together representatives of relevant stakeholders, such as governmental institutions, businesses and the civil society. Jointly, the partners seek to share the vast knowhow and experiences gained in Integrated River Basin Management initiatives and approaches in Europe and elsewhere, and to support their application in the Indian context. As one of the topics, challenges in terms of management of water quality and quantity in Indian river basins are being tackled and it is

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foreseen that successful implementation of optimum e-flows will contribute to successful issues river basin management. Currently, a guidance document on the “Assessment of Environmental Flows in India” is being developed as part of the IEWP Action Plan.

In order to advance the successful e-flows implementation in India, this workshop aims to bring Indian, European and international experiences together. A rich variety of cutting-edge topics and expert speakers from various backgrounds serve to promote challenges and solutions regarding e-flows assessment and implementation. A combination of engaging presentations and interactive discussion sessions will allow to drive forward e-flows science, state-of-the art knowledge and related implementation in India.

In particular, the workshop aims to assist in the e-flows implementation in India by helping to answer the following main questions:

1. What are the overall aims and targets for e-flows assessment in India?
2. What are the short- and long-term steps to implement e-flows according to the overall aims and targets (stated above)?

The outcomes and results of this workshop will be summarized and will feed into an update/the final version of the IEWP guidance document, which will be publicly available in early 2020.

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