

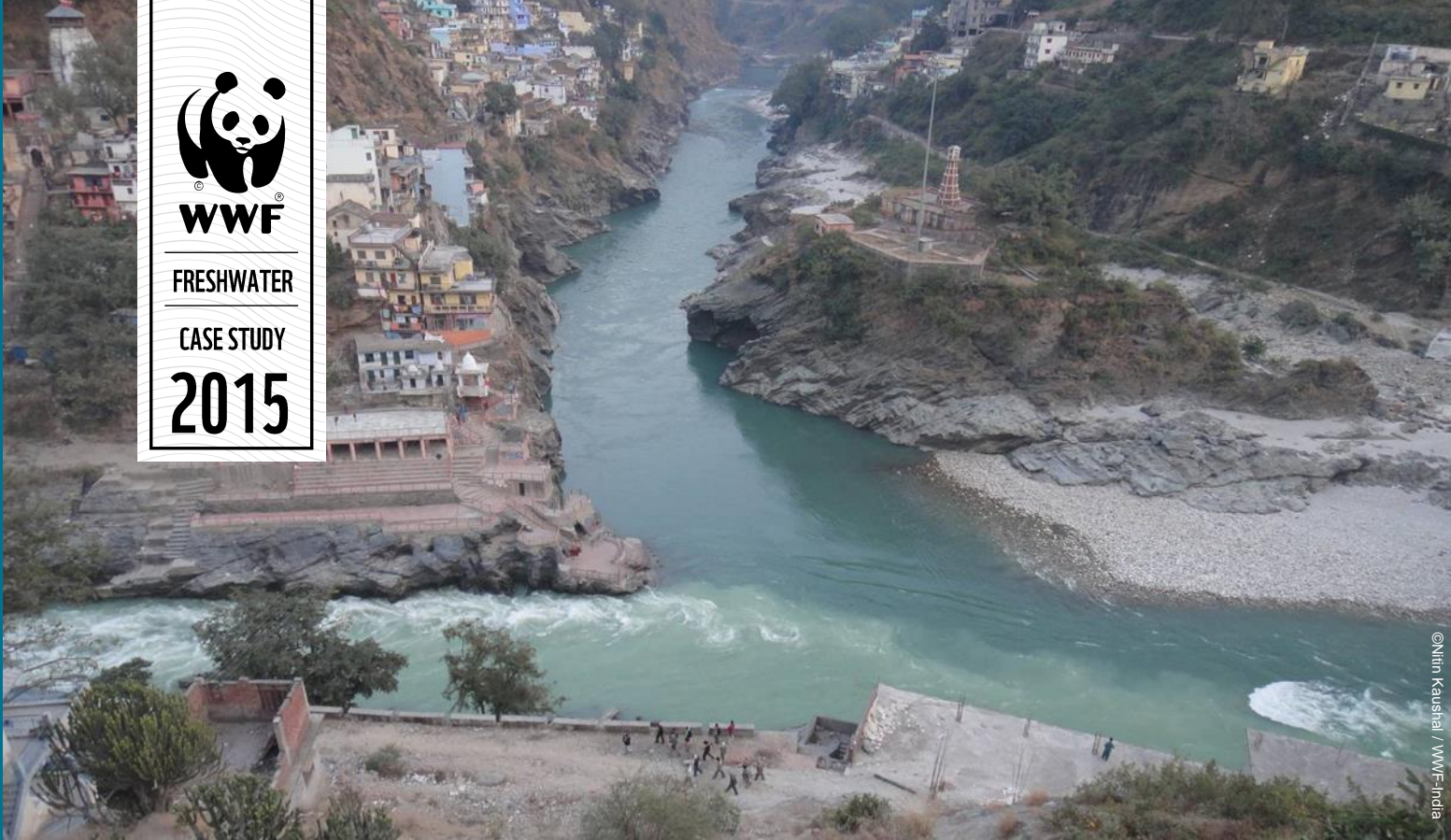


WWF

FRESHWATER

CASE STUDY

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KEEPING THE GANGA FLOWING

How an environmental flows assessment in the Upper Ganga Basin can be a stepping stone for basin-wide results

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Map of the Ganga river basin

Introduction

Understanding the environmental flow requirement of a river is the first step towards ensuring the equitable and sustainable use of water resources. This case study documents lessons learnt from work undertaken by WWF-India from 2009-2013 in an 800km stretch of the Ganga in northern India. The project modified the Building Block Methodology to consider the socio-cultural and economic functions of the river, as well as its importance for biodiversity.

WWF-India demonstrated that a holistic approach to environmental flow assessment is viable within the Indian context and can provide decision makers with tools needed to move towards basin wide assessment of environmental flows.

What did we do?

In 2008, WWF-India started examining methodologies to develop an appropriate approach to environmental flows assessment for large and complex rivers such as the Ganga. Environmental flows (e-flows) are defined as the quantity,

quality and timing of flows required for the maintenance of the ecological integrity of rivers, their associated ecosystems and the goods and services they provide to human society.

The project presented many challenges, ranging from the selection of a suitable methodology from the around 200 methodologies available globally, to the fact that a holistic methodology had never been used for doing an e-flows assessment of a river system as complex as Ganga, and the absence of local expertise to conduct an assessment. Adding to this complexity was the fact that this river is revered by millions of Indians: it is a holy river with strong social and cultural values and a deep emotional attachment, which needed to be accounted for in the e-flow assessment.

Sites within an 800km stretch of the Ganga from Gangotri to Kanpur were selected for a trial study. The study necessitated an integrated assessment of the aspects which were dependent on river flow – livelihood activities, cultural and spiritual activities, biodiversity - as well as the physical and biological aspects of the river.

How did we do it?

The underlying principle was that e-flows are multi-dimensional, and that their assessment is both a social and technical process, with social choices at its core. Social, as it depends on what society wants from a river – to support culture and spirituality or livelihoods or biodiversity or all the above functions and more. Technical, because it requires a range of specialist investigations into past, present, and desired future river functioning to provide the data that will inform and support these choices.

We based our approach on the [Building Block Methodology](#), the most frequently used of the “holistic methodologies” for environmental flow assessment.¹ It is considered to be the most comprehensive, accounting for the socio-cultural and economic functions of the river, as well as its importance for biodiversity. Its characteristics include:

- Bottom up: each element (including biodiversity, fluvial geomorphology, socio-cultural, livelihood and water quality) of the flow is carefully defined to sustain all the associated functions, processes and aspirations of the community.

¹For more information on other methods see: [Keeping Rivers Alive. A primer on environmental flows and their assessment](#). Part of WWF Water Security Series 2 Jay O’Keeffe, Tom Le Quesne 2009

- Multi-disciplinary teams: specialist groups addressing hydrology, hydraulics, fluvial geomorphology, water quality, biodiversity, livelihood and socio-cultural disciplines.
- Flexible: it can be tailored to suit local conditions.
- Rigorous and well documented, with a detailed user manual.

The choice was also driven by the methodology's flexibility, applicability and reliability under different levels of data and information availability.

The methodology was adapted to take account of the cultural and spiritual values of the Ganga, with the Socio-Cultural thematic group briefed to capture people's perspective of the river and their cultural aspirations. The group reviewed historical and mythological literature, and consulted with senior scholars engaged in such studies.

The process: step by step

STEP 1: ZONE THE RIVER

The team defined four homogenous zones to characterise the various stages of the river in its upper reaches. The zones were defined so that physical river features (such as geology, slope, climate, shape & size of channel, landuse) were more or less constant within each zone and therefore biodiversity and human activities were likely to be similar. The initial zonation of the 800 km upper Ganga was confined primarily to the mainstream and the floodplains of the river using a buffer of 50 km on each side of the main river to capture the critical activities in this area. Within each zone a representative site was identified for detailed investigations.

Zone 2 was identified as relatively unaffected by development and was therefore designated as a reference zone against which to assess the state of the other zones. For each representative site, reference or natural conditions were defined for the river's physical, chemical and ecological features.



Zone 2: Garhmukteshwar to Narora

STEP 2: SET THE DESIRED FUTURE CONDITION OF THE RIVER

Specialist groups were established for those river-based functions or activities with environmental flow needs – i.e. biodiversity, livelihood activities, social and cultural activities, and fluvial geomorphology. For example, many fish species require a certain depth and river velocity during spawning times and some religious activities require the river to be at a certain level. In addition, specialists groups for hydraulics,

Ritual and river flow

The water levels in the Ganga are of direct significance to many Hindu rituals. For example, the local community at Bithoor Ghat expects that the platform and footsteps of the temple of Brahma is inundated, interpreting this as a washing of Brahma's feet.

River levels are also relevant to bathing rituals (ideally water should be waist high) and to wash away ritual offerings and cremation remains.

hydrology and water quality conducted relevant surveys and assisted the other groups with defining environmental flow requirements.

Surveys to determine the current state of the river were undertaken at the representative sites in each zone, including biodiversity, water quality and flow, as well as cross-sectional surveys. Social surveys identified groups that are directly dependent on the river ecosystem and determined the river characteristics (e.g. depth, quality, velocity) that are important to each of these groups.

The seven thematic groups² identified the following river parameters necessary to achieve the “desired future condition” of the river in each zone. This was carried out for the driest month³ (January) and the wettest month (August).

- **Livelihood group:** defined depth, general requirements (related to physical appearance of water) and river width required to maintain certain livelihood activities such as ferrying or rafting.
- **Spiritual/cultural group:** defined river depth and water quality required for religious and cultural activities such as ritual bathing.
- **Biodiversity group:** defined habitat characteristics (such as river depth, velocity, width & substrate) required for important flow-dependent species such as the river dolphin, selected fish species, macro-invertebrates and floodplain vegetation.
- **Fluvial geomorphology group:** defined river velocities and depths required to move, sort and deposit different sizes of sediment, so as to maintain required geomorphic complexity and restore channel size and other important channel features such as multiple channels and bars.

STEP 3: DERIVE THE DESIRED FLOWS

The values required to meet the desired future condition for the four functions were summarised on a “flow motivation form.” This also explained the rationale behind the recommended values, as well as the consequences of not achieving them.

The hydraulics group then converted the recommended values into flows (using hydraulic relationships determined through cross-sectional surveys conducted at each site). This was done from the perspective of each of the four specialist groups. The water quality group then estimated the impact of the recommended flows on various water quality parameters.

² See page 40 of the [full report](#) for group composition

³ based on the review of long-term hydrological datasets

STEP 4: FINALISE ENVIRONMENTAL FLOW REQUIREMENTS

The specialist groups came together in an “e-flows setting workshop” to discuss the critical flows for maintenance (normal) and drought conditions which would satisfy the requirements of all groups - i.e. all of the key river functions & activities: livelihood activities, socio-cultural activities, fluvial geomorphology and biodiversity.

These critical flows (expressed as dry season and wet season flows) were then interpolated by the hydrologist group to derive flows for the remaining months of the year. Hydrological records⁴ were used to check whether the recommended flows were within the observed limits. Finally, the total flow volume required annually for maintenance (normal) and drought years were calculated and expressed as a percentage of mean annual runoff. This was the environmental flows requirement.

A detailed description and explanation of the methodology, as well as results of the assessment can be found in [Assessment of Environmental Flows for the Upper Ganga Basin](#).

Where next? From assessment to implementation

Restoring or maintaining environmental flows in the Ganga presents major challenges, as in many parts flows are already over-allocated. Implementation will therefore require either rationalising & re-allocating existing abstractions; reducing the water demand or the “water footprint” of existing uses; or the provision of additional storage to intercept monsoon flows for use during the dry season. These are costly and complex solutions with their own social and environmental costs.

The 2010 WWF report “[The implementation challenge](#)” identified three key obstacles to environmental flow implementation:

- Lack of political will and stakeholder support
- Insufficient resources and capacity
- Institutional barriers and conflicts of interest

WWF-India’s longer-term vision is to integrate e-flows in basin water allocations and e-flow releases a part of river basin plans. The conditions needed to achieve implementation of environmental flows rely on a revision of water allocation

⁴Note that the flow requirements established were based on observed hydrological data. Observed data was only available for a few years and not as a time series— however, together with publically available global data sets, they were sufficient to produce simulated hydrological data. These simulated data could be refined with the availability of more credible data over a longer time period.

Target audiences e-flows training

Government agencies who evaluate, design and implement water resources development projects and investment programmes;

State and district level water resources management agencies, e.g. the Department of Irrigation, dam/barrage operation agencies, etc;

Conservation groups in India who seek to establish environmentally sustainable water resources planning and management practices, and

Farmers, fishermen and members of other riparian communities that may be affected by water management decisions within the river basin

policies. Given the complexity of the issue, there is a need to demonstrate the costs and benefits of environmental flows through their successful implementation in a smaller basin.

We have therefore embarked on work to demonstrate e-flows in the Ramganga, a tributary of the Ganga. The work on the Ramganga will involve work with water users to develop institutional and technical solutions to conserve water use, as well as an e-flow assessment for the tributary, which will involve the development of a framework to address trade-offs and thereafter the implementation of environmental flows. It will be important to ensure that decisions over the implementation of e-flows are not only based on short-term economic criteria, but also on societal values.

Application of the methodology

A NATIONWIDE ASSESSMENT PROGRAMME

To achieve our long term vision, a process to assess the e-flow requirement of all the rivers in the country is needed. We will therefore embark on a programme to build the national capacity of various stakeholders across priority basins on e-flows, aiming to integrate e-flows into the management plans of these basins.

GANGA RIVER BASIN MANAGEMENT PLAN

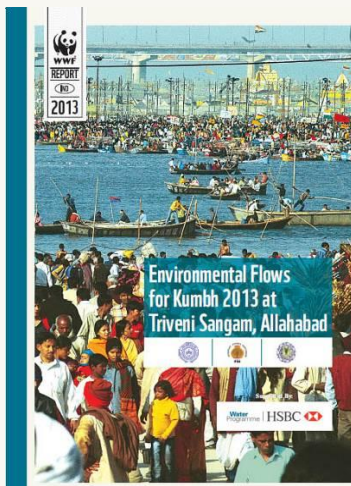
WWF-India is also involved in e-flows work for the Ganga. In 2010, one of our main e-flows partners, the Indian Institute of Technology in Kanpur (IIT-Kanpur) was selected by the National Ganga River Basin Authority to lead a consortium of IITs to prepare the Ganga River Basin Management Plan (GRBMP). This includes the application of environmental flows assessment and the consortium has adapted our methodology for application to the entire Ganga basin. WWF-India is leading the working group on e-flows.

KUMBH MELA

In the run up to the 2013 Kumbh Mela WWF-India applied the methodology to the Kumbh Mela pilgrimage to advocate for adequate release of flows in the Ganga and to build consensus on environmental flows among stakeholders. There was already a High Court order to release 'adequate' flows in the Ganga during Kumbh. WWF-India's study brought more science to the discourse and helped define 'adequate' flows using BBM. A multi-disciplinary team of well respected scientists, cultural leaders and civil society groups added credibility to this exercise. The work involved advocacy meetings with relevant state and central government departments to ensure the

Kumbh Mela

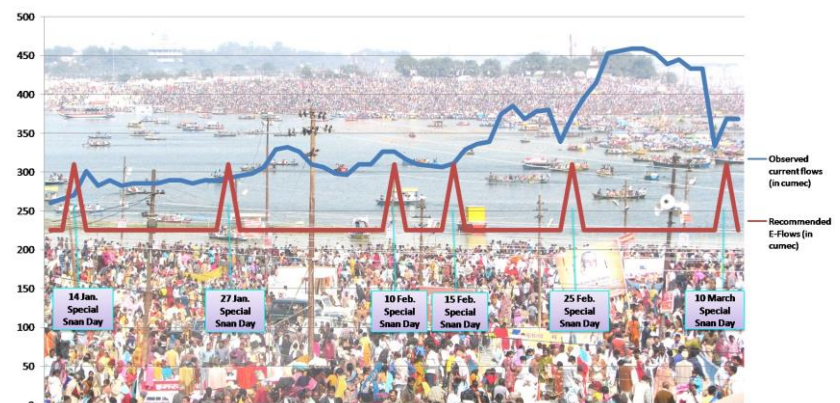
The Kumbh Mela is a triennial mass pilgrimage in which people gather to bathe in a sacred river. The Kumbh Mela 2013 took place in Allahabad on the banks of the Ganga, over 55 days between January and March and attracted an estimated 80-100 million pilgrims.



(Click image to download report)

recommended environmental flows were implemented during the pilgrimage festival.

WWF-India also monitored flows during the entire Kumbh and compared these with the recommended environmental flows. The results showed that for over 90% of the Kumbh's duration the actual flows met the desired flow levels, although water quality objectives were not met. This assessment was completed in 3 months time as compared to the three years spent on Upper Ganga Environmental flows assessment.



Environmental Flows in Ganga at Triveni Sangam, Allahabad: Observed Actual Flows vs Recommended E-Flows (12 January 2013 to 11 March 2013)

What have we achieved?

This initiative was the first attempt to adapt a holistic methodology for the field-based assessment of environmental flows for an Indian river and execute an assessment. Even if implementation is a long way off, the actual completion of this exercise is significant within the context of Indian water policy and politics.

Since its launch, the [report](#) has been referred to by various government and non-governmental organisations and is influencing environmental flows practice.

- The government of India, through the Inter-Ministerial Group for the Ganga has referred to our work along with two other e-flows studies conducted by leading organisations of national repute, such as Indian Institute of Technology (Kanpur).
- The methodology is now applied to the whole Ganga through the Ganga River Basin Management Plan. The Ganga Inter-Ministerial Group has already pointed out that the IIT's consortia report should be the next point of dialogue with respect to e-flows for the Ganga.
- The work on the 2013 Kumbh helped to raise awareness and create debate in policy circles around e-flows.

- The work has also contributed hugely to the building of capacity and awareness amongst Indian experts. The fact that our e-flows partner IIT Kanpur was selected to prepare the Ganga River Basin Management Plan is testament to this.

Finally, the work has also strengthened knowledge and capacity within WWF-India. For example, the assessment for the 2013 Kumbh was only possible because of the confidence derived from the Upper Ganga work.

What helped to ensure our success?

- **Access to technical expertise.** WWF network support helped to engage UNESCO-IHE (Delft, Netherlands) and IWMI (Sri Lanka) as facilitators of the process. This proved highly beneficial, ensuring successful design and implementation of the assessment.
- **Credible partners.** The composition of the multidisciplinary, multi-stakeholder team established to carry out the e-flows assessment was critical. Partnerships at the state, national and international level brought together different knowledge sets and perspectives which helped shape the holistic approach to the e-flows assessment. The credibility and influence of national partners (for example, IIT-Kanpur, People's Science Institute Dehradun and individual experts) was significant in helping us to mainstream e-flows thinking into the water sector debate in India.
- **Long term commitment** of time, funding and network support allowed WWF-India and its partners to lead the assessment from start to finish over three years
- **Wide stakeholder engagement.** Given the spiritual importance of the Ganga, the adaptation of the Building Block Methodology include socio-cultural aspects was important in gaining greater acceptability of the project by stakeholders from civil society, environment groups and the Ministry of Environment and Forests.
- **Active dissemination.** We put a significant effort into disseminating the assessment, particularly to the government ministries, state governments and multilateral funding organisations. This has proved important in sensitising these groups to the importance of e-flows and gaining buy-in for further studies and implementation.

The hard lesson: How much data is enough?

The confidence level in the methodology itself was high, with the final recommendations firmly based on scientific reasoning and a consultative process. The confidence level in the results was less, and could be improved had more reliable hydrological data been available. For example, better river and floodplain cross-sections, including additional sites and extension of cross section surveys, would have significantly enhanced the ability of the biodiversity, livelihood and socio-cultural groups to link their requirements to specific features of the river channel at the study sites. A more detailed knowledge of the hydraulic habitat requirements of different biotic communities could have improved the recommendations of the biodiversity group.

However, we think it is important not to shy away from the uncertainties, the lack of data and the incompleteness that are an inevitable consequence of ground-breaking work. The assessment of e-flows is an evolving process, with the levels of confidence continually being improved as new data emerges. Data limitations should not stop the process of implementation going forward.

Resources

[Assessment of Environmental Flows for the Upper Ganga Basin](#)
Jay O'Keeffe, Nitin Kaushal, Luna Bharati, Vladimir Smakhtin,
2012

WWF 2010: [The Implementation Challenge](#)

WWF-India 2013: [Environmental Flows for Kumbh 2013 at Triveni Sangam, Allahabad](#)

[UNESCO-IHE](#)

[IWMI](#)

FOR MORE INFORMATION

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