WWF

POLICY BRIEF 4

IND

2017

THIS BRIEF HAS BEEN PRODUCED IN COLLABORATION WITH:

Valuation of flow regimes for implementing environmental flows:

The case of the upper Ganges

River health is suffering due to extensive human interference, especially because of flow diversion to meet agricultural needs. Can we restore the basin health by ensuring the environmental flows without compromising with farm incomes? Valuation of flow regimes provides the answer to how demand management can help in ensuring environmental flows and in enhancing farm incomes simultaneously.

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INTRODUCTION

The challenge of water resource management and governance has grown complex over time: the challenge to satisfy human economic needs without compromising with the integrity of the ecosystem so as to sustain the ecosystem functions and services in the long run looms large. In this context, environmental flows eventually emerged as an important cornerstone of Integrated River Basin Governance (IRBG).

Almost in line with the popular Brisbane convention definition, the Indian Institute of Technologies' (IIT) consortium defines environmental flows... as "a regime of flow in a river or stream that describes the temporal and spatial variation in quantity and quality of water required for freshwater as well as estuarine systems to perform their natural ecological functions (including sediment transport) and support the spiritual, cultural and livelihood activities that depend on these ecosystems".

WWF-India, jointly with International Water Management Institute (IWMI), IIT Kanpur, and with Institute of Rural Management Anand (IRMA) in the consortium, as part of the broader research programme on Water, Land, and Ecosystems of the Consultative Group on International Agricultural Research (CGIAR), designed a research study to understand the benefits offered by a regime of flows including environmental flows (or e-flows), in order to create the implementation framework for e-flows in the upper Ganges. Valuation of the ecosystem services (benefits offered by the ecosystem to human community) associated with each flow regime is being proposed and construed as offering an objective instrument for analysis in this context.

CONCEPTUAL FRAMEWORK

FIG. 1

The conceptual framework of e-flows implementation can be understood from the following diagram (Fig. 1).

The idea presented in the flow chart is as follows:
• Various flow regimes are associated with various services provided by the ecosystem,
• Changes in flow regimes might entail changes in ecosystem structure, function and services as also the target groups who receive the services.
• Monetary valuation of flow regimes is proposed to evaluate the importance of current flow regime and understand the trade-offs as we move from one flow regime to another.
• This will help in allocation of water across sectors, and create a framework for E-Flows implementation.
The last arrow from “Recommendations to implement E-Flows” to “flow regime” is essentially the feedback loop on the appropriateness of the flow regime.

THE STUDY SITE

The primary survey was conducted at upper Ganga canal (UGC) and lower Ganga canal (LGC) .i.e Bhimgoda Barrage and Narora Barrage. The districts of Muzaffarnagar, Meerut, Ghaziabad, Bulandshehar, Gautambudh Nagar, Aligarh, Hathras, Mathura, Agra, Etawah, Firozabad, Kanpur Dehat, Kanpur Shahar, Mainpuri, Fatehpur, Kannauj, Farrukhabad, Kausambhi, Auriya, and Etah in Uttar Pradesh, and that of Haridwar in Uttarakhand were considered for the study. A map depicting the locations is given as Fig. 2.

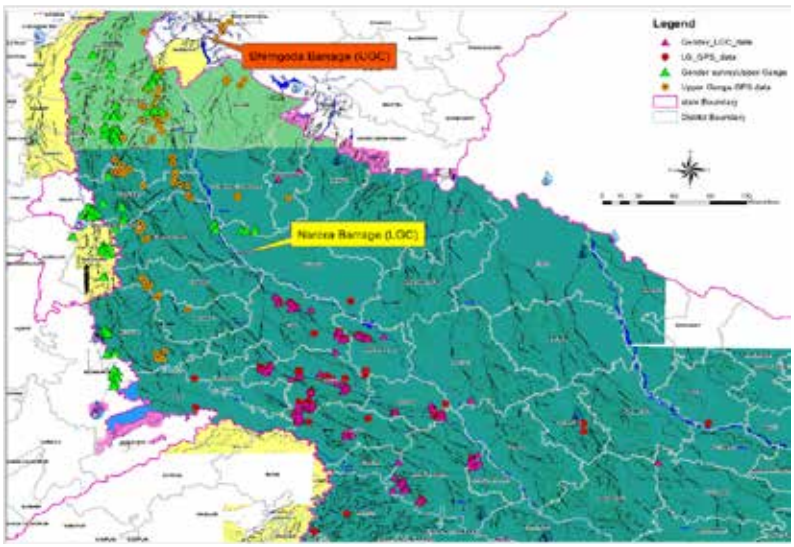
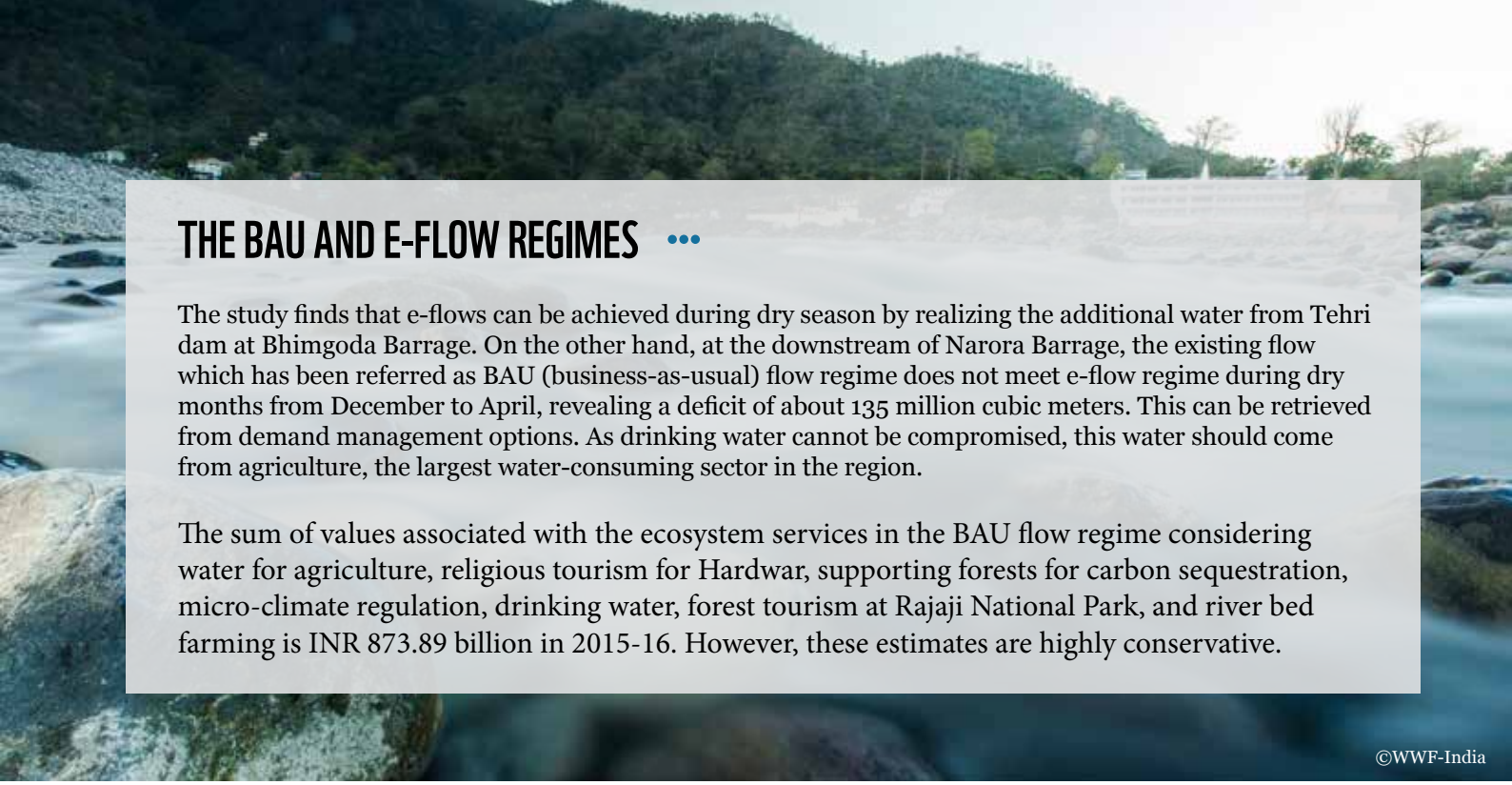


FIG. 2



THE BAU AND E-FLOW REGIMES

The study finds that e-flows can be achieved during dry season by realizing the additional water from Tehri dam at Bhimgoda Barrage. On the other hand, at the downstream of Narora Barrage, the existing flow which has been referred as BAU (business-as-usual) flow regime does not meet e-flow regime during dry months from December to April, revealing a deficit of about 135 million cubic meters. This can be retrieved from demand management options. As drinking water cannot be compromised, this water should come from agriculture, the largest water-consuming sector in the region.

The sum of values associated with the ecosystem services in the BAU flow regime considering water for agriculture, religious tourism for Hardwar, supporting forests for carbon sequestration, micro-climate regulation, drinking water, forest tourism at Rajaji National Park, and river bed farming is INR 873.89 billion in 2015-16. However, these estimates are highly conservative.

DEMAND-ORIENTED APPROACHES TOWARDS ACHIEVING E-FLOWS

Enhancing water-use-efficiency (WUE): It is a mechanism that results in lower water consumption without compromising with crop production by changing the management of plants, soil, water and nutrients (e.g. System of Rice Intensification or SRI). Table 1 presents 4 different WUE scenarios, based on stakeholder consultation.

TABLE 1

A	Water-use-efficiency enhanced by 1% and 1% increase in yield
B	Water-use-efficiency enhanced by 0.5% and 1% increase in yield
C	Water-use-efficiency enhanced by 5% and 10% increase in yield
D	Water-use-efficiency enhanced by 2% and 5% increase in yield

Crop diversification: The other way to release water in-stream during dry months is to shift from high water consuming crops to drier crops. Sorghum has been taken as a substitute for wheat during the dry months, as that can be promoted as a staple crop. Table 2 gives 7 different scenarios of crop diversification, based on stakeholder consultation.

TABLE 2

E	1% decline in area of wheat
F	2% decline in area of wheat and taken by Sorghum
G	5% decline in area of wheat and taken by Sorghum
H	6% decline in area of wheat and taken by Sorghum
I	20% decline in area of wheat and taken by sorghum
J	15% decline in area of wheat and taken by sorghum
K	12.5% decline in area of wheat and taken by sorghum

THE RESULTS OF THE SCENARIO ANALYSIS: UNDERSTANDING THE TRADE-OFFS

The study reveals that the best scenario emerges from scenario B (water-use-efficiency increases by 0.5%, and yield increases by 1%) that reveals the highest value of the flow regime, the highest value for the farmers, while meeting the E-Flows requirements. E-flows can be secured even with incremental improvement (farmers on average gain +1% of WUE and yield) in a win-win situation for farmers, when WUE and yields increase by 10%.

On the other hand, in the crop-diversification cases, when 5% of wheat acreage is converted into sorghum (which has 1/8ththe water need of rice), enough water is saved for e-flows and farmers' gains are still positive but scenario F (2% decline in area of wheat and taken by Sorghum) turns out to be the best option that give the highest value of the ecosystem services, highest increase in farm incomes, while E-flows requirements are met.

In all the scenarios H-K that entail 6-20% of the area converted to sorghum from wheat the farm income has declined, thereby implying the role of diminishing marginal product of area and water and the negative coordinates for sorghum production at the given level of area and water under the crop.
Therefore, by having "water-use-efficiency enhanced by 0.5% and 1% increase in yield" combined with "2% decline in area of wheat and taken by Sorghum", the best possible situation can be arrived at through attainment of E-Flows regime and high increase in farmers' value.

POLICY IMPLICATIONS

1. Through combination of approaches, it is possible to restore the e-flows in the Ganga. Eco system services value merely for one year is INR 873.89 billion compared to the entire investment for the National Mission for Clean Ganga (also called Namami Ganga) project which is INR 200 billion for five years. The proposed investment is justified not only by the benefit it yields, but more investment will be needed in years to come to maintain or augment the ecosystem services.

2. E-flows can be attained by diverting water from agriculture without sacrificing farmers' interest through crop-diversification and water-use-efficiency.

3. A new replicable framework for e-flows implementation is created by this study, enabled by economic valuation of ecosystem services across various flow regimes. This can guide future decisions on river basin governance.

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