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Stakeholder Consultation: Identification of measures for adequate E-Flows in Ramganga River Basin



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Responsible

Laura Sustersic
Support to Ganga Rejuvenation (SGR) B-5/1,
Safdarjung Enclave New Delhi 110029,
India
Phone +91 49495353
Fax +91 49495391
Laura.Sustersic@giz.de www.giz.de/India
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Coordinators/Editors

Laura Sustersic, Chhavi Sharda, Jyoti Nale

Authors

Gosain Ashvin, McClain Michael, Nale Jyoti, Parasiewicz Piotr, Sharda Chhavi

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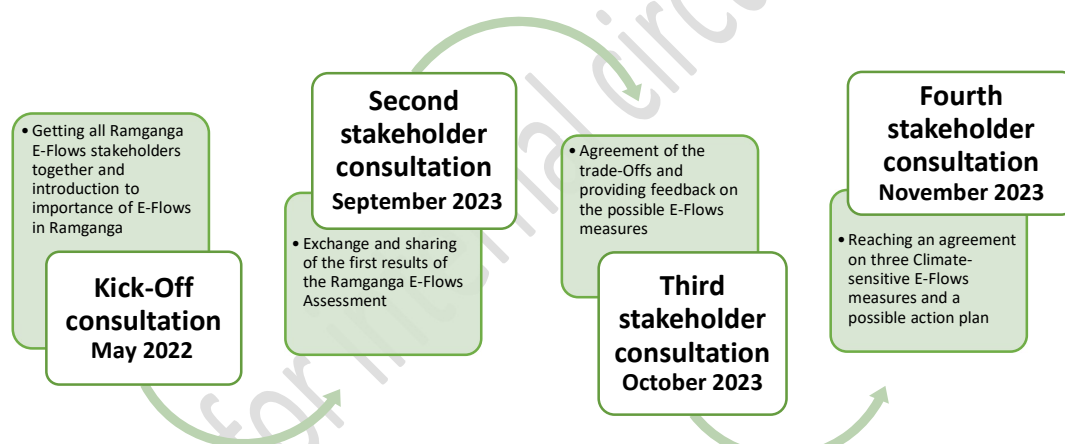
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Executive Summary

The National Mission for Clean Ganga (NMCG) has undertaken the process of environmental flows (E-Flows) assessment in the Ramganga River Basin to achieve NMCG's mandate to maintain minimum ecological flows in the river Ganga and its tributaries with the aim of ensuring water quality and environmentally sustainable development. The assessment was carried out in consultation with basin stakeholders and implemented by GIZ India through the Indo-German Technical Cooperation Project Support to Ganga Rejuvenation-II (SGR II) in conjunction with the India-EU Water Partnership (IEWP) Action Phase 2 together with Central Water Commission (CWC), and other relevant partners. This effort builds from the NMCG's Ganga E-Flows Notification of 2018 (amended in Sept 2019), which is among the pioneer E-Flows implementation actions in the country, and aimed to bring Indian, European and other international experiences together to exchange and blend knowledge on E-Flows in order to advance successful E-Flows implementation in India.

It was also decided to further strengthen the results of the E-Flows assessment through a stakeholder consultation process. In total, a series of four major consultations and three more targeted discussions were held. Key stakeholders included NMCG, CWC-UGBO, Central Inland Fisheries Research Institute (CIFRI), Wildlife Institute of India (WII), World-Wide Fund for Nature (WWF), India, Irrigation Departments from Uttar Pradesh and Uttarakhand, and a number of other governmental and non-governmental organizations with stakes in the Ramganga Basin. The aim of each of the four wider stakeholder consultation is elaborated in the below table.



The consultations succeeded in engaging with and informing many of the key national and basin institutional stakeholders about the project and its relationship to NMCG and other partners. Many technical aspects of the E-Flows assessment and scenario development were discussed and clarified with the stakeholders, and inputs were incorporated into the further technical developments. Several potential measures to facilitate implementation of E-Flows were deliberated, and from the feasible alternatives, the following key priority measures were identified and agreed upon: (1) modification of cropping patterns, (2) improvement of irrigation efficiency, (3) wastewater reutilization, and (4) dynamic E-Flow. During the consultations, how these measures can support in implementing E-Flows by reducing the pressure of freshwater abstractions was also presented with some representative seasonal trade-offs assessments and briefly discussed.

These measures are integrated into the wider management of water resources in the Ramganga River Basin and to some extent detailed in the Ramganga River Basin Management Plan. Next steps and timelines for implementation will be determined by NMCG in cooperation with basin stakeholders and in conjunction with the next phase of the India-EU Water Partnership.

Introduction

Background

The process of Environmental Flows (E-Flows) assessment in the Ramganga River Basin and simultaneous stakeholder consultations with basin stakeholders is carried out by the National Mission for Clean Ganga (NMCG) with support from GIZ India through the Indo-German Technical Cooperation Project Support to Ganga Rejuvenation-II (SGR II) in conjunction with the India-EU Water Partnership (IEWP) Action Phase 2 together with Central Water Commission (CWC), and other relevant partners. The comprehensive stakeholder consultation process was targeted to identify three climate-sensitive improvement measures to ensure adequate E-Flows in the Ramganga River Basin with key basin stakeholders. The consultation process was aligned with the Ramganga Basin E-Flows assessments (which follows the IEWP E-Flows Guidance Document (2020) for E-Flows assessment methodology).

E-Flows Background

River flows of a certain quantity, timing duration and quality are needed to maintain the healthy and functioning riverine ecosystems inclusive of all their related components (river, floodplain, groundwater). These flows are referred to as Environmental Flows (E-Flows). In India, E-Flows in the riverine and connected ecosystems are increasingly being advocated at the political level. The Government of India recognizes in its National Water Policy (2012), that “environmental needs of aquatic ecosystem, wetlands and embanked floodplains need to be recognized and taken into consideration while planning”. An environmental management plan is an integral part of any water resources development project in a country. Accordingly, there have been few efforts to assess the E-Flows in terms of flow related needs of the riverine and associated ecosystems. In addition, socio-economic and cultural aspects associated with river flows also get some attention, though not significant. Efforts are also being made at the government level to implement these E-Flows. The National Green Tribunal (NGT) has specified that for all rivers in the country a minimum 15 % to 20% of the average lean season flow of that river shall be maintained. Most significant E-Flows assessment and implementation actions so far have been undertaken in the river basin of national importance i. e. Ganga River Basin. National Mission for Clean Ganga (NMCG) is responsible for ensuring these activities. NMCG’s Ganga E-Flows Notification of 2018 (amended in Sept 2019) is among the pioneer E-Flows implementation actions in the country. It demands and specifies the continuous release and monitoring of E-Flows in the upper stretch of the main Ganga River (up to Kanpur) based on the findings of the study carried out by the Central Water Commission (CWC) India. While these efforts are significant and the current policy/ practices duly emphasize the assessment and provision of E-Flows in rivers, it remains challenging to assess the E-Flows at basin wide scale and to implement them successfully. The project under its components SGR II and IEWP Action, Phase II has been strongly supporting NMCG and CWC towards improved assessment and implementation of E-Flows in India. Under the first phase of IEWP Action component, the *Guidance Document for E-Flows Assessment and Implementation in India* was developed. The Guidance Document aims to help the Indian stakeholders to understand the science and administration of E-Flows using most appropriate methodology/methodologies. During 21-22 October 2019, an international workshop on ‘Environmental Flow Assessment and Implementation for India’ was organized under the project in cooperation with NMCG, CWC and others. It aimed to bring Indian, European and other international experiences together to exchange and blend knowledge on E-Flows in order to advance successful E-Flows implementation in India. Learnings from these activities highlight that one of the key challenges in the process of successful implementation of E-Flows in India is successful involvement

and agreement of the stakeholders on various aspects of E-Flows. Against this background, NMCG in cooperation with GIZ India envisaged a comprehensive process of E-Flows assessment in parallel with a stakeholder involvement process towards ensuring that assessed E-Flows can be better implemented by the decision makers. For this, Ramganga Basin (which is also a sub-basin of Ganga River Basin) was selected. An **E-Flows assessment in the Ramganga Basin is carried out** based on the IEWP Guidance Document 2020. The guidance supports the improvement in E-Flows Assessment process and methodology in India. The **results of the assessment are taken forward to a stakeholder consultation process with an objective to identify (three) climate sensitive measures towards ensuring E-Flows in the Ramganga Basin together with the basin stakeholders.**

For identification of climate-sensitive improvement measures that ensure adequate E-Flows in the Ramganga River Basin, an inclusive stakeholder consultation process was held.

With support from the international E-Flows experts, **the technical E-Flows assessment process for the Ramganga River Basin** was carried out. The results of the assessment were processed forward, communicated for **steering to identify and agree on climate-sensitive improvement measures.** This was done via a comprehensive and inclusive stakeholder consultation process where key-stakeholder meetings and wider stakeholder consultations were held for Ramganga stakeholders.

Stakeholder consultation process: Aims and Strategy

The stakeholder consultation strategy considered that the consultation process will be as inclusive and participatory as possible. The exchanges and discussions were held with the National Mission for Clean Ganga (NMCG) in a steering role for the overall consultation process together with GIZ and other key partners (e.g. CWC). The NMCG together with GIZ (including the E-Flows team of experts from EU) acted as a neutral facilitator throughout the process which was aimed to encourage Ramganga stakeholders to actively provide their inputs with an effort to eliminate perceptions of bias, asymmetries of power, entrenched positions or conflicts that arise around diverging viewpoints, such as priorities for use among major water users.

In total, a series of four major consultations were planned as part of the strategy. The consultations were timed to coincide with the milestone stages of the Ramganga E-Flows assessment. Stakeholder values and perspectives, shared experiences, critical review and feedback, and key decisions on next steps have been seen of particular importance while detailing the agenda and programme of each of these wider stakeholder consultations. In addition to these consultations, smaller, more targeted key-stakeholder discussions with particular stakeholder group(s) were also held to address specific issues or concerns, including the assessments of future scenarios, measures and trade-offs.

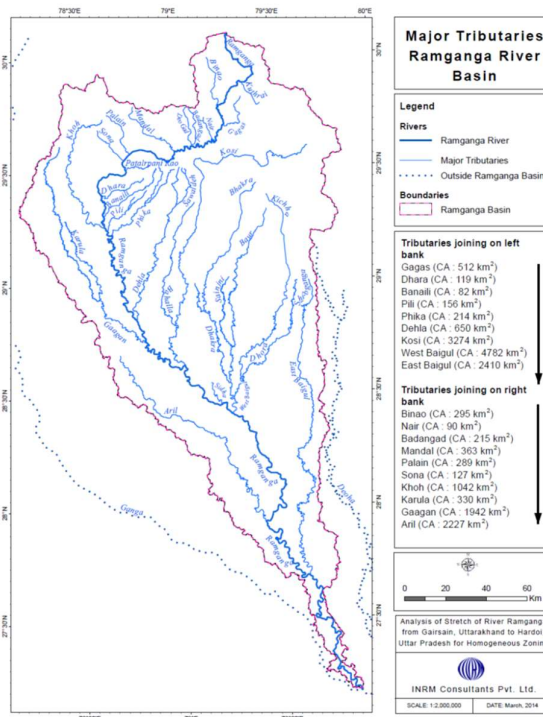
Overall, the consultation process was aimed to:

- Exchange, cooperate and contribute to the joint E-Flows assessment in the Ramganga Basin to process and take up the results of the E-Flows assessments into E-Flows scenarios for agreement within the consultation process along with their associated trade-offs.
- Achieve agreement with the key stakeholders on three climate sensitive improvement measures to ensure adequate E-Flows in the Ramganga Basin.

Ramganga River Basin

Ramganga is the first tributary of river Ganga which meets Ganga at Kannauj, Uttar Pradesh. The river originates in lower Himalaya in Uttarakhand and passes through major towns of western Uttar Pradesh during its course of 600 kms. Several small tributaries such as Khoh, Gangan, Aril, Kosi and Gorra also meet main stem of Ramganga at different locations. The Ramganga Basin has a catchment area of more than 30,000 km², with an approximate population of 18 million people. The major sources of pollution in the Ramganga river are industrial and municipal wastewaters. The river also houses one major dam at Kalagarh and is integral part of various economic activities in the basin. As per Uttar Pradesh Pollution Control Board's (UP PCB) Ramganga restoration plan, a total of 445,000 m³ per day

wastewater from 121 major industries and several cities enter the Ramganga river on daily basis, making its 375 km stretch from Moradabad to Kannauj critically polluted.



The Ramganga Basin is immensely important for biodiversity, both nationally and internationally. The basin division into two biogeographic zones, the Himalaya zone and the Upper Gangetic Plain, is influential in this regard. Numerous species of flora and fauna (both freshwater and terrestrial) of high conservation value, including the Royal Bengal tiger, elephant, Gangetic dolphin and golden mahseer occur in the basin, and it also supports important migratory birds. Around 22 % of the basin is designated as Forest Area, with a further approx. 2000 sq. km. constituting other different types of protected areas.

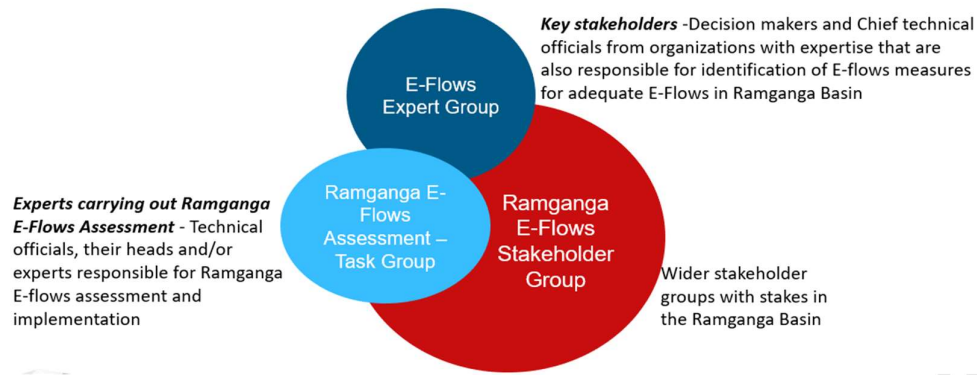
Various inland waters and wetland systems make up a basin total of around 1200 sq. km, including the river network (Figure 1) of the Ramganga, oxbow lakes, swamps and other wetlands, as well as manmade reservoirs. While many reaches of the Ramganga River

Figure 1 Key Drainage Features of Ramganga River Basin.

system are measurably modified from natural by human uses and water resources development, several reaches and tributaries, including key refuges for the future under a changing climate, remain ecologically functional and healthy. Such reaches are critical for ecosystem services for local communities, particularly in terms of food fisheries and flood-driven subsistence agriculture, as well as for cultural purposes.

Ramganga Stakeholders

The figure below schematically depicts the three levels of stakeholder groups engaged as part of the E-Flows stakeholder consultation process for the Ramganga.



As the role of neutral facilitators throughout the consultation process was to encourage stakeholders to actively provide their inputs as well as to help steer such that information-based agreements are achieved even with diverging priorities. Here, the involvement of decision makers/ chief technical officials from organisations with expertise i.e. key-stakeholders was needed. In case of the Ramganga River Basin – NMCG, CWC-UGBO, Irrigation Department from both basin states formed the **E-Flows Expert Group**. Further, role of the expert group in the Ramganga Basin was supported by other E-Flows experts that formed the E-Flows Assessment Team/Group. The Ramganga E-Flows Assessment Group under with EU experts, experts from GIZ, CIFRI, WII and others carried out the carried out the E-Flow assessment study under the directions of the Expert Group.

On the other hand, other stakeholders from the Ramganga River Basin with their stakes were involved for consultations to achieve an agreement of the climate-sensitive E-Flows improvement measures in the Ramganga Basin. When these stakeholders were engaged, they formed the complete Ramganga E-Flows stakeholder group.

Stakeholders Consultation Process

The section below elaborates the objectives of the four wider stakeholder consultations:

- Kick-Off consultation (May 2022)
- Second stakeholder consultation (September 2023)
- Third stakeholder consultation (October 2023)
- Fourth stakeholder consultation (November 2023)

1 Kick-Off consultation

A kick-off consultation meeting was held on 20 May 2022 in New Delhi, to initiate the process towards the determination of E-Flows in the Ramganga Basin. It brought together representatives from national and state-level stakeholders from the Ramganga Basin. A common understanding was achieved regarding the overall consultation process, and its structure and interlinkages with the E-Flows assessment for the Ramganga River system. First insights into the vision and objectives towards E-Flows measures were shared, which have been used to draft a proposed vision statement and objectives. Inputs were received from participating stakeholders regarding additional basin stakeholders that further should be included in the process of E-Flows assessment and the identification of measures.

A. Aims and objectives

The objectives of the First Consultation were to:

- Bring all relevant stakeholders on board and develop a common understanding of the importance of E-Flows and their assessment, particularly in water resource planning and management in the Ramganga Basin.
- Understand the expectations of different stakeholders and agree on the vision and objectives towards the E-Flows assessment and identification of measures to ensure adequate E-Flows, with a particular focus on national and state-level stakeholders.
- Establish and agree on the overall stakeholder consultation process, its structure and mechanism for steering.

B. Contents

This initial consultation started the consultative process towards the identification of E-Flows measures for the Ramganga Basin and created a common platform for convening the representatives of all national and state-level stakeholder groups. It aimed towards a consolidated understanding among stakeholders of the overall consultation process, its structure and steering. Additionally, a vision and objectives towards E-Flows measures were discussed. Further inputs were sought on any additional basin stakeholders to be included in the consultation process towards the measures identification.

C. Summary of outcomes

The kick-off consultation succeeded in engaging with and informing many of the key national and basin institutional stakeholders about the project and its relationship to NMCG and other partners. It was informed that it is only the start of what is anticipated to be a participatory stakeholder consultation process, with milestone consultations that will align with the main stages identified for the E-Flows assessment and shall lead towards measures to ensure adequate E-Flows in the Ramganga River system.

2 Second Ramganga E-Flows stakeholder consultation

After the kick-off consultation the E-Flows assessments for the Ramganga River Basin was initiated. The CWC, NMCG and partners such as CIFRI and WII participated in the data collection field visits from six representative sites along the Ramganga River Basin. The data collected was used by the EU expert teams for simulations and E-Flows assessment. These results were also discussed with partners and the E-Flows assessment Group. This was then followed by the second stakeholder consultation which took place in hybrid mode on 18 August 2023 with a group of officials in the NMCG offices and other stakeholders and experts joining online.

A. Aims and objectives

The aims and objectives of the second stakeholder consultation were to:

- Recap the discussions on expectations of different stakeholders and their stakes (institutional mandates and individual roles and responsibilities) pertaining to E-Flows.
- Refresh the established common understanding on the key characteristics of the Ramganga basin, including the hydrological and ecological conditions as well as the critical E-Flows Reaches, basin vision statement and specific objectives for E-Flows assessment.

- Share the first results from the Habitat-Modelling and discuss the next steps by capturing the stakeholder views towards identification of potential measures and possible scenarios to be developed for further clarifications.

Contents

The consultation began with welcoming remarks from both the ED-Technical of NMCG including the presentation of objectives for the Second consultation meeting. The first cut results of the joint E-Flows assessment for the Ramganga Basin were presented and understood by participating stakeholders. There were queries that were addressed and responded to by a team of experts (EU expert consulting GIZ). Next, they introduced a range of potential measures to support E-Flows implementation in the Ramganga and carried out an interactive discussion with stakeholders to learn what, in stakeholder's opinions, are the critical areas that required to be addressed and what further scenarios need to be developed to bring clarity to identify appropriate measures? The consultation ended with a vote of thanks from NMCG and GIZ and reference to the future engagement in this regard.

B. Summary of outcomes

Many technical aspects of the E-Flows assessment and scenario development were discussed and clarified with the stakeholders, and assurance was given that their inputs will be incorporated into further technical developments. In addition, several agreements were made.

It was agreed that the six identified data collection sites represent six distinct cluster zones (determined by the homogeneity of six bio-geographical parameters). Together, these six cluster zones (macrohabitat types) encompass the entirety of the Ramganga River Basin.

It was agreed that despite the feasibility of understanding, the E-Flows recommendation will not be based on water level units; rather, it will be based on water discharge units. This choice is grounded in the stability of water discharge as a reliable indicator of morphological characteristics and the riverine ecosystem health. It was also agreed to document the predominantly found fish, plankton, and benthos across various stretches of the Ramganga River.

Regarding the plausible climate-sensitive measures, there was a discussion about enhancing water use efficiency being an effective approach. This is because it has already been successfully implemented by using trend-based irrigation instead of flood irrigation for sugarcane cultivation. Moreover, the wastewater produced by the sugarcane industry can undergo treatment and subsequently be utilized to enhance water efficiency. Wetland rejuvenation was also judged to be a plausible measure. This is supported by prior research conducted by IIT Kanpur. The discussion explored the possibility of categorizing the plausible measures into short-term and long-term strategies. While the array of short-term options is relatively limited, enhancing water efficiency through revisiting water allocation quotas emerged as a viable approach in this category.

Finally, it was agreed that the feedback will be incorporated and the discussions to identify the three priority measures will continue during the third Ramganga E-Flows stakeholder consultation with the basin stakeholders. The updated summary of the consultation process and the E-Flows Assessment Report was shared before the next consultation that was held in September 2023.

Intermediate Key stakeholder meetings

In preparation for the third stakeholder consultation, more focused virtual meetings were held with stakeholders connected with particular measures. In each of these meetings the technical team

presented preliminary work done to investigate the impact on river flow of implementing the focal measures, and feedback was requested on the correctness and applicability of the approach used. Outcomes from these meetings assisted the technical team in better preparing for the full stakeholder consultation. The focus of the three meetings was as follows:

Meeting 1: Exchange on potential E-Flows measure – Water use efficiency for irrigation and change in cropping pattern (11th October 2023)

Meeting 2: Exchange on potential E-Flows measure – Restoration of water bodies and wetland (11th Oct 2023)

Meeting 3: Exchange on potential E-Flows measure – Reservoir for buffer storage to maintain E-Flows (13th October 2023)

3 Third Ramganga E-Flows stakeholder consultation

C. Aims and objectives

The key objectives of the Third Consultation were to:

- Present and develop a common understanding on the E-Flows assessment results and their meaning for future improvement measures
- Discuss on the draft future E-Flows scenarios towards potential E-Flows measures and capture stakeholder views to be considered in trade-offs.

D. Contents

Past data collection efforts, stakeholder consultations, shared vision statement for the Ramganga basin, outlined objectives for future E-Flows scenarios, and measures concluded from the earlier stakeholder consultations, were showcased during the third Ramganga E-Flows stakeholder consultation. A comprehensive technical session on the E-Flows assessment methodology and results of the Ramganga E-Flows was deep-dived for the stakeholders.

E. Summary of outcomes

There were largely 10 measures that were identified. Out of these examined in the second consultation, five were extensively discussed and designated for further consideration within the consultation process. In-depth deliberations on their feasibility and alignment with existing government programs, schemes, and initiatives were conducted to narrow down the selection to three measures. The following five measures were identified for comprehensive discussion with stakeholders:

- i) Changing cropping pattern,
- ii) Enhancing water use efficiency,
- iii) Reuse of treated water,
- iv) Rejuvenation of water bodies and wetlands and
- v) Creating dedicated storage for E-Flows

The primary result of the third consultation centered on deliberating various feasible strategies and metrics aimed at augmenting the environmental flow (E-Flows) of the Ramganga River. During the consultation, a comprehensive examination of plausible measures took place, with a focus on those aligning with government initiatives and demonstrating practical implementation.

Ultimately, three viable measures were identified and consensus was reached on interpreting the E-Flows assessment findings, understanding their implications to E-Flows for identified measures, and recognizing their potential impact.

It was decided that in the concluding consultation (fourth consultation), a detailed, updated E-Flows assessment report, inclusive of identified scenarios and impact analyses, would be presented to the relevant departments and stakeholders.

4 Fourth Ramganga E-Flows stakeholder consultation

A. Aims and objectives

The primary objectives of the Fourth consultation were:

- To have an agreement on the final E-Flows scenario and consolidation of three improvement measures for future implementation in the Ramganga Basin.
- To develop a roadmap for implementation of the E-Flows in the context of identified E-Flows measures for Basin Management (including relevant measures within the Ramganga RBM Plan).

B. Contents

The Fourth Consultation was organized to have a final agreement on the climate-sensitive measures to be taken up for implementation towards enhancement of E-Flows in the basin with minimum socio-economic implications on human water uses. The measures that were discussed and shortlisted during second and third consultations were further deliberated and finalized along with the possible trade-off implications.

Five measures identified were deliberated at length during the third Consultation and prioritized for further discussions:

- i) Changing cropping pattern,
- ii) Enhancing water use efficiency,
- iii) Reuse of treated water,
- iv) Rejuvenation of water bodies and wetlands, and;
- v) Creating dedicated storage for E-Flows

C. Summary of outcomes

Key points discussed included:

1. The overview of project activities during the fourth Ramganga E-Flows stakeholder consultation, emphasized on the progress of discussions, significance of the Ramganga E-Flows assessment as a basis for this discussion. The nation's goal of self-sufficiency in response to increasing water demand was acknowledged and the discussions focused on how to implement the decided measures and how NMCG would take it forward.
2. DG-NMCG emphasized the importance of Aviral Ganga, one of the pillars of Namami Gange, and the crucial role of E-Flows in sustainable water management. Continuous water flow was highlighted as essential, with emphasis on the difficulty of E-Flows implementation. Potential measures

discussed in previous consultations were reiterated, and the commitment to push forward the E-Flows notification by NMCG was emphasized.

3. ED-PROJECT/DDG, NMCG, highlighted E-Flows as an essential component for Namami Gange, advocating for comprehensive river basin management. The discussion included addressing various water management issues, assessing associated risks, and proposing mitigation measures.

4. ED-Technical, NMCG, expressed the value of estimates with present knowledge and their role in furthering work in Ramganga. The work done for E-Flows was seen as a catalyst for positive change.

5. The understanding that the Ramganga Basin involves the states of Uttar Pradesh and Uttarakhand, involvement of key stakeholders such as NMCG, CWC, CGWB, Irrigation Department, and Forest Department, was emphasized. Collaboration with organizations like WWF, WII, and CIFRI for data collection, as well as insights from academia (NIH, IIT Kanpur), was crucial. The perspectives of all actors were compiled during the consultation process, and GIZ showcased past data collection efforts, stakeholder consultations, shared vision statements, and outlined objectives for future E-Flows scenarios.

6. The discussion emphasized engaging basin stakeholders in water sharing discussions and utilizing E-Flows assessments' outcomes for strategizing and finalizing measures. This collaborative approach aimed to enhance acceptance and long-term sustainability of E-Flows management. The focus was on working ahead on the three priority E-Flows measures out of the identified measures.

Summary of Agreed Priority Measures

Several measures were deliberated, and from the feasible alternatives, a few key priority measures were identified and unanimously agreed upon. The quantification of impacts of some of these measures such as change in cropping pattern and enhancement of water use efficiency was done through hydrological simulation and the same was presented during the Fourth consultation meeting. Finally, after very intensive deliberations with basin experts and stakeholders, the following four measures were outlined:

1. **Modification of Cropping Patterns:** Utilizing scientific simulations, it has been demonstrated that altering cropping patterns can conserve water, and consequently contribute towards enhancing low flows. Transitioning from water-intensive crops like sugarcane and rice to less water-intensive options such as millet aligns with government initiatives of promoting millets. Millets offer health benefits and require less water for cultivation. The water thus saved can be utilized towards fulfilling the E-Flow requirements as a near-term measure.
2. **Improvement of Irrigation Efficiency:** Scientific simulations indicated that modifying irrigation practices, such as adopting sprinkler and drip techniques instead of conventional flood irrigation, can conserve water resources. This reduction in water demand shall result in more water in storages and enhanced ground water table and shall work towards Eflow enhancement during the lean season in the long run. Thus, this measure should be taken up as a long-term strategy.
3. **Wastewater Reutilization:** Deliberation on this measure occurred due to its practicality, with the government actively planning and designing initiatives for wastewater treatment in major urban centers. The incorporation of additional treated water is anticipated to facilitate its reuse for diverse purposes, concurrently elevating the water quality of the river. Part of the treated wastewater can be used for irrigation, whereas another part can also be used to compensate for the E-Flows provided the quality of water is of the acceptable level as per

the CPCB norms. This measure may be taken up as a medium-term measure since the implementation of sewage treatment plants (STPs) is still underway in many of the cities.

4. **Dynamic E-flow:** An ultimate option to secure the flows necessary for survival and thriving of aquatic fauna is to secure necessary water in times of habitat deficits. MesoHABSIM simulation model was used to develop a flow augmentation strategy that secures dynamic E-flows while conserving water for human uses. The dynamic E-flow strategy requires short (2 days) augmentation (either through additional storage or withdrawal limitations) only when drought conditions exceed persistent durations. There are three threshold flows identified for every macrohabitat type: subsistence, trigger and habitat base flows. The values are adjusted seasonally to the needs of aquatic fauna. Management actions in response to conditions of flow below base flow thresholds for more than the allowable duration are highly recommended to ensure suitable habitat for fish communities. While management action in response to conditions of flow below trigger flow thresholds for more than the allowable duration should be required to avoid significant harm to fish communities. Another rule frequently used is that exceedance of catastrophic duration is allowed every 10 years and that three consecutive exceedances of allowable durations in one bio-period are equivalent to catastrophic duration. Figure 2 demonstrates commonly occurring flow pattern in the case of application of this strategy at Bareilly site. It is compared with measured and simulated virgin (naturalised) flows.

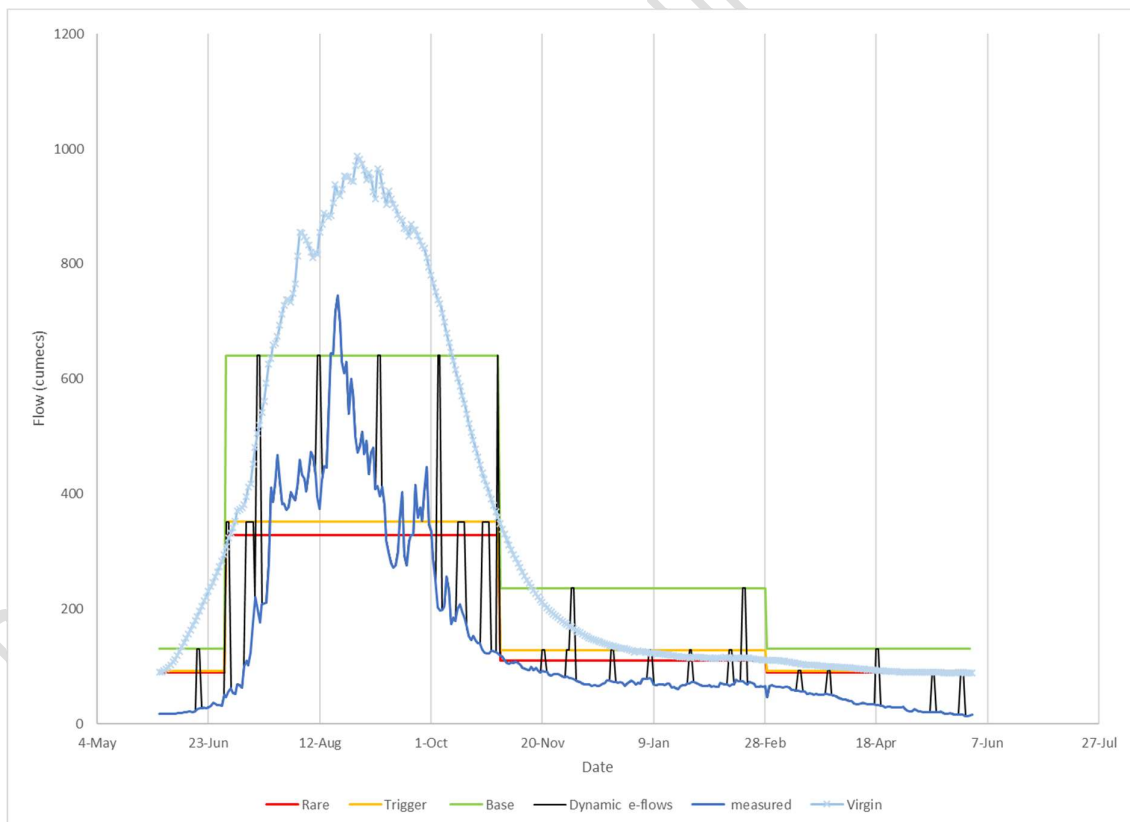


Figure 2 Simulation of dynamic e-flows compared with median of measured and virgin daily flows over the period of record at Bareilly site. The horizontal lines represent the three flow thresholds.

The effect of applying the three measures (change of cropping patterns, optimized irrigation efficiency, and dynamic e-flows) for the fish fauna was investigated comparing the number of habitat

stress days (days when the persistent duration thresholds are exceeded) that would occur under each of the scenarios as compared with simulated current conditions. Although may be easier to introduce both, irrigation efficiency and change of cropping patterns, scenarios offer much less in terms of habitat stress reduction as compared to dynamic E-flows, which are therefore ecologically most beneficial.

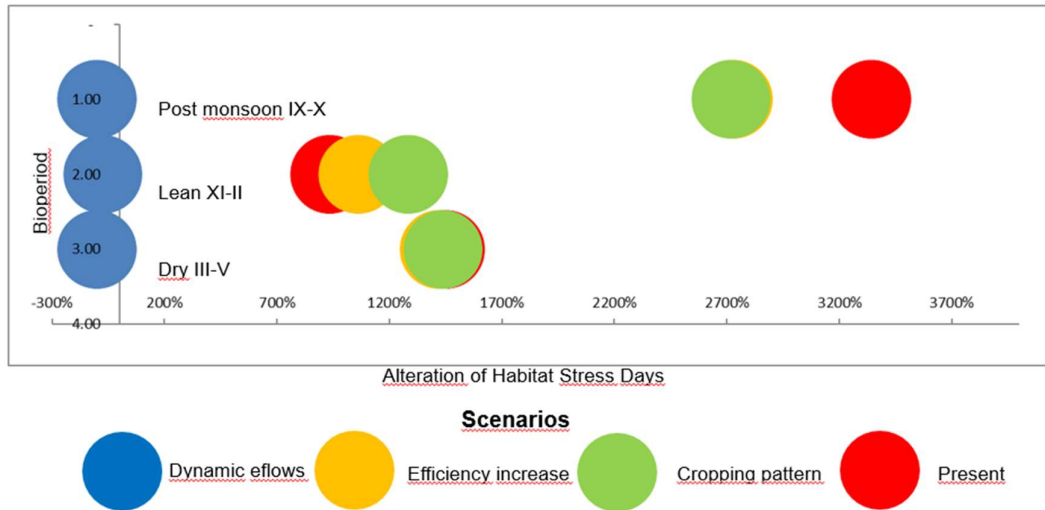


Figure 3: Comparing habitat stress days for different scenarios.

These measures are to be further evaluated and integrated into the wider management of water resources in the Ramganga River Basin as detailed in the Ramganga River Basin Management Plan. Next steps and timelines for implementation will be determined by NMCG in cooperation with basin stakeholders in conjunction with GIZ India.

Annex-I - List of Stakeholders

Offline Participants in Kick-off Consultation:

Organisation / Department	Name, Designation
National Mission for Clean Ganga	Mr. D P Mathuria, ED - Technical
	Dr Hema Patel, Nodal officer for SGR
	Mr. Peeyush Gupta, GIS Nodal person
Central Water Commission (CWC)	Mr. R.K. Gupta, Chairman
	Sh. Kushvinder Vohra, Member (RM)
	Sh. Anupam Prasad, CE, UGBO
	Mr Rajesh Kumar, SE UGBO
Central Ground Water Board (CGWB)	Dr P Nandakumaran, Chairman, Central Ground Water Board
	Dr. S.B. Bhartariya, Director, Central Ground Water Board
Central Pollution Control Board (CPCB)	Dr Prashant Gargava, Member Secretary
	Mr. A. Sudhakar, Scientist E
	Mr. A K Vidyarthi, Scientist E
c-Ganga	Dr. Vinod Tare, Head
WWF India	Mr. Suresh Babu, Director-Rivers for life programme
	Mr. Nitin Kaushal, Associate Director
G.B. Pant National Institute of Himalayan Environment	Er. Kireet Kumar, Scientist G,
	Dr. GCS Negi, Scientist G
IWMI	Mr. Alok Sikka
SMCG UK	Mr. Uday Raj Singh, Project Director
UK-Pollution Control Board	Mr. S. P. Subudhi, Member Secretary
UK Pey Jal Nigam	Mr. K K Rastogi, Chief Engineer
	Mr. Dinesh Kumar Bansal, Ex Eng AMRUT - Kasipur
	Mr. Sukhbir Singh, Ex Eng - Ramnagar
	Mr. Sunil Kumar Pant, MD
UK Jal Sansthan	Mr. S K Sharma, Chief General Manager
UK Forest Department	Mr Sushant Kumar Patnaik, CFO Garhwal
	Mr Deepak Singh, DFO, Kotdwar
UK Irrigation Department	Mr Mukesh Mohan, Engineer in Chief
UK Watershed Management Directorate	Mr. Sanatan, Project Director - Garhwal
	Mr. R C Tiwari, Deputy Project Director - Pauri

	Mr Anand Vardhan, Chief Project Director
SIDCUL	Mr Rohit Meena, MD- SIDCUL
	Mr. Paritosh Verma, Regional Manager Pantnagar
	Mr. Mrityunjay Singh, Regional Manager Kotdwar
	Mr. Kamal Kishor Kafaltiya, Regional Manager Kashipur
UJVN Ltd	Sandeep Singhal, MD
	Purshottam Singh, Director (Operations)
Central Electricity Authority	Shri. Manoj Tripathi, Hydro Project Monitoring, CEA
	Jyoti Singh, Assistant Director, HPA, CEA
	Balwan Kumar, Dy Director, HPP&I, CEA
CIFRI	B.K. Das, Director, ICAR- CIFRI
NHPC	Mr. Yamuna Kumar Chaubey, Director, Technical,
NWDA	Mr. Bhopal Singh, DG -NWDA
NIH	Dr. J.V. Tyagi, Director
	National Institute of Hydrology
	Roorkee - 247667 (Uttarakhand), India
SMCG UP	Mr. Rajesh Kumar Pandey, Additional Project Director
	Mr. Anurag Srivastava, Project Director
	Mr. Mithilesh Kumar Mishra, Water Resource Management Specialist
UP Pollution Control Board	Mr. Ajay Kumar Sharma, Member Secretary
	Mr. Nishi Kumar Chauhan, Chief Environmental Officer - Circle 7 (Ramganga area)
	Mr. Vikas Mishra, Regional officer-Moradabad
	Mr. Rohit Singh, Regional Officer - Bareilly
UP Jal Nigam	Mr. Anil Kumar, MD, U.P.Jal Nigam
	Mr. Amit Kumar Singh, Joint Managing Director
	Mr. Sanjay Kumar, Ex. Engineer-Bareilly
	Mr. Munna Singh, Executive Engineer - Moradabad
UP Irrigation and Water Resource Department	Mr. Anup Kumar Srivastav, HoD and Engineer in Chief, Irrigation and Water Resources Department
UP Forest Department	Chief Forest Conservator and DFOs at Moradabad, Bareilly, Rampur, Bijnore, Kalagarh
UP Jal Vidyut Nigam	Mr. P Guruprasad, MD

	Mr. Brijesh Gangwar, Ex. Engineer Planning
SWaRA	Mr. Anil Garg, Principal Secretary/ Chairman
	Naresh Chandra Upadhyay, Chief Engineer Level-1 & Irrigation and Drainage Expert

Online Participants in Kickoff Consultation:

1. Dr. Rajendra Singh, Uttarakhand Pollution Control Board (UKPCB), Dehradun
2. Bharat Gupta, Central Electricity Authority (CEA)
3. Chandreyee De, Central Ground Water Board (CGWB)
4. Dr. Brajesh Shrivastava, Central Pollution Control Board (CPCB)
5. A. Sudhakar, Central Pollution Control Board (CPCB)
6. Dr. Ajit Vidhyarthi, Central Pollution Control Board (CPCB)
7. Bharat Gupta, Central Electricity Authority (CEA)
8. Naveen Singhal, Irrigation Department, Uttarakhand
9. Dr. Anupma Sharma, National Institute of Hydrology
10. Maneesh Semwal, Uttarakhand Jal Sansthan (UJS), Dehradun
11. Mr. Akshay Kumar, SPMG Uttarakhand
12. Mrs. Anju Panwar, SPMG Uttarakhand
13. Mr Rohit Jayra, SPMG Uttarakhand
14. Dr Sujana Dhar, Jomiso
15. Mithilesh Kumar Mishra, SMCG-Uttarkhand
16. Nilanjan Saha, District Ganga plans for Ramganga River Basin Management, Adelphi
17. Forest Officer, Budaun, Uttar Pradesh
18. Dr. Pooja Mishra, Urban Development Directorate, Uttarakhand
19. Dr. Sitaram Taigor, SMCG-UP
20. Rajesh Dehradun, UGBO/ICAR
21. Philipp Thumser, SYDRO Consult
22. Hubert Lohr, SYDRO Consult
23. Dr Sumit Gautam, Support to Ganga Rejuvenation (*SGR, GIZ-India*)
24. Anjana Pant, Support to Ganga Rejuvenation (*SGR, GIZ-India*)
25. Mr. Meraj Ahmed, (*SGR, GIZ-India*)
26. UGBO (Upper Ganga Basin Organisation)

27. Purushottam, Central Pollution Control Board
28. Shobhit Singh, IIT Kanpur
29. Rajiv Sinha, IIT Kanpur
30. Naveen Singhal, Irrigation Department, Uttarakhand
31. Dipro Sarkar, IIT Kanpur
32. Anupma Sharma, National Institute of Hydrology

Participants in Second Stakeholder Consultation:

S.N.	Organisation / Department	Name, Designation and Postal Address
1	NMCG	Mr. D P Mathuria, ED - Technical
		Mr Alok Shrivastava, GWM expert
		Mr. Peeyush Gupta, GIS Nodal person
		Anu Chetal, Scientist B
		Harish Kr Mahavar, Small River Rejuvenation Experts
		Sandeep Behera, Consultant Biodiversity
		Hema Patel, Project Officer Technical
		Anuj Kushwaha, Support Engineer
		Ishaq Ahmad, Scientist C
2	Central Water Commission (CWC)	Anupam Prasad, CE, UGBO
		S S Singh, UGBO, LKO
		Deepika Barthwal , Junior Engineer
3	UPPCB	Ram Gopal, CEO-Laboratory, Lucknow
		UPPCB LUCKNOW (Guest)
4	SPMG/SMCG	Shefali Srivastava, SMCG-UP
		Rohit Jayra, M&E specialist, SPMG Uttarakhand
		Piyush Kumar, RFD, Env Specialist
5	Water Board, Irrigation Dept and others	Rakesh Kumar Deputy Director, Central Electricity Authority, Ministry of Power
		B C Nainwal , Exe Irrigation Engineer, US Nagar
		Naveen Singhal, Irrigation UK
		Purushottam Singh, Director Operation Uttarkhand Jal Vidyut Nigam Limited
		Chandreyee De, Scientist, Central Ground Water Board
		Himanshu Joshi , Basundhara PSJKS, Almora, NGO, UK
6	WWF India	Nitin Kaushal, WWF India
7	CIFRI	A.K.Sahoo, ICAR-CIFRI
8	Consultants and Experts	AK Gossain (Director, INRM)
		Puja Singh Training & Capacity Building Expert (INRM)
		Wolfgang Bogacki (SYDRO)
		Sujana Dhar (SYDRO)

		Michael McClain (IHE Delft)
		Salahuddin Ahmed, Project Manager- ETLog
		Suvajit Dey (Large Data and RS, GIS)
		Shubham (Rushing River)
9	GIZ	Martina Burkard, Head of Programme, GIZ
		Laura Sustersic, IEWP, Project Manager
		Jyoti Nale, IEWP
		Sumit Kr Gautam, SGR
		Chhavi Sharda, SGR
		Nikolai Smith
		Merajuddin Ahmad
		Supriya Rathore, Intern

Participants in Third Stakeholder Consultation:

Organisation / Department	Name, Designation
National Mission for Clean Ganga	G. Asok Kumar
	D.P. Mathuria
	Sandeep Behera
	Hema Patel
	Anu Chetal
	Shubhyali Saxena
	Anuj Kushwaha
	Harcharan
	Nadim
	Alok Srivastava
	Harish Kumar Mahawar
Anu Radhakrishnan	
Central Water Commission	Anupam Prasad, CE UGBO (online)
	Pranav Shukla, Deputy Director
	Deepak Kumar
UPPCB	Anil Kumar, Scientific Assistant, Moradabad
	Bipin Kandpal, RO Bareilly, UPPCB
WWF India	Nitin Kaushal
GB Pant HIHE	Mahendra Lodhi
NWDA	Bhopal Singh
Consulting experts and GIZ India	Laura Sustersic, GIZ India
	Piotr Parawiecz, Rushing Rivers
	Michael McClain, IHE Delft
	Ashwin Kumar Gosain, INRM
	Puja Singh, INRM
	Salahuddin Ahmed

	Jyoti Nale, IEWP, GIZ India
	Chhavi Sharda, SGR, GIZ India
	Sumit Kumar Gautam, SGR, GIZ India
	Supriya, Intern, GIZ India
	Vandana Yadav
	Suvajit Dey
SMCG Uttar Pradesh	Anil Kumar Gupta (online)
ICAR CIFRI	A K Sahoo (online)
Uttarakhand Irrigation Department	Ranikhet Irrigation Division (online)
	Naveen Singhal (online)
	Uddham Singh Nagar, IWCUSN (online)
	M K Khare (online)
Uttar Pradesh Irrigation Department	SE IWC, Moradabad (online)
Central Electricity Authority	Satyam Soni
	Pradeep Kumar

Participants in Fourth Stakeholder Consultation:

Organisation / Department	Name, Designation
NMCG	<p>Shri. G Asok Kumar, Director General (NMCG)</p> <p>Mr. A.K. Srivastava, ED – Technical</p> <p>Mr. Nalin. K. Srivastava ED- Project</p> <p>Dr Hema Patel, Nodal officer for SGR</p> <p>Dr. Sandeep Behera, Consultant</p> <p>Dr. Harcharan Singh</p> <p>Mr. Peeyush Gupta, GIS Nodal person</p> <p>Mr. Harish Kumar Mahavar</p> <p>Mr. Alok Shrivastava</p> <p>Mr. Anuj Kushwaha</p> <p>Sh. Brijesh Sikka , Senior Consultant (River Conservation & Regulation)</p> <p>Ms. Anjali, Deputy Director</p> <p>Ms. Shubhyali Saxena</p> <p>Dr. S.P. Raghuvanshi, Scientist 'D'</p> <p>Dr. Anu Radhakrishnan (Online)</p>
CWC	<p>Anupam Prasad, CE, Upper Ganga Basin Organisation, Central Water Commission</p> <p>Lalit Mohan DD CWC</p>

UK Irrigation Department	Naveen Singhal (Online)
CGWB – Uttar Pradesh	Prashant Rai (Online)
CGWB – Uttarakhand	Chandreyee De (Online)
UPPCB	Vishal Bharti- UPPCB, Moradabad Anil Kumar UPPCB
SMCG UP	Mithilesh Kumar Mishra (Online)
SPMG Uttarakhand	Akshay Kumar, Environment Specialist (Online) Rohit Jayara, Monitoring & Evaluation Specialist, SPMG, Namami Gange, Uttarakhand (Online) Piyush Singh (Online)
WWF	Arjit Mishra
IWMI	Faiz Alam, IWMI
ICAR CIFRI	Dr. AK Sahoo (Online) P.K Dixit
Consultant - Ramganga RBM Programme of Measures	Bart Hilhorst (Online)
GIZ	Laura Sustersic Jyoti Nale Chhavi Sharda Sumit Gautam Merajuddin Ahmad (Online) Supriya Rathore Suvajit Dey
E-Flows experts and consultants	Prof. Dr. Piotr Parasiewicz Prof. Dr. Ashvin. Gosain, INRM Prof. Michael McClain, IHE Delft Dr. Puja Singh, INRM Dr. Ankush Mahajan, INRM

Annex-II – Agenda

Agenda - Kick-Off Stakeholder Consultation:

Description	Speaker(s)
Opening Remarks	G. Asok Kumar Director General, NMCG
Introduction to the Stakeholder consultation process to identify measures towards adequate E-Flows in Ramganga Basin	Martina Burkard, GIZ India
E-Flows assessments and the IEWP Guidance Document under the IEWP Action Phase 2	Birgit Vogel IEWP Action, GIZ India
Introduction Round	All
Importance of E-Flows in the context of Ramganga River Basin and stakeholders' engagement process.	Rebecca Tharme Riverfutures
E-Flows assessment process to feed into the consultation: Focusing the eco-hydrological interrelationships	Piotr Parasiewicz Rushing Rivers Institute
NMCG's vision towards E-Flows; steering and coordination in the Ramganga E-Flows	D P Mathuria ED-Technical NMCG
Moderated discussion- Ramganga E-Flows: stakeholders' expectations and perception for the E-Flows in the Ramganga Basin	A K Gosain IIT Delhi/ Jyoti Nale GIZ India
Moderated Discussion and agreement on: <ul style="list-style-type: none"> • Overall strategy for the E-Flows assessment and consultations • Vision and objectives of E-Flows in Ramganga • Roles and responsibilities of different levels of stakeholders • Timelines and expected outcomes 	Michael McClain IHE Delft Chhavi Sharda GIZ India
Way forward and vote of thanks	SGR, GIZ India

Agenda - Second Stakeholder Consultation:

Description	Speaker(s)
Welcome, and Opening remarks on E-Flows	D P Mathuria ED-Technical, NMCG
Overview of Indo-German Technical Cooperation Project Support to Ganga Rejuvenation-II (SGR II) in conjunction with the India-EU Water Partnership (IEWP) Action Phase 2	Martina Burkard, GIZ India/ Laura Sustersic IEWP Action, GIZ India
Brief Introduction of participants and a quick recap of the consultation process	Chhavi Sharda, GIZ India
Ecological considerations for E-Flows Assessment in the Ramganga Basin: Journey so far	Piotr Parasiewicz, E-Flows Experts and GIZ Consultants
Interactions, feedback, and Q&A	Conclusion: Ashwin Gosain Inputs from all stakeholders Moderation by: Michael McClain, E-Flows Experts, IHE Delft
Interactive session with moderated discussions on possible measures: <ul style="list-style-type: none"> - What in stakeholder's opinion are the critical options that required to be considered to ensure these E-Flows? - What further scenarios are needed to be developed to bring clarity to identify appropriate measures? 	Inputs from all stakeholders Moderation by: Ashwin Gosain and Michael McClain, E-Flows Experts and GIZ Consultants
Way forward, and vote of thanks	D P Mathuria ED-Technical, NMCG

Agenda - Third Stakeholder Consultation:

Description	Speaker(s)
Registration	All
Welcome remarks and overview of project activities	Laura Sustersic, GIZ India
Address by DG, NMCG	G. Asok Kumar, Director General, NMCG
Ramganga E-Flows consultation process: Quick Recap on the perspectives compiled from the Ramganga stakeholder consultations for E-Flows	Chhavi Sharda, GIZ India
Reflection of E-Flows Assessment results considering the vision for E-Flows in Ramganga Q&A (10mins)	Piotr Parasiewicz, Rushing Rivers Poland
Break for Tea/Coffee	All
Potential measures linked to assessment clusters, perspective from exchange meetings as basis to set three E-Flows measures Discussion for stakeholder perspectives and inputs:	Ashvani Gosain, INRM Consultants Michael McClain, IHE Delft Institute for Water Education

Possible future E-Flows measures and their benefits Challenges for future possible measures	
Lunch Break	All
Technical Session: Ramganga E-Flows Assessment approach, results, and their meaning for future measures in the Ramganga Basin	Piotr Parasiewicz, Rushing Rivers Poland
Moderated discussion to compile views on Stakeholders that need to be further be involved for agreement of potential measures Agreement of scenarios Possible trade-offs	Michael McClain, IHE Delft Institute for Water Education
Q&A	All
Updates and introduction to “Guidance document for E-Flows assessment and implementation in India”	Jyoti Nale, GIZ India
Concluding remarks	D P Mathuria ED-Technical, NMCG/
Way forward, and vote of thanks	Laura Sustersic, GIZ India

Agenda - Fourth Stakeholder Consultation:

Description	Speaker(s)
Welcome remarks and overview of project activities	Laura Sustersic, GIZ India
Address by DG, NMCG	G. Asok Kumar, Director General, NMCG
Ramganga E-Flows consultation process: Quick Recap	Chhavi Sharda, GIZ India
Updates on E-Flows Assessment results considering the vision for E-Flows in Ramganga	Piotr Parasiewicz, Rushing Rivers Poland and Jyoti Nale, GIZ India
Q&A (10mins)	
Break for Tea/Coffee	All
Improvement measures towards implementation of the final E-Flows Scenario. Discussion for agreement: <ul style="list-style-type: none"> - Benefits of the selected E-Flows measures - Opportunity and challenges for selected E-Flows measures 	Ashvani Gosain, INRM Consultants Michael McClain, IHE Delft Institute for Water Education
Roadmap for the implementation of the E-Flows in the Ramganga River System Discussion and inputs: <ul style="list-style-type: none"> - What are the appropriate next steps for 	Michael McClain, IHE Delft Institute for Water Education

<p>implementation of the E-Flows recommendations in the Ramganga River Basin?</p> <ul style="list-style-type: none"> - Linkages of the agreed E-Flows measures with the Ramganga RBM Plan measures 	
Lunch Break	All
Technical Session: Ramganga E-Flows Assessment approach and the result	Piotr Parasiewicz, Rushing Rivers Poland
Overview of alteration in river Hydrology and quantity as key issue for the Ramganga RBM Plan: Risk assessment results and Programme of measures	Sumit Kumar Gautam, Chhavi Sharda, GIZ, Bart Hilhorst, Adelphi
<p>Moderated discussion to compile views on</p> <ul style="list-style-type: none"> - Possible trade-offs - Agreement on appropriate pathway for the dissemination of findings among the different stakeholder groups at national, basin to local levels including districts and state level. 	<p>Michael McClain, IHE Delft Institute for Water Education</p> <p>Ashvani Gosain, INRM Consultants</p>
Q&A	All
Updates and introduction to “Guidance document for E-Flows assessment and implementation in India”	Jyoti Nale, GIZ India
Concluding remarks	A K Srivastava, ED-Technical, NMCG
Way forward, and vote of thanks	Laura Sustersic, GIZ India