Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
National Metrology Institute

INTERNATIONAL COOPERATION

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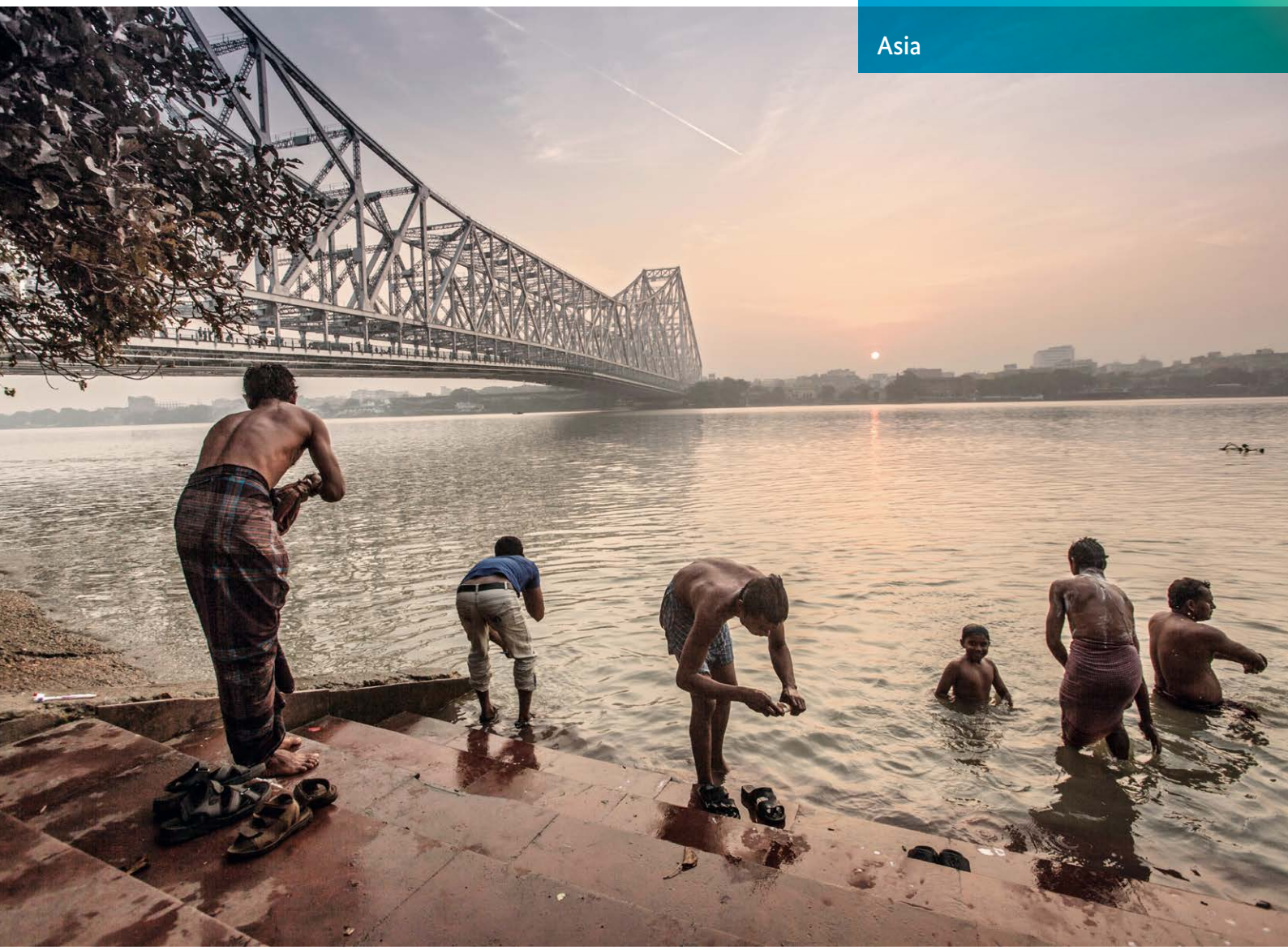


Collaboration in Confidence: Building Quality Infrastructure for the Ganga River

Strengthening water quality monitoring systems to support the rejuvenation of India's holiest river

german cooperation
DEUTSCHE ZUSAMMENARBEIT

On behalf of

Federal Ministry
for Economic Cooperation
and Development

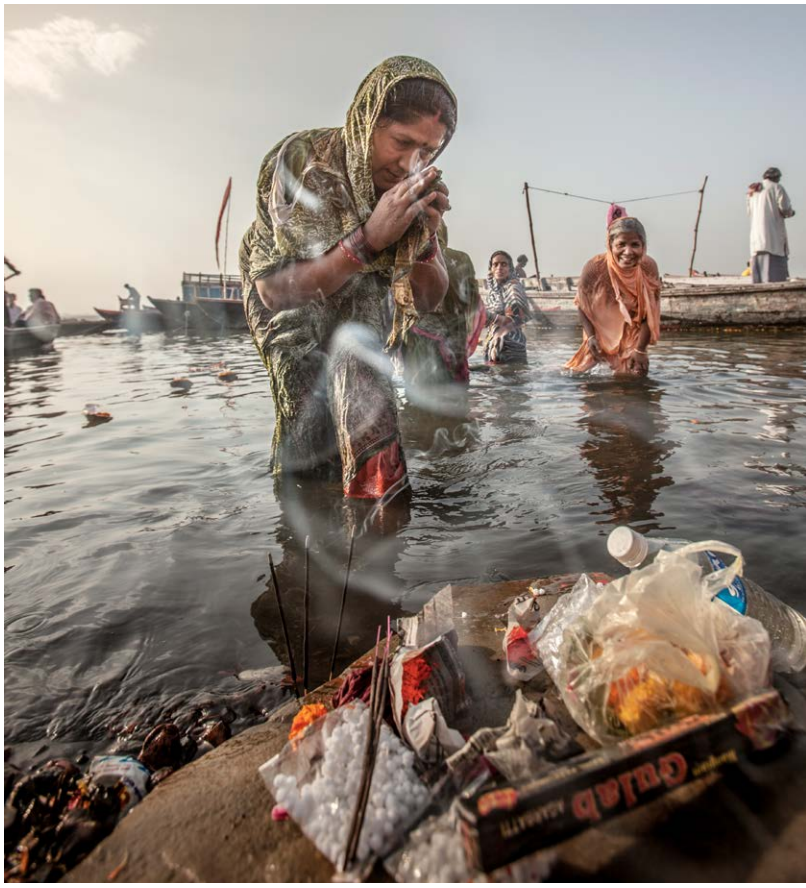
On behalf of the Federal Government of Germany, the Physikalisch-Technische Bundesanstalt promotes the improvement of the framework conditions for economic, social and environmentally friendly action and thus supports the development of quality infrastructure.

This brochure can be found here:
https://www.ic.ptb.de/media/fileadmin/Publications/PTB_Impact_Report_India_Ganges_95376_EN.pdf

1. Summary

The Ganga River Basin is home to more than 650 million people. It is the source of over 40 % of India's GDP, and the most sacred river to the Hindus. Despite this, the Ganga faces formidable environmental pressures, and high levels of pollution that threaten public health, economic prosperity, and environmental sustainability. The lack of reliable quality-assured water monitoring data has long been a bottleneck to developing targeted pollution-mitigation measures for this vital waterway.

Since 2018, Germany's Physikalisch-Technische Bundesanstalt (PTB) has partnered with India's National Mission for Clean Ganga (NMCG) who are directly responsible for measures to reduce pollution and restore the ecological health of the Ganga River. Jointly, PTB and NMCG focus on improving the quality assurance system (Quality Infrastructure) of water monitoring across the Ganga basin. The results have been transformative, with a significant growth in internationally recognised (accredited) laboratories, expanded testing capability, and comprehensive training provision. Thereby, the project has provided strong foundations for policy and funding decisions under the Indian government's flagship *Namami Gange* program, which aims to reduce pollution and sustain the rejuvenation of the Ganga.



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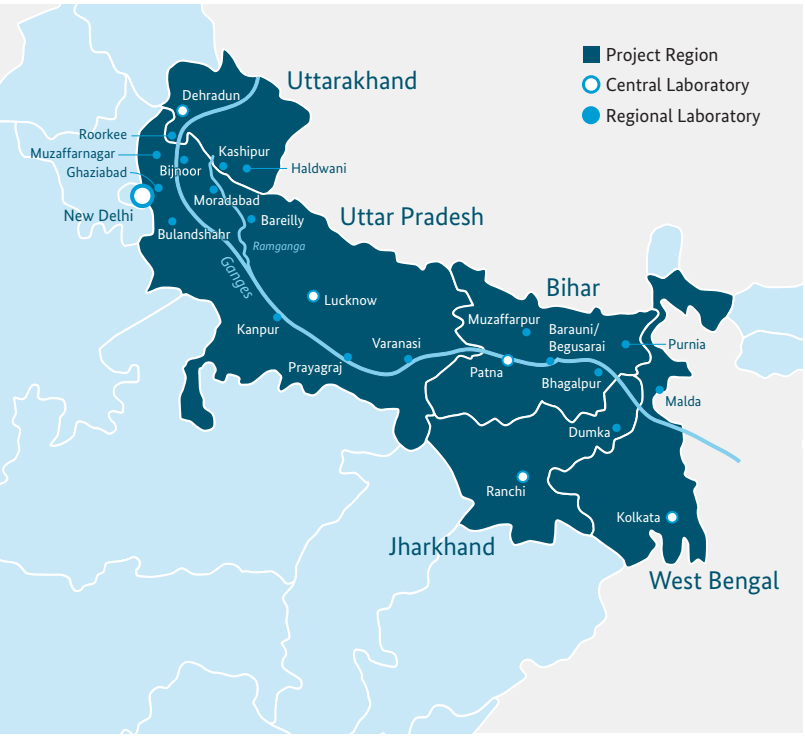
2. Key Achievements

- In the states of Uttarakhand and Uttar Pradesh, from 1 accredited laboratory in 2018, there are now 14 laboratories (under the PTB-NMCG project) which have achieved or are currently pursuing ISO/IEC 17025:2017 accreditation
- More than 72 people across laboratories in Uttarakhand and Uttar Pradesh received expert metrology training
- 13 laboratories participated in a Proficiency Testing scheme
- Additional funding secured to expand the reach of the project.

3. Project Background



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The mighty River Ganga (or Ganga) stretches from the Himalayas to the Bay of Bengal, a distance of 2,500 km. Its river basin is the world's most populous; home to over 650 million people[1]. It is the source of more than one-third of India's surface water and helps to generate over 40 % of the country's GDP[2]. The Ganga holds profound religious significance to Hindus, and bathing in it is central to many rituals and ceremonies.

Despite its importance in all aspects of life, the river faces constant environmental pressures. Every day, billions of litres of untreated domestic sewage and industrial effluent flow into the Ganga[2], contaminating it. This poses a significant threat to both human health and the wider basin ecosystem.

In 2014, the Indian government initiated the flagship programme *Namami Gange*, with a budget of ~ € 2.4 billion, managed and implemented by the National Mission for Clean Ganga (NMCG). In addition, international development partners including the German Development Bank and the World Bank provided funding for NMCG and infrastructure projects to treat and manage domestic sewage and industrial effluent in the Ganga basin.

However, a major bottleneck to rejuvenating the Ganga was identified early on in the program – the lack of reliable water quality data across its entire length. Prior to the partnership between NMCG and Germany's Physikalisch-Technische Bundesanstalt (PTB), the assessment and monitoring systems for the river were largely lacking sufficient quality assurance in regard to:

- Strategic river water monitoring
- Use of adequate equipment and continuous training of laboratory personal
- The coordination and sharing of water quality data

These bottlenecks posed a challenge for decision-makers to adequately identify pollution sources, prioritise interventions, or quantify the effectiveness of investments in wastewater treatment and management. PTB, funded by Germany's Federal Ministry for Economic Cooperation and Development (BMZ) started a project in 2018 to help establishing a more comprehensive quality-assured water quality monitoring system along the Ganga.

1 *https://www.wwf.org.uk/where-we-work/ganges*

2 *https://www.worldbank.org/en/news/feature/2015/03/23/india-the-national-ganga-river-basin-project*

4. Project Implementation

Securing early buy-in from, and building positive working relationships with, India's government agencies was a key priority in the development of the project plan. In addition to NMCG, the project works closely with the State Pollution Control Boards, State Missions for Clean Ganga and regulatory bodies including the Central Pollution Control Board. Furthermore, the CSIR-National Physical Laboratory of India acted as an important technical partner throughout the project.

The project's original focus was the small state of Uttarakhand (about 10 million inhabitants) which sits at the source of the Ganga. Based on discussions with partners and past successes, the focus was broadened to also include the state of Uttar Pradesh (about 200 million inhabitants). From May 2026 onwards, the project will enter its third phase covering all main states along the Ganga Basin including Bihar, West Bengal and Jharkhand (about 270 million inhabitants).

PTB's approach to the project was to identify three ideal outcomes that could then be used as a metric to measure its success:

1. Authorities responsible for measuring water quality along the Ganga have a greater capability for planning, implementing and using monitoring programs
2. The laboratories for monitoring water quality show improved competency in quality management, sampling and analysis
3. Authorities show increased coordination and connectivity with each other and with other stakeholders.

Ultimately the goal was to establish a quality infrastructure system for water that could generate accurate, reliable, and trustworthy data, following international standards, for the benefit of everyone living in the Ganga river basin.

At the heart of this strategy was supporting laboratories to become accredited to ISO/IEC 17025:2017; the international standard for the competence, impartiality, and consistent operation of testing and calibration laboratories [3]. PTB sponsored training on required topics such as laboratory systems, risk management, and measurement uncertainty. Hands-on technical training on water sampling and analysis was provided by global experts from PTB and CSIR-NPL. Additional support was provided via webinars and PTB's e-learning platform, when in-person workshops were deemed impractical.

Detailed lab assessments and internal audits were also carried out for laboratories across Uttar Pradesh and Uttarakhand. This identified issues with infrastructure, equipment provision and condition, and gaps in sampling, testing and analytical processes (e.g. how many water quality variables could be reliably measured in a given lab). Later, participating labs took part in a proficiency test, whereby identical samples prepared from certified reference materials (CRMs) were sent to the labs to test the labs' competency to analyse ten key water quality parameters. By comparing their results to the true value, these labs could then validate their measurements.

By developing a stakeholder map at the start of the project, PTB could facilitate a series of network meetings with all relevant authorities across the Ganga basin. These allowed representatives to exchange ideas, identify opportunities for collective action, and lines of conflict. These meetings and those of the project steering group established enduring communication links between partners.

3 *https://www.iso.org/standard/66912.html*

5. Project Challenges

The Covid-19 pandemic significantly hampered project implementation and expenditure spending. It prevented international and national experts from traveling to partner laboratories and institutions for close to two years. This forced some assessments, training, and site visits onto online formats, which were viewed as “less fruitful and effective than face-to-face interactions”.

Throughout the project, there was a high staff turnover in regional laboratories. Many trained participants were Junior Research Fellows, employed on contract basis. This led to low employee retention after training. To partially address this risk, a dedicated training package has been developed for PTB’s e-learning platform, accessible to new staff at each lab. The use of regularly meeting local expert networks, and *train-the-trainer* approaches will be explored in the next stage of the project.

Despite substantial improvements to participating laboratories, some still operate in challenging conditions. Space constraints, a lack of a reliable power or data connections, or inadequate climate and environment control all make it challenging to operate scientific instruments, which partially effects the quality and reliability of collected data.

6. Project Outcomes

6.1. Laboratory accreditation

Prior to this project, there was only one accredited water quality testing laboratory in the Uttarakhand and Uttar Pradesh Pollution Control Boards. As of October 2025, there are 14 laboratories that have achieved (10) or are currently pursuing (4) ISO/IEC 17025:2017 accreditation. This establishes confidence in all test and calibration results from these labs, and demonstrates that they meet stringent, internationally-recognised requirements for laboratory quality and reliability. And because accreditation is continuous, renewable process, there is an incentive for laboratories to maintain the standards of their services beyond the timescale of the project.

> "Our project can be successful because we strive towards a common goal: the rejuvenation of the Ganga. This shared priority with our partners, and the Government of India creates trust and a foundation for collaboration. It allows us to significantly advance evidence-based pollution abatement for the river's long-term protection."
>
> Lukas Nagel, Project Coordinator

6.2. Upskilling staff

Specialised training programs – mostly delivered in-person – were a central part of this project. Over 72 personnel from across laboratories in Uttar Pradesh and Uttarakhand received training in topics including measurement uncertainty, method validation and verification, laboratory systems, internal audits, and risk management.

6.3. Supporting infrastructure investment

While the project primarily focused on capacity-building, its outcomes were complementary to infrastructure investments from the Indian government. For example, under the Namami Gange program, 97 manual water quality monitoring and 36 real-time water quality monitoring stations were established along the Ganga. In addition, many new scientific instruments were installed in participating labs, including UV-VIS spectrophotometers and total organic carbon analysers. The technical training provided by PTB ensured that each lab has access to suitably qualified people to carry out measurements and analysis.

International development partners committed to fund large-scale infrastructure projects in the Ganga basin, such as wastewater treatment facilities. The ability to accurately monitor, map, and quantify specific pollution sources was viewed as "an indispensable prerequisite"[4] to building such facilities.

6.4. Better data for policy enforcement

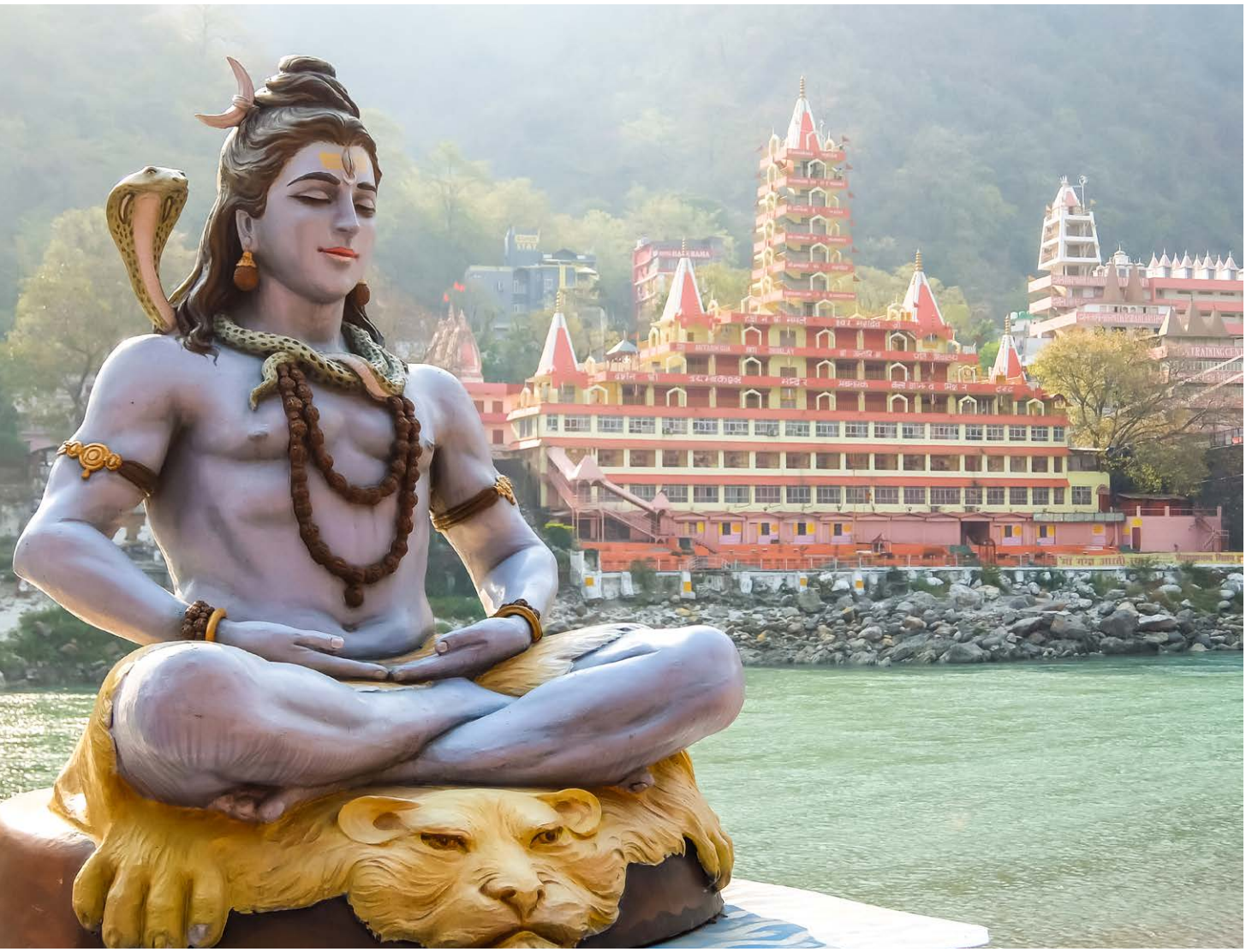
The project's impact extends beyond the laboratory into real-world policy challenges. Water quality assessments can become the subject of legal and regulatory scrutiny as for example during publicly relevant cases or events. Reliable, comparable monitoring data and a robust quality assurance system across all levels of governance are crucial to underpin regulatory measures and enable policy enforcement.

4 *https://www.evaluierung.ptb.de/en/evaluation-database*

7. Conclusion

The PTB-NMCG collaboration demonstrates how targeted investment in quality infrastructure and metrological capacity can address fundamental barriers to environmental protection and public health. By focusing on meeting international standards, building competencies at an individual and organisational level, and securing high-level political buy-in, the project achieved measurable improvements in the performance of water quality labs along the Ganga, despite facing significant challenges.

This project has established a strong foundation for the ongoing improvement in Ganga water quality monitoring; a vital prerequisite for protecting the health and livelihoods of the 650 million people who call this mighty river system, home.



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Footnotes

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Notes

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