

RIVER ECOLOGY

An assessment of the impact
of the COVID-19 lockdown



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ActionAid Association (India)

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First Published October, 2020

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Printed at: Baba Printers, Bhubaneswar

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FOREWORD

Rivers are India's lifeline. Our ancient civilisation developed on the Indo-Gangetic plain. Across the length and breadth of the sub-continent rivers have brought prosperity to communities and societies.

If the monsoon is considered to be the "true finance minister" of India, as the late Shri Pranab Mukherjee is said to have remarked, then the rivers of India would be its Reserve Bank. More than just an economic resource, rivers have contributed to the biodiversity and ecological health of the country.

However, we have not treated our rivers well. Despite the bounty of the monsoon, and the many rivers that course through our lands; India is said to be facing the worst water crisis in its history. Rivers are choked, their flows diverted and reduced, and pollution is making their waters unfit for human consumption and non-conducive to aquatic life.

The COVID-19 induced lockdown brought news of the river waters running clean, fish stock increasing and birds appearing in increased number. Media has brought many such cases into the limelight.

News of revival of Nature has encouraged us to take up this evidence-based study on River Ecology: An assessment of the impact of COVID-19 lockdown. The report has emerged from interactions held with respondents across multiple locations on ten major rivers flowing through different states. The study has captured people's immediate reactions and perceptions about the impact of the shutdown of industries and decrease in pollutants.

The evidence shared by local communities confirms the reports mentioned above. Nature's resilience is showing with just a few weeks of the shutdown of human activity that generated pollution. This is great learning for all of us, especially for the planners to note how we intend to bring change in our rivers.

The hard work for this study, with all the limitations it has, will be helpful for future planning of river rejuvenation.

River Ecology

An assessment of the impact of COVID-19 lockdown

I thank all my colleagues in the water commons national synergy group and water volunteers who helped in information collection to complete this study. I warmly thank our partners in the Nadi Adhikar Abhiyan who have collaborated with us in conducting the study and publishing this report.

I look forward to comments and suggestion as we carry this conversation further.

In solidarity,

Sandeep Chachra

Executive Director

ActionAid Association

ACKNOWLEDGEMENTS

We are extremely grateful to all those who have contributed towards successfully completing this study. Particularly, all communities' members across ten rivers who spared time to talk to us over telephone and inform about the ground realities.

We express our gratitude to members of Nadi Adhikar Abhiyan, all water volunteers and fellows for their constant support. Especially, we thank Upendra Shukla, Mal Singh Tomar, Khageswar Ganda, Nishikant Pagre, Jitendra Kumar, Ashok, Neeliaiah, Nagaratna and Shailendra and Esha for sincere efforts for collating data from field.

We thank Ratikanta Rana for field level coordination with different states for information collection, Ashok Nath for his contribution and T.K Ramesh for study coordination.

Our sincere gratitude to Preeti Srivastava, Rajasekhar G, Raghavendra B, Ghasiram Panda and Debabrata Patra for supporting study coordination in different states. We thank Biren Nayak for his contribution to this study from the very beginning to the end. We thank Joseph Mathai, Nabajit Malakar and MV Rajeevan from the Communication Unit of ActionAid Association for their support.

We are thankful to Sandeep Chachra, Executive Director, ActionAid Association for his support and encouragement.

Bratindi Jena

Associate Director
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LIST OF ABBREVIATIONS

BHU	:	Banaras Hindu University
BOD	:	Biological Oxygen Demand
CPCB	:	Central Pollution Control Board
CSO	:	Civil Society Organisation
DCPC	:	Delhi Pollution Control Committee
DO	:	Dissolved Oxygen
ETPs	:	Effluents Treatment Plants
GAP	:	Ganga Action Plan
NBS	:	Nature Based Solutions
NO3	:	Nitrate
NGO	:	Non-Government Organisation
NRGBA	:	National River Ganga Basin Authority
STPs	:	Sewage Treatment Plants



Introduction

Rivers play a crucial role in sustaining life on the landmasses of planet Earth. They are essential to maintaining the hydrological cycle. Water is kept in continuous motion, moving from the seas and oceans¹ to the atmosphere, to the land and through rivers and underground flows back to the seas and oceans. Rivers do not just move water from one place to another; they also function as ecosystems.² While all ecosystems have boundaries, rivers and river systems are amongst the most open of all ecosystems. Rivers are a dynamic combination of water, aquatic organisms, sediment and riparian vegetation. All are participating in an intricate ballet that continues from the point of origin, or headwaters, toward the ocean or basin where the journey ends. As water is known as the cradle of life, rivers play an essential role in sustaining life on Earth.

Rivers are also central to civilisation. It is around them that the earliest of civilisations arose. Water consumption, crop irrigation and transportation enabled by rivers generated the surplus to build the first cities. In modern times the importance of rivers continues with added pressures on them. Industrial processes draw water from rivers and aquifers and deposit inadequately treated industrial waste in them. Rivers are also a source of power, and hydroelectric projects disrupt river ecology in a myriad of ways.

Rivers in India have always been integral to human society. The Rig Veda has a hymn in praise of seven rivers, though more than twenty rivers are mentioned in the sacred text. As with most oral traditions, there is much scope for adaptation, and local rivers often take the place of one or more of the rivers in the sacred hymn.³ Rivers flowing in different parts of the country are the cultural and economic backbone

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1. Middleton, N. (2012). *Rivers: a very short introduction*. OUP Oxford.
 2. Likens, Gene E. (2010). *River Ecosystem Ecology: A Global Perspective*. Academic Press
 3. Eck, D. L. (2012). *India: A sacred geography*. Harmony.

of India. The Ganga and the Indus have contributed to the rise and prosperity of the earliest civilisations in history, and they continue to be a source of life and livelihood for millions today. River basins support rich ecosystems and sustain riparian communities. The river, in its many facets, matters for humans, while the social, cultural, ideological and religious roles of water include deep ontological relations and identities ranging from personal perceptions to religious rituals.

Scholars speak of four major river systems in India. These include the river systems of the Ganga, the Indus, the Brahmaputra and that of the peninsular rivers.⁴ While there is marked continuity in the use, management and control of natural resources from the days of British colonial rule, with Independence economic modernisation became the primary objective of the State. The construction of large dams took a central place with the purpose of securing “irrigation, electricity and water supplies to underpin the effort to modernise agriculture and expand industrial production.”⁵

With industrialisation, construction of dams, increase in mining activities, encroachment over the path of rivers through unchecked urban land use and spread of cultivation and rural habitation, rivers are facing twin threats of pollution, reduced flow due to over-extraction of water and choking of channels.

River ecology

Rivers in India regulate the entire economy, agriculture, livelihood, ecosystem, power sector, infrastructure development and many other aspects that contribute to survival and growth. Rivers are a significant source of water for domestic consumptions. River ecosystems provide space for aquatic life, including micro-organisms, plants and animals, many micro-organisms, which together play a very vital role in ensuring the health of many ecosystems. India is bestowed with many rivers and tributaries. Many of them originate from the Himalayas, other mountain

4. Singh, D. S. (Ed.). (2017). *The Indian Rivers: Scientific and Socio-Economic Aspects*. Springer.

5. Nilsen, A. G. (2010). *Dispossession and resistance in India: The river and the rage*. Routledge.

ranges and a few from groundwater and either flow into the Bay of Bengal or the Arabian Sea passing through numbers of rural and urban habitations. The flow of each river is determined by the watershed and physical feature of the country. In India, the Ganga, the Indus, the Brahmaputra, the Mahanadi, the Narmada, the Krishna, the Kaveri (or the Cauvery) and the Godavari are major river basins.

Rivers are a major form of water commons. While travelling for miles through mountains, plains, forests, grasslands, villages and cities, it nurtures everything alongside till reaching the sea. In order to keep the valley nurtured, it has to remain healthy in terms of adequate, incessant water flow and free from pollution for the survival of both aquatic and externally dependents. Rivers are not simple channels of water at varied flow intensity. Rivers must flow free.

There have been debates about economic flow and ecological flow of the river, but the ecological flow is a must. Ecological flow describes the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystem and human ensuring their well-being.⁶

Ramaswamy Iyer (2005), advocated the importance of distinguishing between in-stream flows for different purposes: "Flows are needed for maintaining the river regime, making it possible for the river to purify itself, sustaining aquatic life and vegetation, recharging groundwater, supporting livelihoods, facilitating navigation, preserving estuarine conditions, preventing the incursion of salinity and enabling the river to play its role in the cultural and spiritual lives of the people."⁷

Though a healthy and diverse ecosystem and ecology, are integrally connected and inseparable from human health, not much has been done to protect the environment. The consequences of the unbridled pillage of natural resources, expanding industrial and mining activities and the adverse impact of all forms of pollution are often ignored.

6. <http://www.eflownet.org/viewinfo.cfm?linkcategoryid=4&linkid=64&siteid=1&FuseAction=display>

7. Iyer, R. R. 2005. The Notion of Environmental Flows: A Caution NIE/IWMI Workshop on Environmental Flows, New Delhi, March 23-24, 2005.

However, for the healthy survival of planet Earth and all living beings, including humans, we need clean air, water, fertile soil and healthy ecosystems with rich biodiversity. Different aspects of ecology are interconnected and interdependent. The varieties of ecosystems, including forest, grassland, wetland and water bodies, need to be protected from the onslaught of polluting and over-extractive industrial processes. However, the unchecked exploitation of natural resources and rapid growth of urbanisation has not only destroyed the ecological balance of river ecosystems, has endangered the lives of plants, animals and human life.

River pollution

With the advent of rapid industrialisation, construction of dams, open cast mining activities, heavy transportation, increasing use of automobiles, growth of urbanisation, different forms of pollutants emerged on the river bank. These pollutions have been growing at an uncontrollable pace and primarily rivers; have been converted into drains, which carry both urban and industrial wastes in massive scale by affecting the aquatic lives and the people living along rivers. Rivers are also facing the threat of choked flow and pollution. Restricted flow is also a significant reason for unclean and polluted river condition.

Construction of dams along rivers not only restrains the river flow but also increases the level of pollutants in river water. On the one hand, flow is checked, and on the other all kinds of pollutants are dumped in the river, nearly suffocating the river and all aquatics living in it.

According to the UN World Water Development Report of 2003, India's water quality is placed at 120th among a list of 122 countries.⁸ Most of the rivers of India are polluted. The Fifth Citizen's Report of the Centre for Science and Environment states that: "India's rivers, especially the smaller ones, have all turned into toxic streams. Moreover, even the big ones like the Ganga are far from pure. The assault on India's rivers

8. Unesco. (2003). *The UN World Water Development Report: Water for People, Water for Life*. Unesco.

– from population growth, agricultural modernisation, urbanisation and industrialisation – is enormous and growing by the day.... Most Indian cities get a large part of their drinking water from rivers. This entire life stands threatened.”⁹ As a result, the entire river-linked biodiversity is at threat in India and people, aquatic lives and agriculture, are the worst victim of it.

Recognising that India is facing the “worst water crisis in its history” the NITI Aayog developed a Composite Water Management Index to enable effective intervention in States to improve the situation. The results from the application revealed that most States achieved a score below 50 per cent, indicating that significant improvement was required in their water management practices. It was encouraging that States facing the most severe scarcity were leaders in the index performance and that across the board water management was improving. However, the low performers on the water index were home to around 50 per cent of India’s population – and this posed a severe risk to people welfare and food security.¹⁰

Efforts have been made to clean rivers. If we look at the river Ganga, the Ganga Action Plan (GAP) was launched on June 1986, covering 25 towns of Uttar Pradesh, Bihar and West Bengal. The object was to improve water quality, the diversion and treatment of sewage and to prevent toxic and industrial chemical waste from identified polluting units near the river. National River Ganga Basin Authority (NRGBA) established in on 20th February 2009 declared Ganga as ‘National River’, and in 2011 World Bank approved \$1 billion to this authority to build institutional capacity to rejuvenate the river on five major states of Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal. Namami Gange Programme was launched on 10th July 2014 for a minimum 10-year period and adopt a public-private-partnership (PPP) and special purpose vehicle (SPV) approach for pollution hotspots. The Namami Gange Programme focused on diversion and treatment

9. Agarwal, A., Narain, S., & Sen, S. (Eds.). (1999). *The Citizens’ Fifth Report* (Vol. 5). Centre for Science and Environment.

10. The Niti Aayog -‘A Composite Water Management Index’ report from June 2018, <http://pibphoto.nic.in/documents/rlink/2018/jun/p201861401.pdf>

of wastewater flowing through open drains through bio-remediation, appropriate in-situ treatment, use of innovative technologies, sewage treatment plants (STPs), effluent treatment plant (ETPs); rehabilitation, augmentation of existing STPs and immediate short term measures for arresting pollution at exit points on the riverfront to prevent the inflow of sewage.¹¹ In reply to an RTI query, the Jal Shakti Ministry recently shared that in the past six years, water quality in the river Ganga has improved. Data from 27 locations shows that dissolved oxygen (DO) has increased, making aquatic life more possible. In 42 locations, the biochemical oxygen demand (BOD) has shown decrease showing less organic pollution, and in 21 location faecal coliform (FC) has decreased, indicating greater suitability for consumption.¹² Several projects have been launched to clean the Yamuna and also other rivers. Despite all efforts, and some improvement, rivers continue to be polluted.

Amidst the criticality of water and air pollution, a ray of a solution emerged from COVID-19 lockdown when changes in water and air quality become visible in different locations. People felt the changes and different media reflected it in their reports. Not just in terms of reduced impact of air pollution¹³ but also in terms of cleaner water and healthier fish stock.¹⁴

COVID-19 pandemic and the accompanying lockdown provided us with a rare opportunity to introspect about the State of our rivers, their waters, their ecosystem and related issues of human health and the ecology and environment. The need for assessment of these

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11. <https://nmcg.nic.in/ngrbaread.aspx>
 12. <https://www.hindustantimes.com/india-news/may-take-decades-to-clean-ganga-water-say-experts/story-jlafKgSUMi8h3EF6E9qQ6J.html>
 13. <https://www.thehindu.com/sci-tech/energy-and-environment/covid-19-lockdown-like-interventions-may-help-combat-air-pollution-in-india-say-scientists/article31746151.ece> ; <https://edition.cnn.com/2020/03/31/asia/coronavirus-lockdown-impact-pollution-india-intl-hnk/index.html> ; <https://www.bbc.com/news/world-asia-india-52313972> ; <https://www.hindustantimes.com/mumbai-news/cleaner-air-could-bring-down-pollution-deaths-by-6-5-lakh-in-india-study/story-KbvzbepYakX2MYpPz2smN.html>
 14. <https://timesofindia.indiatimes.com/city/delhi/lockdown-high-yamuna-water-records-more-oxygen/articleshow/77698061.cms> ; <https://theprint.in/india/ganga-water-became-fit-for-a-dip-aquatic-life-at-many-places-in-lockdown-iit-study-finds/491933/> ; <https://india.mongabay.com/2020/08/west-bengal-fishermen-observe-fewer-shrimp-and-fish-deaths-by-pollution-this-year/> ;

environmental changes and to collect evidence was felt strongly. ActionAid Association was thus motivated to design this study taking into account restrictions and limitations imposed by the lockdown. This represents the small effort to put the findings before the Government, policy makers, civil society organisations and all stake holders in the hope that these efforts would help to develop and adopt strategies to address environmental problems particularly in cleaning river water.



Study Overview

As mentioned in the earlier chapter over-extractive and polluting industrial processes and agricultural activities had become a significant challenge for the health and vibrance of various water commons, and especially rivers. The flow of rivers has been reduced and subverted by dams, irrigation processes, and the courses of rivers and their floods plains are being infringed on due to unplanned urbanisation and forced settlement by vulnerable communities. Rivers are fast becoming mere carriers of all forms of pollutants, including industrial waste, urban sewerage, construction waste and other pollutants.

Impact of lockdown on river ecology

In about approximately two months of complete lockdown on all human, industrial and commercial activities, there was an improvement in river water quality proved with water testing and open visibility. Two months Coronavirus-induced lockdown did what successive governments could not do in 25 years despite infusing a big budget of 50 billion rupees to clean Yamuna River. A finding by the Delhi Pollution Control Committee (DPCC) shows that in Delhi, compared to the pre-lockdown days, the river Yamuna is now cleaner by around 33 per cent. Additionally, the committee found that the water improved further downstream near Mathura. “The river has cleaned itself using its own biological capacity. Now, state governments need to ensure that industrial waste is not dumped into it again,” said Diwan Singh, an environmental conservationist who has been working for the revival of water bodies in Delhi, especially the Yamuna River. He says the level of pollution has reduced, making the river’s water clearer near Etawah where the water from Chambal River further dilutes the pollution. “I am amazed at the effect the lockdown has had on all rivers, I have been associated with the Yamuna Action Plan since the year 2000 and I have never seen the river this clean,” says Rajeev Chauhan,

a conservation officer with the Wildlife Institute of India-Dehradun, who has been studying the Yamuna River for the past 30 years.¹

Suresh Semwal, president, temple committee of Gangotri Dham, told India Today TV: “The holy river has cleaned itself to a large extent during the lockdown and the government should not allow people to come for Chardham Yatra. They should seek blessings of the holy river by remaining inside their houses.” “The water of the river Ganga near Uttarkashi is looking very clean in the absence of pilgrims. The lockdown has proved to be a boon for the river as nature itself has done what we could all not do,” Ajay Puri, the Mahant of Kashi Vishwanath Mandir said. NGO Ganga Vichar Manch convener Lokendra Singh Bisht said: “We have been working in the area for many years now, but the kind of cleanliness that we see now is unprecedented for me. I hope we are able to keep it this way for times to come.”²

“What could not be achieved in last 34 years since the inception of Ganga Action Plan (GAP) in 1986 and the launch of ‘Namami Gange’ in 2014, with hundreds and crores of rupees being pumped in, is visible in just 34 – 35 days of lockdown,” said Prof B.D Tripathi, chairman of Mahamana Malavya Research Centre for Ganga, River Development and Water Resource Management, Banaras Hindu University (BHU). Similarly, in Prayagraj, the lockdown has been a blessing for pollution ridden Ganga and Yamuna. A comparison of the quality of water of the two rivers on three different dates - March 13th, April 9th and April 30th – shows how clean the rivers have become. With industries closed because of lockdown, fewer people visiting river bank and substantial decline in the volumes of effluent discharged in the two rivers, pollution levels in Ganga and Yamuna at Prayagraj has declined. According to J. B Singh, of the regional office of the U.P Pollution Control Board, results of the samples

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1. Matters India (May 27th 2020), Lockdown helps India’s River to self - clean
<https://mattersindia.com/2020/05/lockdown-helps-indias-dirtiest-river-to-self-clean/>
 2. Negi Manjeet (June 6th, 2020) Lockdown impact: Ganga in cleanest phase now, *Lockdown has helped Ganga regain its purity and activists want it to remain that way.*
<https://www.indiatoday.in/mail-today/story/lockdown-impact-ganga-in-cleanest-phase-now-1686073-2020-06-06>

collected from the rivers on those dates showed there was a remarkable drop in pollution level during the lockdown period.³

The nationwide lockdown was imposed on March 25th, 2020, and within ten days, signs of improvement in water quality started surfacing. According to the real-time water monitoring data of the CPCB, out of the 36 monitoring units placed at various points of the Ganga river, the water quality around 27 points was found suitable for bathing and propagation of wildlife and fisheries. On April 4th, at Varanasi's Nagwa Nala, the dissolved oxygen (DO) values were found increased to 6.8 milligram/litre against 3.8 mg/litre on March 6th, showcasing an extraordinary improvement of 79 per cent in DO values. Dr PK Mishra, Professor of Chemical Engineering at the Indian Institute of Technology, Banaras Hindu University, attributed these changes to industrial lockdown and rainfall on March 15th and March 16th, that increased the water levels of Ganga.⁴

The Pollution Control Board conducted a study of the quality of Narmada water in Khandwa, Khargone, and Barwani districts in April 2020. The results indicated that 'Grade A' quality water in the river, which flows through 14 districts of Madhya Pradesh. Dr Ravi Upadhyaya, a Professor of Botany at Government PG College Pipariya-Hoshangabad, conducted a study of the water of the Narmada in Hoshangabad on four parameters – the pH value of water the presence of dissolved oxygen, suspended solids and faecal coliform. On all four parameters, there was a sea change in quality before and after lockdown. "This meant the water in the river had become very transparent and clear and of superlative quality," Dr Upadhyaya informed. "There has been remarkable growth in plants in the river bank's riparian zone, spawning activity (release and deposition of eggs) of indigenous fish varieties and the stay of migratory birds like

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3. Singh Binay, Mishra Ananta Shekher & Mani Rajeev (May 21st 2020), How lockdown has been a gift for Ganga, Times of India.
http://timesofindia.indiatimes.com/articleshow/75569852.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst_prime
 4. Singhal Sumitra & Matto Mahreen (April 29th 2020), Covid – 19 lockdown: A ventilator for rivers, Down To Earth,
<https://www.downtoearth.org.in/blog/covid-19-lockdown-a-ventilator-for-rivers-70771>

Surkhab and Comb Ducks too has stretched up to May first week in contrast to March end of the past," he added.⁵

There were signs of rejuvenation and a significant improvement on many parameters in the Ganga River. Increasing trends of dissolved oxygen (DO) and decreasing trends of biological oxygen demand (BOD) and nitrate (NO₃) concentration has been found. The river becomes fit for drinking (Class A) in the upper stretches and fit for outdoor bathing (Class B) in the middle and low stretches.⁶

A technical study conducted in April 2020, at six different points of Ganga River along Kolkata proved the positive effect of lockdown on river ecology. The study confirmed an improvement in water quality in context to DO (Dissolved Oxygen) level, which is congenial for aquatic biodiversity. The DO level, which supports the aquatic biodiversity, is a function of several physical, chemical and biological factors. In the rivers, the physical factor encompasses ripples, tides, wind-generated waves etc. through which diffusion of atmospheric oxygen occurs at the air-water interface. The oscillation of DO levels has a far-reaching impact on the biotic community. A comparative analysis with baseline data indicated improvement in DO level within one month of lockdown (March 25th 2020).⁷

Clean rivers and healthy aquatic life symbolise that the ecosystem is functioning well. Many rivers have shown signs of rejuvenation and a significant improvement on many parameters, following the eight-week nationwide lockdown due to coronavirus pandemic.

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5. Singh Anurag, (May 15th 2020), Lockdown cleans up Narmada River as water quality improves in MP, Indian Express
 6. Dutta Venkatesh, Dubey Divya & Kumar Saroj (June 2020), Cleaning the River Ganga: Impact of lockdown on water quality and future implications on river rejuvenation strategies, Science of The Total Environment. <https://www.sciencedirect.com/science/article/pii/S0048969720342807>
 7. Indrani Dhar, Sujoy Biswas, Ankita Mitra, Prosenjit Pramanick & Abhijit Mitra COVID-19 Lockdown phase: A boon for the River Ganga water quality along the city of Kolkata (June 2020), <https://www.researchgate.net/publication/341881732>,

Methodology

Objectives of the study

1. To study the impact of national lockdown on river ecology.
2. To assess the impact of lockdown on major rivers in terms of quality of water.
3. To find out the impact of water quality on aquatic species and migratory birds.
4. To assess water quality effect on agriculture, household consumption and other requirements for socio-religious functions.

Study universe

The study universe covered ten rivers as they cut across ten states at different points to get a holistic view of different communities. (Please see Table 3.1)

The river Ganga arises from the Gangotri glacier in the Himalaya mountains near Gaumukh, and it travels through Uttarakhand, Uttar Pradesh, Bihar and West Bengal in India till it reaches the Bay of Bengal in Bangladesh, in the world's largest delta region that stretches across both the state of West Bengal in India and Bangladesh. The Yamuna river originates from the frozen Champasar lake located in Bandarpooch glacier, above Yamunotri which is regarded as the origin of the river. The Yamuna travels through Uttarakhand, Himachal Pradesh, the border of Haryana and Uttar Pradesh, Delhi, reenters Uttar Pradesh and joins the river Ganga at Allahabad in Uttar Pradesh. The river Gandak rises from the Great Himalayan Range in Nepal and travels through along the border of Uttar Pradesh and Bihar, till it joins the river Ganga in Bihar. The river Gomati originates from the Gomat Taal (Fulhaar Jheel) in Pilibhit, Uttar Pradesh travels through Uttar Pradesh and meets Ganga near Saidpur in Ghazipur district of Uttar Pradesh. The river Narmada rises in the Amarkantak

Table 3.1: Locations on rivers where respondents were located

Sl. No.	Name of the River	State	Location
1	Mahanadi	Odisha	Sambalpur district (Chamunda, Kansar and Meghpal)
2	Gandak	Uttar Pradesh	Maharajganj district (Nichloul) and Sonbhadra district (Doma)
3	Narmada	Madhya Pradesh	Alirajpur district
4	Ganga	Uttarakhand and Uttar Pradesh	In Uttarakhand: Chamoli district In Uttar Pradesh: Varanasi district
5	Yamuna	Uttar Pradesh and Delhi	In Uttar Pradesh: Agra district, Mathura district (Vrindavan and Mathura). Delhi
6	Gomati	Uttar Pradesh	Lucknow district, Amethi district and Sultanpur district
7	Krishna	Andhra Pradesh and Telangana	In Andhra Pradesh: Krishna district (Vijayawada and Tummalapalem), Guntur district (Muttayapalem), and West Godavari district (Surya palem) and Guntur district (Rayapudi). In Telangana: Nalgonda district
8	Kaveri	Karnataka	Chamarajnagar district (Kolegal block), Ramnagar district (Malevally block), Mysore district (HD Kote)
9	Nagavali	Odisha	Raygada district (Kalyanasinghpur)
10	Godavari	Maharashtra	Nashik district

plateau in Anuppur district, Madhya Pradesh, travels through Maharashtra and meets the Gulf of Cambay in Gujarat. The Godavari river originates from the Brahmagiri mountain, in the Triambakeshwar mountain range

in Nashik district of Maharashtra, it travels through Telangana and enters into the Bay of Bengal in Andhra Pradesh. The Mahanadi river arises from the hills of southeastern Chhattisgarh, travels into Odisha, where it enters the Bay of Bengal at False Point. The river Nagavali originates from a hill near Lakhbahal village in Thuamul Rampur block, Kalahandi district of Odisha, and merges in the Bay of Bengal in Andhra Pradesh. The source of the Krishna river source is at Mahabaleswar near Jor village in the extreme north of Wai Taluka, Satara District, Maharashtra in the west, it travels into Karnataka and Telangana and empties into the Bay of Bengal at Hamasaladeevi (near Koduru) in Andhra Pradesh. The river Kaveri (Cauvery) rises at Brahmagiri hill of the Western Ghats at Talakaveri, Kodagu district in Karnataka, passes in Tamil Nadu where it empties into the Bay of Bengal through two principal mouths in Poompuhar.¹

Respondents

The study adopted a stratified random sampling method for the selection of the respondents. Communities living on the bank of rivers and dependent on the water source were contacted. Also, people who depended on the river either directly or indirectly were reached out to understand the impact of lockdown on river ecology. Efforts were made to reach out to diverse communities located in different places along the river bank.

The number of respondents covered from each river valley is 50 from various locations. A total of 550 (500 plus 50 from Uttarakhand for upper Ganga region) respondents were interviewed for this study. Efforts were made to reach out to communities on different locations on the river to cover all issues and get diverse opinions of people.

A simple questionnaire to collect information either over phone calls or through messages was developed. The questionnaire was shared with water volunteers and investigators, who collected primary data from the field. The quantitative data tabulation and analysis were done in MS Excel. The volunteers captured case studies.

1. <https://knowindia.gov.in/profile/rivers.php> <https://www.britannica.com>

Limitations

- » Reaching out to people in person was a big challenge. It was difficult for our volunteers to physically visit and contact people for information due to continued nationwide lockdown.
- » In many places, there were shutdowns and containment zones declared. Non-availability of transportation to reach many locations was another hurdle.
- » The only way of collecting information was through mobile phone, whose number was available and accessible during the time of this study.
- » Many phone numbers were not reachable very often due to network connectivity issues.
- » In some places where volunteers could reach the river bank locations, not many people were available for interaction or avoided due to corona fear.

Study Results & Analysis

This study presents information collected from respondents through a questionnaire prepared with the objective of getting the people to reflect on the changes in quality of river water, changes in the presence and availability of aquatic species, changes in river ecology due to COVID-19 lockdown and in river water consumption patterns. Along with the responses to the questionnaire, people's remarks, comments, statements and case studies from different locations were also collected by the investigators to substantiate the study findings. Apart from primary data from the field, secondary data analysis has been done about the impact of lockdown on river ecology.

Changes in quality of river water

This study was intended to act as an exploratory exercise to examine the changes perceived by people and make some tentative analysis of its implications for the overall river ecosystem.

One of the major objectives of this study was to assess the impact of lockdown on quality of water in terms of colour, odour, level of pollution, amount of industrial, domestic and hospital waste in different river water. Although data for individual rivers on these aspects have been collected and analysed, the findings were drawn from taking all 10 rivers together. The study found that more than 70% respondents expressed increase in colour of the water indicating cleanness, around 20% said there is decrease in water colour indicating dirtiness of water and less than 10% said there is no change in colour. As regards to bad odour from river water due to pollution and other garbage, around 80% felt decrease in bad odour, 10% said increase and 10% said there is no change.

The most important findings of this study is decrease in industrial pollution in river water as expressed by more than 95% respondents and only less

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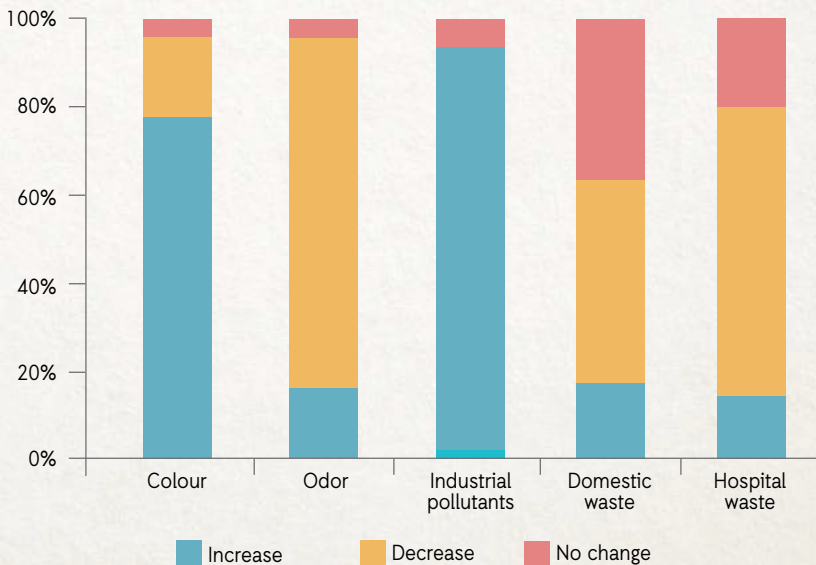
An assessment of the impact of COVID-19 lockdown

than 5% said there is no change. This is because of complete shutdown of industries and stop releasing effluents to river due to lockdown.

The study further found there has been decrease in domestic and hospital waste as expressed by 40% and 60% respondents respectively. Around 30% respondents said there no change in domestic waste 20% said no change in disposal of hospital waste into river water. This data varies from river to river as hospitals and urban set ups are not in every data collection points or locations. As a whole, there have been visible changes in quality of water in different rivers due to lockdown and reduction in discharge of pollutants or waste into the river. People could feel the difference within this limited period of shutdown.

Yogesh Kumar age 35 from Etowah has a shop in Agra close to the Yamuna river. After the lockdown situation improved he returned back to his village and shared that river water use to stink so foul that it was not easy to stand nearby. But after lockdown all effluents coming from

Figure 4.1: Changes in quality of river water



Delhi drastically reduced as industries got shut and with that colour and odour of Yamuna changed. Even the foul smell was spreading beyond 100 km till other village locations. In case of the Ganga river, Ravi Prakash from Kanpur informed that pollution level was too high in the river. "All effluents were visible in patches, along with bad odour river looked black. No one could think of going near the Ganga though we worship her as Devi. Forget about taking a dip, it was difficult to pass by the river side. However, all factories being closed down there are no industrial discharge to the river. Now the river water quality has improved around 40% to 50% making life easy for all of us."

Anjali Singh, 29 years old from Lanka, Varanasi shared that "Ganga had become a dumping ground for all pilgrims. They come and drop their old cloths, discarded idols and all kinds of religious items while taking a dip. Entire river water near Daswashmedha Ghat becomes dirty with offered shaved hair often floating in water. Ganga has some limit to carry our sins in the form of dirt but how much it can? In addition all industrial pollutants flow from upstream this way downwards. But due to lockdown no pilgrims were allowed and all factories and industries were closed. This was a great relief for Ganga Ji and all of us residing on the bank. Now water is so clear and we feel like taking dip any time of the day. All ghats are neat and clean water looks transparent and blue with clear visibility of swimming fish. Now after lockdown ends government must take care to continue Ganga River the way it is now. Simply putting money in projects will not help clean Ganga – it requires our especially women's involvement to keep it clean. Also all industries polluting Ganga must be punished."

Changes in aquatic species

Life is thought to have originated from an aquatic environment. Numerous aquatic species including plants, animal and small living organism grow in marine as well as fresh water bodies. Some organisms are adapted to flowing water in river while many more exist in stagnant water. Aquatic lives are threatened due to water pollution, destruction of biodiversity and climate change. All these possess considerable threat to aquatic life. But any reduction in water pollution level has positive effect.

The month-long lockdown due to corona virus lead to decrease in pollution level in major rivers. The study found that there have been changes in aquatic life in water. People perceived that presence of fish and other aquatic species have increased due to decrease in water pollution. Aquatic plants like algae have come up in many places as expressed by local people. Almost 100% respondents expressed that there has been increase in aquatic species in Mahanadi, Narmada, Ganga, Yamuna and Nagavali while there was large majority reported increase of aquatic life in Krishna (75%), Kaveri (70%), Gandak (75%), Godavari (80%) and Gomati (78%).

This finding indicates that due to shutdown of industries on river banks and decrease in river water pollution, there has been visible changes in aquatic life. This change has not been taken place in rivers before despite of measures taken to control pollution and clean river.

Sadul age 35 years from Baluatola of Nichlol, Maharajganj shared that “both I and my father Magru use to do fishing. When I was 17 years old, my father passed away. Since than I have taken over this as my profession, being the eldest son of the family and to support six member families, I have to work hard and look for good quantity of fish in river. Since last few year fish variety and quantity started reducing in the river. As a result many of my friends went in search of labour work to different cities. However, with this lockdown, I am in a better position. Because now there is increase in fish quantity and sizes are big enough, also I don't get to see floating waste in the river. That allows fish to grow better. So now I am earning good amount of money by selling fish and at home able to cook some fish and rice (provided by government as ration).”

Umesh K age 48 from Mandya resides on the river bank of Kaveri he informed that “I have a family of six members, In my family, two of my sons could not study due to extreme poverty conditions. Now both of them accompany me for fishing. Elder son is married, he has a daughter of 2 years and we live together. Since last 30 years we are into fishing profession and we observed slow decline of fish variety and size. However, after lockdown not only river water looks clean and deep blue but we get good size fish. However, during lockdown all markets were

Figure 4.2: Changes in aquatic species I

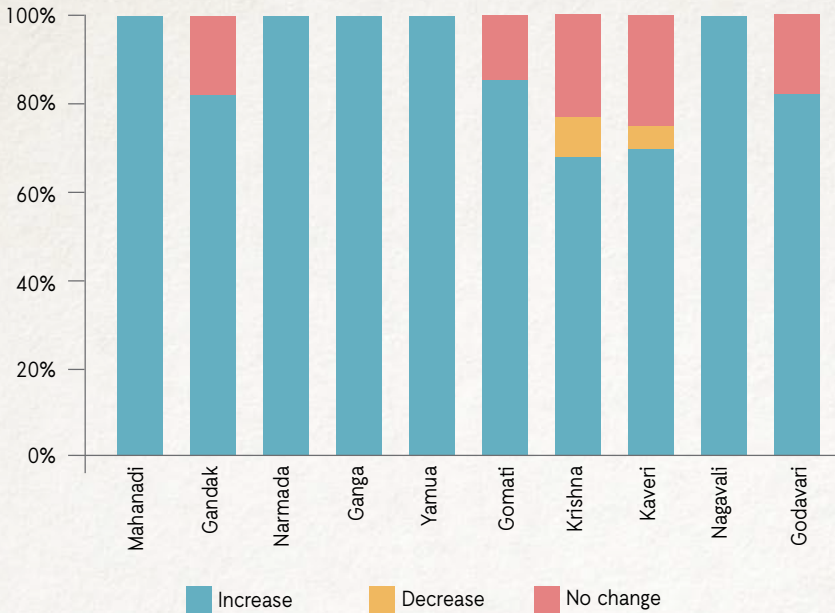
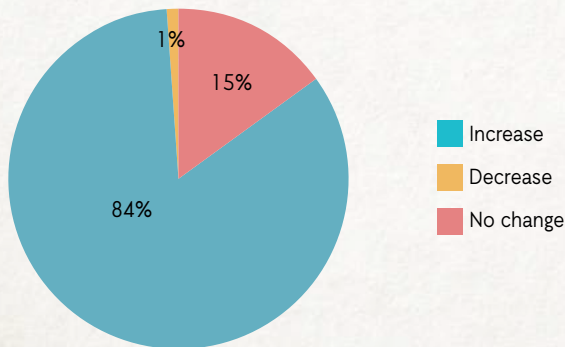


Figure 4.3: Changes in aquatic species II



closed so we could not sale fish. So we dried the fish to store for the year for our own consumption and to be sold after markets reopened. Also after many years we could eat a lot fish as didn't get any other items from market. After unlock started we could sale goof amount of fish in a good price. This is the result of pollution free clean river and we request

government to keep it clean always. So that poor people like us get both good foods at home a fair business in the market.”

In an overall situation taking all rivers together, the study reveals about positive changes in water quality of the river, which helped in improving river biodiversity with increased fish population and visibility of new species. 84% of the respondents shared about increasing number of fish population in the rivers. The fishermen, had opted other employment out of compulsion since, fish population remarkably dwindled earlier due to heavy pollution, now some of them have returned to their traditional occupation i.e. fishing & selling during such a crisis period. Also many have secured their daily food requirement of rice, fish and crab.

Presence of migratory birds

Presence of migratory birds around any water bodies is a positive indicator of biodiversity and less human interference. This has happened due to COVID-19 lock down. The study findings reveal that presence of migratory bird has increased around major rivers of Ganga, Yamuna, Mahanadi and Kaveri up to 100%. Increase in case of Gandak, Gomati (80%) each and Narmada, Nagavali (70%) each.

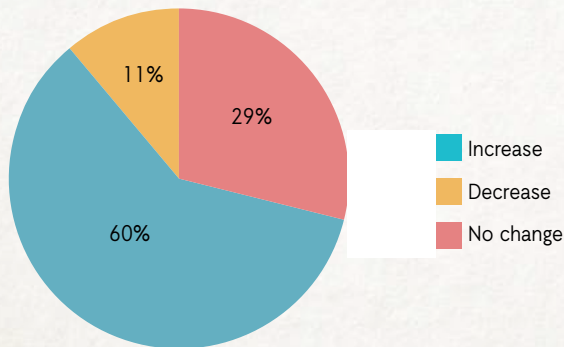
Besides, the overall scenario indicates that 60% of respondents shared that there were increasing number of migratory birds seen in the rivers during the period, it might be due to reduced pollutants as well as increase in the health of river biodiversity and lockdown. Decrease in human interference and reduction in tourist on river banks and other water bodies lead to this increase in number of migratory birds. This indicates that nature has its own healing process to maintain biodiversity, provided there is no human intervention. A short period of lock down has substantiated this truth. People in many places have experienced changes in natural process.

Suranjan Pradhan 32-year-old man from Sambalpur, Odisha resided on the bank of Mahanadi. He works in an NGO office nearby. He shared that “during this time of the year number of birds decline in the area and we get to see hardly three to four varieties visiting the river bank.

Figure 4.4: Presence of migratory birds I



Figure 4.5: Presence of migratory birds II



But this year after lockdown this situation has changed. Now more than twenty varieties of bird play around on the river bank. It's such a pleasant site to watch them hop from one place to other and varieties of sound they make. Morning and evening times are the best time to watch birds sitting in calm and quite atmosphere. I have started identifying birds and

try to imitate their sound and also get their response. I think this is all happening because river water is clean and clear now and the vegetation around has grown without much human interference that provides birds food and shelter. May be this is river ecology that I read in books. Since my house is nearby often birds tap on the glass window as if they are calling me to come out and play with them. It's high time we all and the govt. learns a lesson from this lockdown and controls pollution for the survival of all living beings in and around river bank, so that our biodiversity gets enriched."

Changes in visits of tourists

One of the major impacts of COVID-19 lockdown is reduced movement of people including tourists. People visit river banks for religious rituals and rituals related to other functions of life like birth, death and marriage. During lockdown there were no public transport facility and people were not allowed to gather for any function. Round the year, highest number of tourist visit to river bank of Ganga, Yamuna, Narmada, Godavari and Kaveri. Where sharp drop of tourist was notices ranging from 80% to 100%. However, incase of Nagavali and Gandak which attracts relatively less tourists did not witness much change. Visit of large number of tourist has different impact on river and its water. Tourist visit has almost stopped during lock down impacting on river water, local business, hotels and transport. Often irresponsible tourism takes a toll on ecology and contributes to polluting river bank and water by dumping garbage and types of waste.

As regards to the overall situation, the study found that 78% of the respondents shared that visits of tourists stopped and 21% of the respondents reported no change in visits of tourists due to lockdown. However decrease in number of tourist visit to river banks has contributed in keeping the river water clean and safe and maintain in river ecology.

With no tourist visiting river bank of Yamuna at Brindavan, pollution level has drastically reduced. Savitri Devi residing near Chir Haran Ghat shared that "all the time tourists came to this bank of Yamuna and dirtied the entire place with a lot of plastic and other discarded items. We had no

Figure 4.6: Changes in visits of tourists I

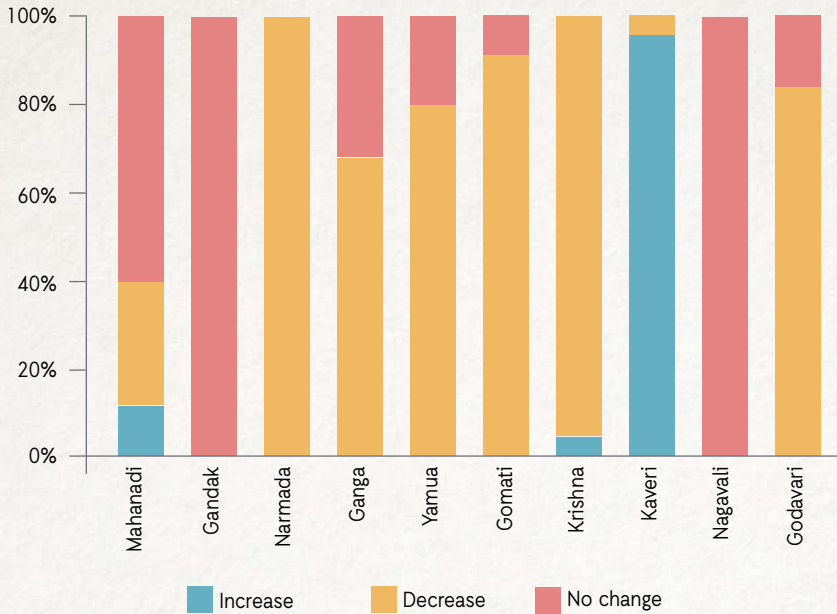
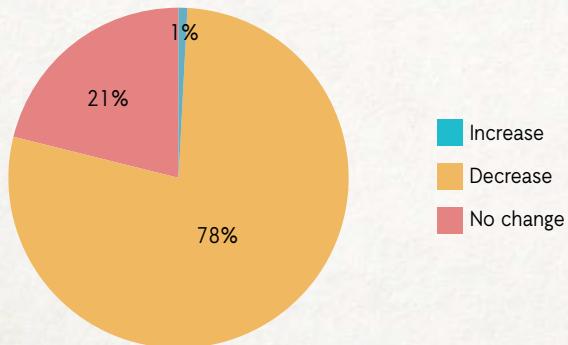


Figure 4.7: Changes in visits of tourists II



place to step in clean area, while approaching the river. Also number of dogs and stray cows roamed around eating such garbage, that sight was painful and the area use to have foul smell always. Several times we approached the municipality office but that did not work. However, when all transport system closed and no one was allowed to move around, this

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place has become clean as never before. At time we come and sit on the back and watch clean Yamuna flowing in front of us and the sight is really soothing.”

In Ganga River many boatmen depend on tourist for their livelihoods. They ferry tourist to all the eighty four ghats and earn a good income. Apart they ferry people from one side to the other side for a dip and worship of Ganga. However, during lockdown, that got affected. Rupesh Majhi from Asi ghat reported that “after lockdown visit of tourist completely stopped and for days I had no work at hand. There no tourist to ferry and no other work available around. Along with fair I used to earn good amount of tips. But everything stopped in the season and this is the most difficult time to manage my living.”

Transport system in river water

Nationwide lockdown has impacted road transport, rail, air and transport system in water ways. Since everything was closed and people feared

Figure 4.8: Transport system in the river I

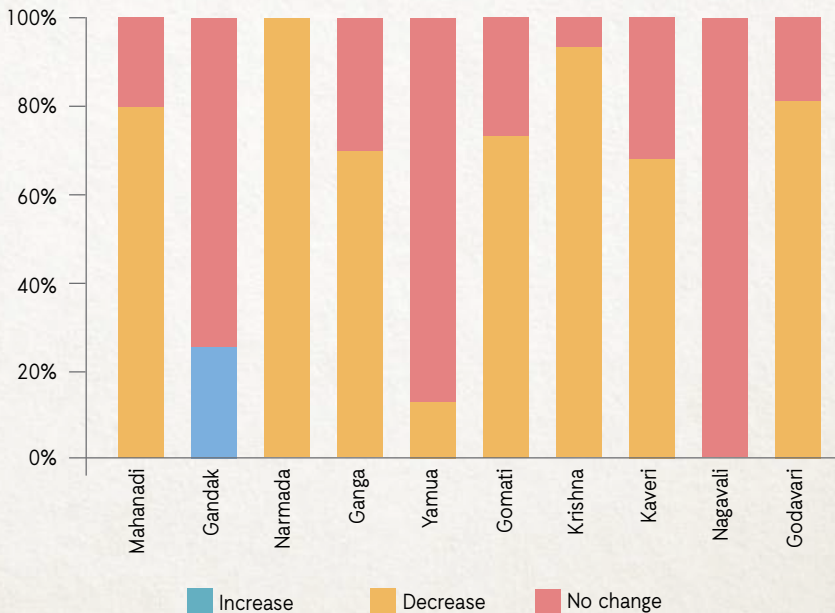
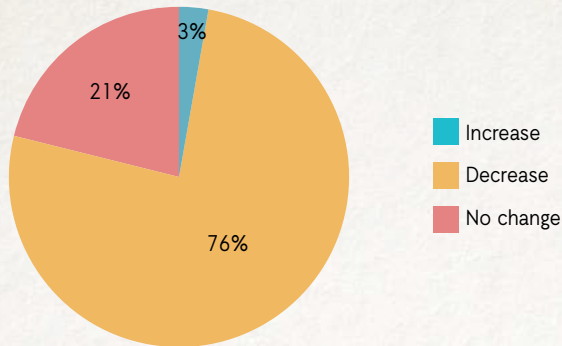


Figure 4.9: Transport system in the river II

corona infection, no one was willing to travel anywhere. Also no one was welcome at any friend or relatives' place.

Hence of all the rivers reported, Narmada, Nagavali reported 100% reduction in transportation. While Ganga reported 60% and Krishna 80%, Mahanadi 80%, Godavari 70%, Kaveri 60%, Gomati 60% reduction.

When it comes to overall situation, 76% of the total respondents shared that there was reduction in transportation in the river and 21% respondents reported no change.

As a result of reduced transportation in river related pollution of fuel oil spill, smoke also reduced drastically.

River water use for domestic purpose

People use river water for different purposes starting from bathing to cleaning, washing and even for drinking purpose. But due to massive pollution, people in different river bank villages stop using river water. COVID-19 lockdown has brought changes in quality of water, reduction in pollution and other chemical pollutants. As a result people have started using this water for different purposes. The study found that increase in river water use for bathing, cleaning and washing in Gandak, Narmada, Yamuna, Nagavali was 100%. In case of Ganga, Godavari, Krishan and Kaveri the pattern varied from 80% to 25%. People have stopped using

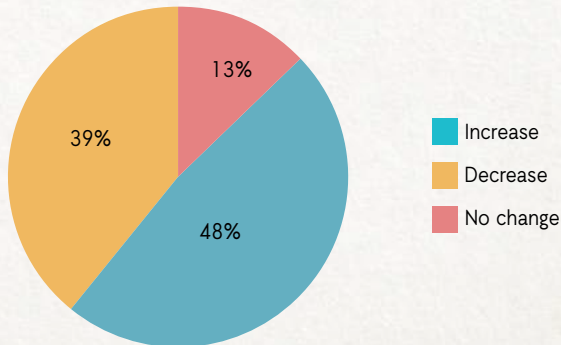
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Figure 4.10: River water use for domestic purposes I



Figure 4.11: River water use for domestic purpose II



Mahanadi river water for bathing because of massive industrial pollution by big industries which has not stopped during lockdown. There is no change in using river water of Gomati and to some extent Ganga river as per study findings.

As regards to overall findings of all rivers together, 48% respondent said increase in use, 39% expressed decrease and 13% said no change in use of river water for washing and cleaning purposes. This indicates that people need clean water to use for their personal use, but pollution has made the water unused. A small period of lockdown and shutdown of polluting industries could change the quality of water and encouraged people to take bath clean and wash their belongings in river water.

Reena from Lucknow, living on the bank of Gomati sells fruits on road side. She shared "that often we don't get public tap water on time to wash cloths or take bath and cook food. But despite having a river next to us we were not able to use its water, as over the years Gomati has become a drain for the city. However, with lockdown; river condition is changing and the water is now suitable for bathing ad washing clothes and looks clear. If it continues this way someday it may become suitable for even drinking. Since everyone can never get individual water supply connection to their houses, its important responsibility of the government to keep rivers clean and not allow any industry or household effluents to pollute river water."

Use of river water for agriculture

People living on river bank use its water for agriculture purpose. That is one major contribution of river to the local economy. Use of river water for agriculture has reduced over the years because of pollution. COVID-19 lockdown has brought changes in this use. The study found that there is increase in use of river water for agriculture in Ganga 100%, Godavari & Nagavali 75% and Krishna & Gandak 60%. This indicates betterment of river water for agriculture purpose.

Taking together findings of all 10 rivers reveals that 47% respondents said there was increase, 35% said decrease and 18% said no change in use of river water for agriculture purposes. People from every locations expressed that use of river water now seems to be safe for agriculture. It is important to minimise industrial pollution and use river water for agriculture and other domestic purpose including livestock use.

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Figure 4.12: River water use for agriculture I

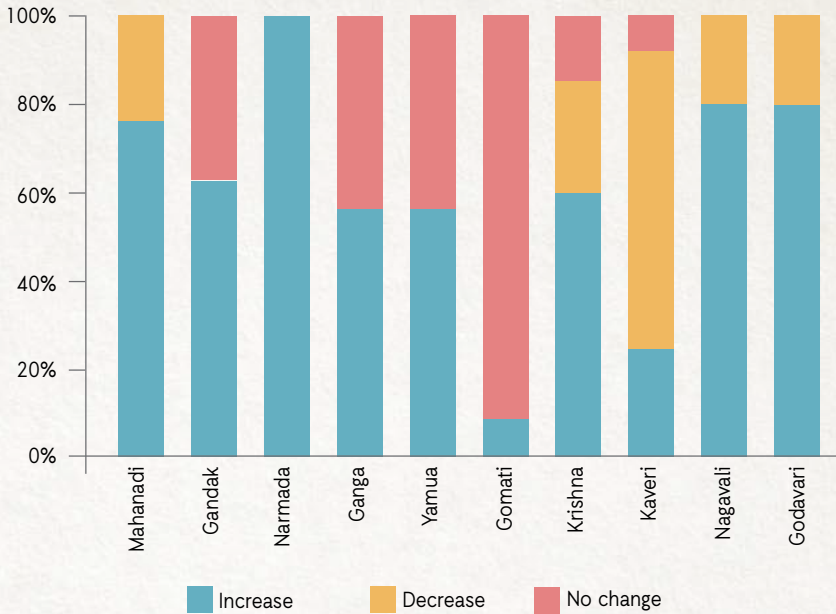
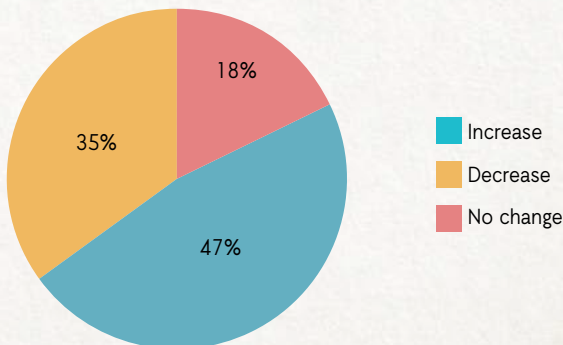


Figure 4.13: River water use for agriculture II



Roop Singh Solanki of Bhilala tribal community age 36, from Pokrana village of Alirajpur shares his story: “We were working as migrant labour worker in the textile mill of Surat, Gujarat along with six family members. With national lockdown, that cloth mill also was shutdown. After wandering there for about two weeks in search of alternative work,

we all decided to return to our village walking for about 300 kilometres, with no food water and a lot of police harassment on the way. Fortunately we all reached home alive, while we know that many people died on the road. Our village is in the forest area and have very little land to cultivate. However, we decided to cultivate vegetables on the land close to Narmada. As a result we harvested good amount of vegetables. This helped us meet our household need and sold in the nearby villages and to the weekly market about 20 kilometres away.”

Use of river water for socio-religious purposes

COVID-19 induced lockdown has impacted all sectors including social and religious gatherings and functions. It may be within religious campuses or outside. The same has been impacted on river banks. Use of river water for socio cultural purposes has decreased in all most all rivers except Mahanadi and Gandak where local people continue their

Figure 4.14: River water use for socio-religious purpose I

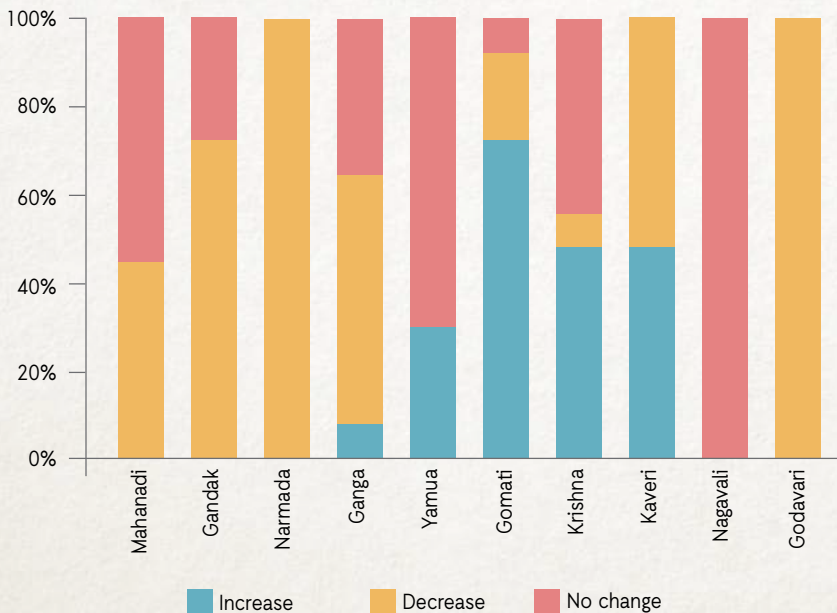
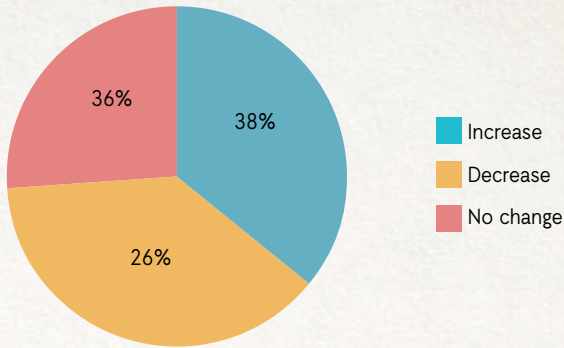


Figure 4.15: River water use for socio-religious purpose II



use irrespective of any lockdown. It has reduced in case of major sacred rivers like Ganga, Yamuna.

The study further found taking together all rivers that 38% said increase, 26% said decrease and 36% respondents said no change in use of river water for socio-religious purposes.

Though all rivers have socio-cultural and religious importance some are considered more pious.

Nishikath Pagre age 48 years from Nasik, Maharashtra works for an NGO to keep the river clean reported: "Now I find Godavari really clean as all religious affairs are stopped and temples are closed. As a result all kinds of religious offering polluting river water have stopped now. Hope after unlock the local administration will regulate in a manner that the river continues to remain clean".

Conclusion and Recommendations

River ecology showed improvement as a result of the COVID-19 induced lockdown. The resultant restricted human activities gave a pause to industrial operations and reduced movement of vehicles, trains and planes. Marked changes were seen in rivers as the colour of water looked clean in water bodies. Increase in the arrival of migratory birds on riverbanks was noticed. Birdsong was noticed in the heart of busy squares of the metro cities. With complete lockdown, tranquillity was suddenly felt, as all activities came to complete halt.

Many changes were observed with the naked eye but also proved through scientific studies. These changes have attracted many researchers, research organisations to conduct studies on changes in air and water qualities. In India, the Central Pollution Control Board (CPCB), different state pollution control boards and research organisations have conducted several studies. Some of the findings are also referred to in this study. The scientific studies also justify people's observation and first-hand experiences. Since the COVID-19 induced lockdown situation cannot continue, it is essential to learn lessons from nature and act on these lessons on priority.

Recommendations

1. It is imperative to treat the river as a source of water for all and a cradle for aquatic life. It should not just be seen as a resource that has to be diverted, and indeed not viewed as drainage for pollutants and waste material by both state machinery and communities. The river can no longer be a carrier of garbage and pollutants.
2. There is a need to check all forms of pollutants and waste material from the source point that pollutes the river. River ecology is an essential factor for aquatic species to grow and sustain in the river.
3. It is time to ensure that all polluters stop dumping waste into the river. With no dumping of pollution, the river becomes clean, which

is visible during the lockdown period. Hence this practice should be continued in the long run.

4. The state must ensure 'Corporate Accountability' and ensure that stringent action is taken against river polluters. The principle of 'Polluters Pay' no longer works as the level of pollution has gone beyond control, and no amount of compensation can protect rivers, aquatic and dependents.
5. All industries located on a riverbank or discharging effluent in the river must be closed down with immediate effect and shifted elsewhere.
6. Government/pollution control board needs to have total control over all forms of discharge into the river. More than huge funds and projects, there is a need for an administrative will to control all forms of pollution going to the river.
7. There is a need to implement a sewerage linking plan in both rural and urban locations. All urban local bodies should stop discharging domestic waste, including sewerage to the nearby river. These are another significant source of river water pollution. All domestic waste may be appropriately treated and used for agriculture purposes.
8. Ensure full functioning of sewerage treatment plants (STP), wherever it's set up and install new plants so that no untreated water gets discharged to the river.
9. People's traditional knowledge of water governance systems must be understood and given importance while working on clean river water management plans.
10. Women play an essential role in water collection and storage for household consumption; hence, they should be treated as primary stakeholders. All their expertise, experience and difficulties must be considered as an input to water and river water management plans and policies.
11. It is time to think of alternate development perspective with a focus on nature-based solutions (NBS), natural resource-based livelihood including agriculture, fisheries and riverbank-related resources.

People's health and above all survival of planet Earth should be prioritised.

12. Need to protect the riverbank, sand deposits as these are part of larger river ecology and help in keeping the water source clean with growing varieties and layers of vegetation that promotes growth and regeneration of varieties of spices on the river bank.
13. The river is also a source of food and nutrition for communities, and only clean and adequate water contained river can provide this. During difficult times without secured income, source communities survive depending on river resources.
14. Socio-religious activities on river banks using water are essential to maintain the cultural diversity of India. It is recommended that local people's participation and government regulations are needed to regulate those activities, so that river water remains clean. People need to take a lead role supported by Government for all these.
15. Riverbank communities play an essential role in river governance which is vital for river rejuvenation. It is recommended that people should get space to participate in all aspects of river cleaning and rejuvenation, starting from planning to implementation.
16. Many people from vulnerable communities dependent on ferry boats and tourist visit lost their livelihoods during the lockdown and need some compensation for survival. Also, they need adequate support to restart their business and repair damaged boats.
17. The Government must ensure access to market for all perishable items like fish. Fisherfolk communities lost marketing opportunity during lockdown not everyone had the opportunity to make dry fish. All such families need some supporting amount to sustain their families.
18. There is need to ensure that river waters remain clean as it has encouraged the cultivation of vegetable and other seasonal crops by landless farmers and many jobless migrants who returned to their villages after the closure of industries and factories.



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