



ENVIRONMENTAL FLOWS [E- FLOWS] - ESSENTIAL TO MAINTAIN WATER QUALITY

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ABSTRACT Different groups of people perceive rivers in different ways. The diminishing flows in rivers is a matter of great concern in India amongst the policy makers at Central and State Governments level, environmental experts, technical institutions, Indian Institute of Technology (IITs), people in general, and even by judiciary. The efforts have been made to discuss this issue at international and national forum to consider the issue and fixation or establishment of norms with statutory backing of law for the environmental flows in rivers. The reduction in flows, particularly in river Ganga, and other rivers due to stoppage or obstruction of flow on account of hydro-projects or other infrastructure projects, usage of river water for irrigation etc has resulted not only adversely affect the health of rivers but has caused incidence of increasing pollution besides threat to the biodiversity. The judicial intervention, in some of the cases, due to diminishing flow in rivers has also been discussed in the present paper.

KEYWORDS : Environmental flows(E-flows): means an amount of water that is kept flowing down a river in order to maintain the river in a desired environmental condition; Ecological needs: means to quantify the minimum flows which are acceptable so as to decide as to what comprises the legitimate environmental flow releases.

1. INTRODUCTION

1.1. India is home to an extraordinary variety of climatic regions, ranging from tropical in the south to temperate and alpine in the Himalayan north, where elevated regions receive sustained winter snowfall. The nation's climate is strongly influenced by the Himalayas and the Thar Desert. Accordingly, the discharges /flows in the rivers vary widely according to climatic zones. The short monsoon for about three months a year is characterised by devastating rainfall which cannot be stored, while in the remaining nine months, rivers flow almost dry to a trickle to support any living environmental ecosystem encompassing the human being. Hence, the river flow oscillates widely to meet competing and sometimes conflicting demands. Therefore, there is need to regulate /balance the river flow in such a manner the human needs are fulfilled and the riverine ecosystem is not threatened as well, so that there is a harmony in maintaining the river-ved environmental regime.

1.2. Rivers have been integral to human development and welfare since historical times because many of us are dependent on them for water, which is essential for life. Rivers provide numerous benefits to the mankind including water for drinking, agriculture, food (fish), energy (hydropower, cooling of thermal stations), means of transportation, fertile sediments, and many other products. Rivers have also acquired a central place in the social, cultural and religious activities in certain civilizations, such as India. Different groups of people perceive rivers in different ways. For hydrologists, rivers are channels to transport water and sediments. For energy planners, these are sources of hydro-power generation and for land planners these are essential components of landscape. Rivers provide water to farmers to irrigate crops. For religious leaders, river water has spiritual value. But the river water is not always favourable. Along with the beneficial uses, rivers can also be hazardous when they are in flood.

(References: Jain National Institute of Hydrology, Roorkee 247667, India_s_k_jain@yahoo.com)¹

2. GENESIS OF ENVIRONMENTAL FLOWS.

2.1 The UN Conference on the Human Environment, held at Stockholm in 1972 was a landmark event which laid the foundation for environmental agenda for the world. The United Nations established the United Nations Environment Programme (UNEP) to help in the efforts, among the other things, for environmental governance. Subsequently in 1992, the United Nations Conference on Environment and Development was held at Rio de Janeiro which adopted an Agenda, popularly known as "Agenda 21". Agenda 21 in fact created a link between environment and development, and the imperative need for sustainable development. The Millennium Development Goals (MDGs) included the need for environmental sustainability, such as reducing the rate of loss of species which were threatened with extinction. The water allocated for the environment also supports

people by maintaining the ecosystem services. Establishment of the natural flow paradigm (Poff et al, 1997) marked a significant point in the conceptual development of "environmental flows"

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2.2. The livelihoods of over three billion people living along the world's largest river systems are under threat from a range of stress, as per a study published in a journal "One Earth" on June 19, 2020 (<https://www.sciencedirect.com>). Growing populations placed unexpected stresses on the world's great rivers — hotspots of resources, agriculture, trade and energy production — in developing nations. Rivers respond to changes in the environment through self-adjusting processes of erosion and sedimentation. A range of other stressors, however — including damming, sediment mining, water diversions and groundwater extraction — affected big rivers. The construction of mega-dams for hydropower, flood control, irrigation and water supply increased manifold. Around 3,700 dams which are stated to be planned or are under construction and — if fully implemented — will decrease remaining free-flowing rivers by 21 per cent, according to the study. Dams trapped sediment, altered river flow regimes and — in tropical regions — caused a substantial release of greenhouse gas methane as a result of vegetation decay. Sand and gravel mining destroyed riverbeds across the world, as the demand for concrete and silica increased. This was linked to severe ecosystem degradation, illegal mining, organised crime and social injustice. These stressors inhibited efforts to meet the United Nations' Sustainable Development Goals by 2030.

(Reference: <https://www.downtoearth.org.in/news/scheme-to-interlink-rivers-on-fast-track-govt>)³

2.3 "Environmental flows(E-Flows)" means an amount of water that is kept flowing down a river in order to maintain the river in a desired environmental condition. It is also defined "the flows required for the maintenance of the ecological integrity of the rivers and their associated ecosystems, and of the goods and services provided by them". The working group set up by the Government of India adopted a methodology wherein "certain percentages of the annual flows are prescribed as minimum flows as well as flushing flows during the monsoon".

[Reference: Workshop Resolution from the Indian National Workshop on Environment Flows, held at New Delhi on 23-24 March, 2005, see April 2005 (Vol. 2, issue 1) issue of Environmental Flows, published by International Water Management Institute.]⁴

• 3rd World Water Forum held at Kyoto in 2003 defined, E-Flows as the provision of water within rivers and ground water systems to

maintain downstream ecosystems and their benefits, where the river and underground system is subject to competitive uses and flow regulations.

- IUCN (2003) defined, E-Flows as “the water regime provided within a river, wetland or coastal zone to maintain ecosystems and their benefits where there are competing water uses and where flows are regulated”.
- *The IUCN makes a clear conceptual distinction between the water needed to maintain the ecosystem in near pristine condition, and that which is eventually allocated to it, following a process of a holistic assessment for E-Flows.
- IIT Consortium of 7 IITs in its Report on Ganga River Basin Management Plan (GRBMP): Environmental flows refer to a regime of flows that mimics the natural pattern of a river's flow, so that the river can perform its natural functions such as transporting water and solids from its catchment, formation of land, self-purification and sustenance of its myriad systems along with sustaining cultural, spiritual and livelihood activities of the people or associated population.

2.4 Environmental Flows (E-Flows) Assessment: The assessment and implementation of environmental flows is challenging due to number of reasons. In most countries, often different organizations and regulatory agencies are associated with different components of environment, viz. rivers, forests, wild life, and aquatic life. Role and importance of these components for aquatic ecosystems also change as one moves from mountains to estuaries. It is a big challenge to establish coordination among these agencies. Another important factor is that the water of many rivers is already allocated for utilisation to various sectors such as irrigation, drinking, hydropower and very little or no water is left unallocated. To allocate water for ecological needs, supplies to some of the existing uses have to be curtailed resulting in economic loss and as such there is resistance from the concerned sector.

[Reference: <https://www.downtoearth.org.in/news/scheme-to-interlink-rivers-on-fast>]⁵

2.5. The science of environmental flows has advanced considerably in the last 25 years from little knowledge and awareness to a focus on individual aquatic species to a broader concern about ecosystem protection or restoration these days. At the same time, there have been considerable advances in basic scientific understanding and the development of EFA techniques. However, many of these advances in knowledge are limited to regions (mostly in developed countries) where the scientific studies have been undertaken. The same kind of understanding of ecological responses is not present in many other areas where EFAs are being applied and the knowledge is not directly transportable.

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2.6. The need for the essentials of “Environmental Flows” is being studied for a very long time to take requisite actions to provide norms for environmental flows. The people expressing concern included, amongst other, politicians, policy makers, planners, economists, environmentalist, consumptive water-user activists, non-governmental organisations, river communities, engineers, hydrologists etc. The initiative to promote environmental flows was also undertaken by the *IUCN- Water and Nature Initiative*. Many people and institutions & organisation in India under Central & State Governments and independent experts have contributed to study the need for e-flows including Central Water Commission, Consortium of IITs, Universities and technical institutes others like, Prof Brij Gopal, Professor (Dr) G.D Agarwal @Swami Gyan Swaroop Sanand, former Member-Secretary Central Pollution Control Board, expressing the need for stipulating minimum environmental flows/norms including in the river Ganga, particularly to maintain the health of the river Ganga as the water flow was obstructed by hydro-projects while to meet growing demands for drinking and irrigation needs.

2.7. Environmental flows are stated to be based on the concept of equitable water sharing of available water flows in river or groundwater systems. Hydro infrastructure projects typically generate considerable economic benefits, and these benefits often accrue to populations that are far away distant from the water sources. Benefit

sharing provides an alternative approach to water sharing, where the economic benefits from the developmental project are shared with the affected people. There is, thus, disconnect between the water users, environment and policy making communities which hinders in promoting environmentally sustainable development. Thus, there is a need to bridge the gap.

3. EFFORTS MADE TO MAINTAIN E-FLOWS.

3.1 The efforts of the departments of the Central & State Governments, various authorities and individuals to study the mechanism and methodology for fixation of norms for minimum e-flows to be maintained in the river is mentioned hereunder: -

2001-Water Quality Assessment Authority (WQAA) was constituted by the Central Government under the provisions of the Environment (Protection) Act, 1986 vide notification no S.O 583 (E) dated 29.05.2001 inter-alia with the objectives for taking measures to standardize method for water quality monitoring and to ensure quality of data generation for various purpose. The WQAA in a meeting held on 14.05.2003 decided to constitute a Working Group to advise the WQAA on minimum flows in the Rivers to conserve the ecosystem.

[Reference: *Gazette of India, notification no S.O 583 (E) dated 29.05.2001*]⁷

2003-Aworking Group for advising the “minimum environmental flows in rivers” was constituted on 09.09.2003 under the Chairmanship of Member (RM), Central Water Commission (CWC). The term of reference of the working Group inter-alia provided:

- To take up studies towards deciding minimum flows in rivers
- To take up related issues and consider norms/studies being followed in other countries on the subject
- Recommend criteria to be followed for minimum flows in different types of rivers from environmental and other considerations,
- Any other related issues.

2007 -The Working Group submitted its Report in July, 2007 on the minimum flows in the Rivers. The Report outlines the principles behind environmental flow assessments, provides a description of methods that have been used to assist with such assessments, and highlights the features that will increase the chance of successful implementation of environmental flows. The four components that constitute the minimum flows are low flows, flushing flows, special purpose flows and maintenance of impoundment levels. However, for the purpose of study, only requirements for low flushing flows were considered specific to a particular reach and not a general requirement.

The main difficulties in quantifying the minimum flows are absence of an acceptable definition of ecological needs and, also, the absence of an agreement on the priority of Environmental Flow Releases (EFR). Moreover, while the domestic and agriculture requirements are easily quantified, it is difficult to decide as to what comprises the legitimate ecological needs. A methodology similar to Tennant method needs to be adopted wherein certain percentages of the annual flows are prescribed as minimum flows as well as flushing flows during the monsoon.

Certain studies are undertaken for Indian conditions and recommendations of the Working Group are based on the results thereof.

Salient features of the Recommendations:

- Naturally occurring minimum flows with 99 per cent exceedance can be taken as the minimum flows required for maintaining the in-stream environment. A range of minimum flows may be recommended as flushing flows during the flood period.
- It was also felt that since the Himalayan rivers carry large snow melt component during summer months the recommendations may be different for the rivers originating in the Himalayas and for others.
- From the studies, it is seen that in the case of Himalayan rivers the virgin flows are very high due to snow melt contributions. However, in Himalayan rivers where utilization is mainly through diversions and not through storages, it is felt that the minimum flow should be a function of lean period flow keeping in view the committed utilizations.
- For Himalayan rivers the minimum flow is to be not less than ten

per cent of average virgin lean period flow (1st Dec to 31st May) expressed in cubic meters per second. One flushing flow is required during monsoon of not less than 250 per cent of 75 per cent dependable annual flow expressed in cubic meters per second.

- For other rivers, minimum flow in ten daily period to be not less than observed ten daily flow with 99 per cent exceedance. Where the daily flow data is not available this may be taken as 0.5 per cent of 75 per cent dependable annual flow expressed in cubic meters per second. One flushing flow is required during monsoon of not less than 600 per cent of 75 per cent dependable annual flow expressed in cubic meters per second.
- There is a need for extensive efforts on augmenting wastewater collection, enhancing treatment facilities and ensuring proper operation and maintenance of these facilities.
- Use of wastewater after treatment for irrigation, horticulture and other purposes is recommended.

3.2. In the year, 2009- Central Government constituted, National Ganga River Basin Authority (NGRBA) under the Environment (Protection) Act, 1986, vide Notification no S.O 521(E) dated 20.02.2009 (Reference: *Gazette of India, notification*)⁸. It was felt that since the demand for river water is growing for irrigation, drinking purposes, industrial uses and power due to urbanization, industrialisation and growth of infrastructure and to take into account the need to meet the competing demands, it was felt necessary:

- (a) To ensure effective abatement of pollution and conservation of river Ganga by adopting river basin approach to promote inter-sectoral coordination for comprehensive planning and
- (b) To maintain minimum ecological flows in the river Ganga with the aim of ensuring water quality and environmentally sustainable development

3.3. In the year 2013- Consortium of 7 IITs' Ganga River Basin Management Plan" submitted Interim Report- September, 2013"

The Consortium of 7 IITs submitted its Interim Report on "Ganga River Basin Management Plan" under the caption "Philosophy, Vision and Conceptual framework" the Consortium has inter-alia mentioned that when viewed from a dynamic perspective, the sanctity of the river system imbedded in four points. Out of these, the two points are based on ancient Indian concepts – a testimony to our ancient wisdom (i) Aviral Dhara" (meaning "Continuous Flow"): The flow of water, sediments and other natural constituents of River Ganga are continuous and adequate over the entire length of the river throughout the year and the (ii) "Nirmal Dhara" (meaning "Unpolluted Flow"): The flow in the Ganga River Network is bereft of manmade pollution; hence the river water quality should not be (significantly) affected by human activities.

The other two points are; Viz.* "Geologic Entity": The Ganga River System is a heritage of past geological ages, i.e. they are the earth's creations of ancient times, which may not be repairable if damaged. And * "Ecological Entity": The Ganga River System is a delicately structured balance between various living species and the physical environment, achieved by nature over thousands of years and vulnerable to irreversible changes

In the conceptual framework, based on the above vision, one of the main objectives identified as "Environmental Flows (E-flows) shall be maintained in all rivers and tributaries of Ganga System to fulfil their geological, ecological, socio-economic and cultural functions. Water quality in all rivers and tributaries of Ganga River System shall be consistent with their governing geological, ecological, socio-economic and cultural functions.

"Aviral Dhara" for a given geological setting and climatic pattern, alluvial rivers – as characterized by their morphologies, floodplain geometries and fluvial patterns – achieve stability through long-term physical balance between various dynamic parameters such as water flow rates and sediment loads (including seasonal and inter-year variations), terrain gradient, and river influent/effluent rates. "Aviral Dhara" is a consequence of this long-term stability of rivers. The longitudinal connectivity in the river network is an essential first step to maintain "Aviral Dhara", having adequate river flows depends much on the basin's overall water status. Dams, barrages and other manmade structures block or constrict rivers, thereby interrupting the flow of water, sediments and aquatic species. While the short-term and local benefits of such structures can be reasonably estimated, the long-term,

basin-wide environmental losses in terms of river stability, soil and water fertility, ecological balance, flood events, health effects, and other facets of basin performance are difficult to predict.

*Reference: Interim Report of Consortium of 7 IITs :mentioned from : UNEP, 2008; WWC, 2000*⁹.

3.4. In the year, 2016- The Central Government constituted authorities under the Environment (Protection) Act, 1986, at Central, State and District levels, vide Notification S.O. 3187(E). dated 07.10.2016, to take measures for prevention, control and abatement of environmental pollution in River Ganga and to ensure continuous adequate flow of water so as to rejuvenate the River Ganga to its natural and pristine condition.

4. E-FLOWS - RIVER GANGA AND ITS TRIBUTARIES.

4.1 Ganga basin in India includes eleven States; Uttarakhand, Uttar Pradesh, Madhya Pradesh, Rajasthan, Haryana, Himachal Pradesh, Chhattisgarh, Jharkhand, Bihar, West Bengal and Delhi. Rainfall and the melt water from snow and glacier are the main source of water in the river Ganga. Surface water resources of the Ganga (its long term mean annual flow volume as it enters the ocean) have been assessed at 525 billion cubic meter (BCM). Bhagirathi is the source stream of river Ganga, emanates from the Gangotri. Many small streams comprises the headwater of river Ganga. Important amongst these are the Alaknanda, Dhawliganga, Pinder, Mandakini and Bhilganga, At Deoprayag where the Alaknanda joins the Bhagirathi, the river acquires the name Ganga, It traverses a course of 2525 Km before flowing into the Bay of Bengal. The vast irrigation demands especially in the State of UP is met by the major canal system of the river Ganga at various points, Bhimgoda (Upper Ganga Canal) and Narora (Lower Ganga Canal). These Canal system play a significant role in sustaining the agriculture sector in the State of UP. In fact the sectoral water allocation ;like other States in India is highest in the State of UP i.e 96%. However, the State Government appears to be determined to reduce the allocation to 79 % by 2050.

*[Reference: www.researchgate.next-Environmental flows of river Ganga]*¹⁰

4.2 The River Ganga is of unique importance ascribed to reasons that are geographical, historical, socio-cultural and economic and facing serious threat due to discharge of increasing quantities of sewage, trade effluents and other pollutants on account of rapid urbanisation and industrialisation. The demand for water of River Ganga is growing for irrigation, drinking water supplies, industrial use and hydro-power due to increase in population, urbanisation, industrialisation, infrastructural development and taking into account the need to meet competing demands and with a view (a) to ensure effective abatement of pollution and rejuvenation of the River Ganga by adopting a river basin approach to promote inter-State and inter-sectoral co-ordination for comprehensive planning and management; (b) to maintain ecological flows in the River Ganga with the aim of ensuring continuous flows through out its length so as to restore its ecological integrity. As per the Notification No S.O. 3187(E). dated 07.10.2016 there authorities viz "National Council for Rejuvenation, Protection and Management of River Ganga (in brief National Ganga Council)", "Empowered Task Force on River Ganga", "National Mission for Clean Ganga (NMCG)" at national level and "District Ganga Protection Committee" in each district at state level. As per paragraph 5 of the notification referred to above every State Government, is mandated to ensure that uninterrupted ecological flows of water in river Ganga is maintained at all times. The NMCG being the national agency is charged with the role, responsibility and powers to facilitate the task of rejuvenation, protection and management of River Ganga and its tributaries, under the supervision and direction of the National Ganga Council,

The NGRBA constituted earlier stands dissolved as per paragraph 13 of the notification dated 07.10.2016 mentioned supra.

4.3. The need of predetermining minimum environment flow of a river is an essential feature because of massive reduction in the flow of the river and indiscriminate extraction of groundwater, which resultantly has adversely impacted on the health of the river. The health of the rivers in India and particularly; river Ganga and river Yamuna, have deteriorated considerably. Maintaining flow of river, more particularly, E-flows, have to be adhered to in the interest of

environment, health of the river, its aquatic life and its benefits to the society at large as a natural resource. While refereeing to the preamble in the notification no S.O 3187 (E), dated 7th October, 2016, issued by the Ministry of Water Resources, River Development and Ganga Rejuvenation, under the Environment (Protection) Act, 1986 provides that there is a need to maintain ecological flow in river Ganga with the aim of ensuring continuous adequate flow of water throughout its length so as to preserve its ecological, natural and pristine condition and then enable it to self-rejuvenate. Clause-5 of the Notification No S.O 3187 (E) dated 7th October, 2016, published in the Gazette of India, mandates that every State Government shall endeavour to ensure maintenance of uninterrupted flow of water at all times in river Ganga and its tributaries. To put it simply, the Environmental Flow is a very simple concept. First of all, this term should always be used in plural, implying that a synonym to environmental flows is an ecologically acceptable flow regime designed to maintain a river in an agreed or predetermined state. Environmental Flows are a compromise between water resources development, on one hand, and maintenance of healthy river or at least reasonable condition, on the other. Another useful way of thinking about E-flows is that of 'environmental demand', similar to crop water requirements, industrial or domestic water demand. Despite the simplicity of the concept, complication arose, in the actual estimation of E-flow values, primarily due to meagreness of both understanding of and quantitative data on the relationship between river flows and multiple components of river ecology. Ecologists agree that the major criteria for determining environmental flow should include the maintenance of both spatial and temporal patterns of river flow. The environmental flow should not only encompass the amount of water so needed, but also when and how this water should be flowing in the river. All components of hydrological regime have certain ecological significance. The environmental flow is a very pragmatic concept and it is prepared in the interest of environment and ecology to accept a bare minimum.

Bunn and Arthington (2002) have formulated four basic principles that emphasize the role of flow regime in structuring aquatic life and show the link between flow and ecosystem changes: -

- (i). Flow is a major determinant of physical habitat in rivers, which in turn is the major determinant of biotic composition. Therefore, river flow modifications eventually lead to changes in the composition and diversity of aquatic communities.
- (ii). Aquatic species have evolved life history strategies, primarily in response to the natural flow regimes. Therefore, flow regime alterations can lead to loss of bio-diversity of native species.
- (iii). Maintenance of natural patterns of longitudinal and lateral connectivity in river-floodplain systems determine the ability of many aquatic species to move between the river and floodplain or between the main river and its tributaries. Loss of longitudinal and lateral connectivity can lead to local extinction of species.
- (iv). The invasion of exotic and introduced species in rivers is facilitated by the alteration of flow regimes. Inter-basin water transfer may represent a significant mechanism for the spread of exotic species.

[Reference: NGT's order dated 13.07.2017 in OA No 200/2014- M.C. Mehta Vs Union of India & Ors]¹¹

4. STATUTORY PROVISIONS FOR MAINTAINING "MINIMUM E-FLOWS".

4.1 In India, the Union Government, in exercise of its power vested under sub-section 3 of section 3 of the Environment (Protection) Act, 1986, issued a notification no S.O 3187 (E) dated 7th October, 2016 constituted Central, State and District levels authorities at to take measures for prevention, control and abatement of environmental pollution in River Ganga and to ensure continuous adequate flow of water so as to rejuvenate the River Ganga to its natural and pristine condition. The objectives of the measures taken in pursuance to the said notification further emphasize, amongst others, that since River Ganga is facing serious threat (i) due to discharge of increasing quantities of sewage, trade effluents and other pollutants on account of rapid urbanisation and industrialisation (ii) the demand for water is growing for irrigation, drinking water supplies, industrial use and hydro-power due to increase in population, urbanisation, industrialisation, infrastructural development and taking into account the need to meet competing demands; there is an urgent need to (a) ensure effective abatement of pollution and rejuvenation of the River Ganga by adopting a river basin approach to promote inter-State and inter-sectoral co-ordination for comprehensive planning and management (b) to maintain ecological flows in the River Ganga with

the aim of ensuring continuous flows throughout its length so as to restore its ecological integrity that enables it to self-rejuvenate.

The Principles laid down in the notification in Paragraph 4 & 5 provides that:

Paragraph 4:

- River Ganga shall be managed in an ecologically sustainable manner;
- Continuity of flow in the River Ganga shall be maintained without altering the natural seasonal variations;
- Integral relationship between the surface flow and sub-surface water (ground water) shall be restored and maintained;
- Aquatic and riparian biodiversity in River Ganga Basin shall be regenerated and conserved;
- Bank of River Ganga and its flood plain shall be construction free Zone to reduce pollution sources, pressures and to maintain its natural ground water recharge functions;

Paragraph 5:

Every State Government, shall ensure that uninterrupted flows of water are maintained at all times in River Ganga. Thus in accordance with the provisions of the notification/order dated 07.10.2016, it is mandated that every State government/ Union territory administration to ensure that the uninterrupted e-flows are maintained in river Ganga and its tributaries.

[Reference: Gazette of India notification no S.O 3187 (E) dated 7th October, 2016]¹²

4.2 Institutional mechanism & minimum Environmental flows.

2018- The National Mission for Clean Ganga (NMCG), being one of the authorities at National level and nodal agency, in exercise of its powers under sub paragraph (3) of paragraph 39 and item(h) of sub-paragraph(2) of paragraph 41 [of the notification S.O. 3187(E), dated 7th October, 2016], issued an Order / Notification No S.O.5195 (E), dated 08.10.2018 impressing upon the concerned for maintaining minimum environmental flows in certain stretches of river Ganga within three years from the date of the notification. However subsequently the said notification was amended vide notification no S.O. no.3286(E) dated 14.09.2019 and stipulated that the minimum environmental flows shall be maintained in river Ganga by 15.12.2019 with a view to restore and maintain the wholesomeness of the rivers and simultaneously preventing the pollution ingress into the river. The intent of the order/notifications dated 09.10.2018 & dated 14.09.2019 are to ensure and maintain uninterrupted flows of water throughout its length at all times in River Ganga and to ensure continuity of flows in the river without altering the seasonal variations.

The mini and micro projects which do not alter the flow characteristics of the river or stream significantly are exempted from the stipulated environmental flows. The projects and infrastructures covered under the e-flows notifications are required to ensure the release of desired quantities of water to maintain environmental flows, flow conditions in the river reaches and shall be monitored at hourly intervals from time to time. The CWC is the designated authority and the custodian of the data and shall be responsible for supervision, monitoring, regulation of flows and reporting of necessary information to the appropriate authority as and when required and also authorised to take emergent decisions about the water storage norms in case of any emergency. The CWC is required to submit flow monitoring-cum-compliance report on quarterly basis to the NMCG. The concerned project developers or authorities shall install automatic data acquisition and data transmission facilities or required necessary infrastructure at project sites at appropriate locations specified by the Central Water Commission within six months from the date of the notification. The installation, calibration, maintenance of flow monitoring facility shall be the responsibility of the project developers or authorities and they shall submit the data to the CWC from time to time.

[Reference: Gazette of India notifications no S.O 5195 (E), dated 08.10.2018 & S.O. no.3286(E) dated 14.09.2019]¹³

4.3. The CWC is periodically monitoring the e-flows of the river Ganga at various locations/ stretches and as per the recent study and monitoring report of the CWC, Srinagar Hydroelectric project i.e Alaknanda Hydro- project is non-compliant, on the Upper reaches of river Ganga, and is flouting the stipulated e-flows norms. However, the stipulated norms have been kept in abeyance in respect of the project in

question, as per the *interim* order dated 20.12.2019 of the High Court of Uttarakhand in WP No 3889/2019 Alaknanda Hydro Electric Power Company Ltd. Vs State of Uttarakhand & Ors, till further orders/directions and the matter is sub-judice.

5. JUDICIAL INTERVENTIONS.

5.1. Supreme Court:

Civil Appeal No 1657 of 2018- Bharat Jhunjhunwala vs Pushp Saini & Ors.

In the matter, Bharat Jhunjhunwala, the Petitioner/Appellant has preferred an appeal against the order/judgement dated 09.08.2017, passed by the National Green Tribunal (NGT) [in OA No 498/2015- Pushap Saini vs Union of India & Ors.] whereby it was inter-alia directed by the NGT for the maintenance of environmental flows. The NGT has directed that all the rivers in India shall maintain minimum 15% to 20% of the average lean season flow of that river. However, whichever State is unable to adhere to this average percentage, in that event liberty was granted to that State Government to move the Secretary, Ministry of Environment, Forest and Climate Change, who shall in consultation with the Ministry of Water Resources, River Development (now Ministry of Jal Shakti) shall examine such a representation and if it is desirable to fix any lower percentage than the percentage aforesaid will be fixed and pass appropriate order accordingly. The order shall be reasoned and thereafter it would be left to the discretion of the State Governments concerned to follow the directions of the Ministry in accordance with law. The liberty was granted to the Applicant to move the Ministry of Environment, Forest and Climate Change if it has material with them in respect of any river of the country, which should have minimum environment flow in excess of 20%. If such representation is moved the same shall be disposed of by the Committee headed by Secretary in the Ministry of Environment, Forest and Climate Change in accordance with law.

The Petitioner/Appellant has assailed the Order/judgement dated 09.08.2017, passed by the NGT. The Hon'ble Supreme Court has issued Notice to all the State Governments and UTs Administration to file replies in the matter. The matter as such is seized before the Hon'ble Supreme Court for determination.

5.2 High Court of Uttarakhand at Nainital

(i) WP No. 1189(M/S)/2019- Alaknanda Hydro-Electric Power Co Ltd vs Union of India & Ors.

The petitioner challenged, Notification No 5195 (E), dated 08.10.2018, issued by the NMCG invoking powers vested under notification S.O. 3187(E), dated the 7th October, 2016, stipulating the minimum environmental flows as being ultra-virus to the constitution of India. The Notification dated 08.10.2018 specifies that minimum environmental flows to be maintained at locations downstream of structures or projects meant for diversion of river flows for purposes, like; irrigation, hydropower, domestic and industrial and other requirements, as per the locations at the (i) Upper Ganga River Basin Stretch starting from originating glaciers and through respective confluences finally meeting at Devprayag up to Haridwa and (ii) Stretch of main stem of River Ganga from Haridwar, Uttarakhand to Unnao, Uttar Pradesh.

The flow is to be maintained at different seasons viz dry, lean and high flow season, in terms of the percentage (%) of Monthly Average Flow observed during each of preceding 10-daily period @ 20 to 30%+[30% of monthly flow of High flow season]. The petitioner has inter-alia contended that as per the High Court of Uttarakhand's earlier order [Refer: WPPIL No.116 of 2015 Himadri Jan Kalyan Sansthan vs. State of Uttarakhand and others] the Petitioner is required to release 15% whereas now in terms of the notification dated 08.10.2018, the petitioner has been compelled to release more water instead of 15%. The time period of three years was given to the existing project proponents and structures to comply with the Environmental flows norms. However subsequently vide amended Notification no S.O. no.3286(E) dated 14.09.2019 it has been mandated to comply with the environmental flows norms by 14.12.2019. The matter is pending for final adjudication.

(ii) WP No 3889(M/S)/2019- Alaknanda Hydro-Electric Power Co Ltd vs State of Uttarakhand & Ors.

The Petitioner assailed the amendment Notification no S.O. no.3286(E) dated 14.09.2019 and sought directions to quash the same

as it mandated complying with the environmental flows/ norms by 15.12.2019. It has been alleged that the petitioner has been compelled to release more water instead of 15% of the flow of water, as per the order/directions earlier passed by the High Court of Uttarakhand. The Hon'ble High Court had earlier directed the State authorities and private operators to ensure minimum 15% flow of water downstream of the weir/barrage/dam for downstream requirement of the riparian owners. The Petitioner has also alleged that reducing the time period to 14.12.2019 by the amendment order dated 14.09.2019, the time period of three years granted vide order dated 08.10.2018, although that too being excessive and unnecessary, has been further reduced to 15.12.2019, without affording any opportunity of hearing to the petitioner.

The Hon'ble High Court vide its *interim* order dated 20.12.2019 has directed that, till the next date of hearing the impugned order/notification dated 14.09.2019 shall be kept in abeyance, qua the petitioner.

5.3. National Green Tribunal (NGT)

(i) OA No 6/2012- Manoj Mishra Vs Union of India & Ors. [NGT's order dated 13.01.2015] ['Maily Se Nirmal Yamuna' Revitalization Project, 2017]-River Yamuna Pollution matter.

The NGT, in this matter, has considered the issue for the implementation/execution of a project for rejuvenation of river Yamuna by the Delhi Jal Board (DJB); titled "Maily Se Nirmal Yamuna' Revitalization Project, 2017" with the objectives for prevention and control of pollution in river Yamuna besides other related issues to prevent pollution in river Yamuna because of the discharge of municipal and industrial effluents, in the State of Haryana, U.P. The NGT has *inter-alia* observed that Environmental flow of river as identified, means that the minimum flow which the river should maintain round the year. If no water or minimum desired level of water is maintained in River Yamuna throughout the year, then it would not help the cause of protection of environment. The flow of the river would by itself keep the river and environment healthier and also cause dilution to the requisite levels, even if some extent of pollutants enters the river. The carrying capacity of the river has a direct co-relation to the availability of quantity of water. It has been noticed that water of river Yamuna in Delhi NCR is released at Tajewala. At Tajewala, the river is divided into two canals, which go through different parts of State of Haryana and ultimately join river Yamuna and Ganga. The water released in river Yamuna passing through NCT Delhi is low or negligible except in monsoon period. Thus, it adds to the concentration of the pollution and adds to the environmental degradation. This has to be prevented. Thus, it was directed that the Chief Secretaries of NCT of Delhi and State of Haryana to have a meeting with the Principal Committee[headed by the Secretary, Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti] and fix the quantity of water that should be released throughout the year to maintain the environmental flow of river Yamuna throughout the year to ensure prevention and control of pollution.

The Chief Secretaries of the States of Himachal Pradesh, Uttarakhand, NCT of Delhi, Haryana and Uttar Pradesh, Secretary, Water Resources, Government of India and Secretary, MoEF&CC were directed to hold a meeting within four weeks to prepare an immediate action plan required to ensure proper environmental flows throughout the year, in the entire river and particularly the stretch flowing through Delhi.

[Reference: NGT's order dated 18.02.2020 in OA no 6/2012 (uploaded on 5.3.2020)]⁴⁴

Further on the issue of Environmental Flow, the NGT has also observed that the current regime of Environmental flows may be augmented especially in lean seasons by way of coordination amongst member states stakeholders. NGT has also constituted a Committee, namely; Yamuna Monitoring Committee [YMC] for monitoring the implementation of the compliance of the orders/directions of the NGT.

The observations of the YMC on the aspect of "Environmental Flow" are:-

(I) The YMC has referred to point-wise pilot project for creating a shallow reservoir/pond over 17.6 acres of the floodplain at Palla after obtaining approval of concerned authorities. The key observations of CGWB and the Committee headed by a Member, of the CWC are that this pilot project needs to be executed for one more year to be able to

assess its impact on the ground water. Further, the Committee observed that cost of the project is high as compared to the quantity of water harvested. Therefore, the State will have to take a decision on its continuation based on overall economic and environmental benefits.

(ii) While referring to the report by National Institute of Hydrology (NIH), *inter-alia* stating that the key findings, though provisional in nature, are that minimum environmental flow levels required at Palla will be of the order of 38 cumecs. This has been co-related to a depth of 90 to 120 cm and required for the indicator fish species *Riainas bola* and *Banganadero* and is unrelated to the quantity of water released at present. This flow level is, however, subject to alteration once the cross-sectional study for the different river stretches, which is still continuing, is completed. The study will also cover the various measures that are required to be taken within the river basin for enhancing the flow in the river and the probable quantitative impact thereof.

(ii) *OA No 200/2014- M.C. Mehta Vs Union of India & Ors [River Ganga pollution matter].*

Initially a Writ Petition (PIL) No. 3727, titled *M.C. Mehta vs. Union of India & Ors*, was filed in the year 1985 by M.C. Mehta before the Supreme Court of India *inter-alia* on grounds that pollution is being caused in the river Ganga due to the discharges of untreated/partially treated effluents by the industries and sewage by the municipalities. The Petitioner sought directions that these industries/municipalities should install pollution control equipment's to contain pollution or these should be shifted and/ or closed down to avoid pollution in river Ganga. Meanwhile during the pendency of the matter, several orders/directions including closing of industries and construction of Sewage Treatment Plants (STPs), by the municipalities were passed by the Supreme Court. Subsequently the Supreme Court, vide order dated 29th October, 2014, transferred the matter to the National Green Tribunal (NGT). The issue of environmental flows in river Ganga also found very relevant and crucial for maintain water quality not only in river Ganga but in other rivers as well. The NGT observed that E-Flows is essential for improving the water quality and health of the river. E-flows are the flow regime in a river that describe the temporal and spatial variations in the quantity and quality of water required by the river to perform its natural ecological functions and support the aquatic and terrestrial biodiversity, meet agricultural and consumptive needs and also support the spiritual, social and cultural activities that depend on the river eco-system. The wholesomeness of the water of river Ganga is also viewed in the context of it being 'Aviral', meaning 'continuous flow' and 'Nirmal', meaning 'unpolluted'. These attributes are linked to the maintenance of continuous flow, uninterrupted by dams and barrages, be possessing, not only in mythological beliefs but validated by emerging scientific research. E- Flows are the flow required for the maintenance of the ecological integrity of the rivers and their associated ecosystems. E-Flows are increasingly recognized as a vital contributor to the continuing provision of environmental goods and services upon which the livelihood of people depend.

Thus, E-Flows are required for:-

- (i) *Maintaining river regimes.*
- (ii) *Conservation of self-purification properties of river.*
- (iii) *Maintaining aquatic biodiversity.*
- (iv) *Recharging groundwater.*
- (v) *Supporting livelihoods.*
- (vi) *Maintaining sediment movement.*
- (vii) *Preventing saline intrusion in estuarine and delta areas.*
- (viii) *Providing recreation.*

Longitudinal connectivity and lateral connectivity of the river are key considerations for flows and sediment transport along its entire length in an unpolluted and pristine form. Such attributes are considered key ingredients of the self-purification and sediments transport. If longitudinal connectivity is not maintained, the geomorphic as well as ecological functioning of the river will collapse.

(Reference: para 131 of the NGT's order dated 13.07.2017 OA no 200/2014)¹⁵

The NGT directed the Central Ground Water Authority (CGWA), Irrigation Department of State of UP, U.P. Pollution Control Board to carry out study as to the requirement for minimum environmental flow of river Ganga, that is essential to maintain the health of the river, its aquatic life and biodiversity. The Committee was asked to submit a

report to the NGT. The NGT *inter-alia* observed that there is a need to maintain ecological flow in river Ganga with the aim of ensuring continuous adequate flow of water. The NGT vide its order dated 13.07.2017 accordingly directed that:

- (i) While diverting the water from Haridwar to the Ganga canal or even otherwise, the minimum E flow in the main stem does not fall below 20% of the average monthly lean season flow, which will be referable to the status of the river at Haridwar pre-diversion. Also, the extent of diversion of water of river shall be adequately reduced and/or adjusted, in the event the flow falls below 20%. Further the water of river canal is being wasted indiscriminately which ultimately joins various drains in Segment-B which should be prevented.
- (ii) Further it was directed that the CGWA, Irrigation Department of State of UP, UPPCB to carry out study as to the requirement for minimum environmental flow of river Ganga, that is essential to maintain the health of the river, its aquatic life and biodiversity. This Committee should submit the report to the Tribunal within six months from the date of passing of this judgement. [Referencing's order dated 13.07.2017]¹⁶
- (iii) O.A. No. 425/2019- Vijay Kumar Vs. State of Himachal Pradesh, the NGT vide its order dated 03.12.2019 directed to the effect that Hydropower projects in hill States including Uttarakhand must ensure minimum specified e flow.
- (iv) *OA No 673/2018- In Re: News item published in "The Hindu" authored by Shri Jacob Koshy, titled "More river stretches are now critically polluted: CPCB"*.

The NGT in the above matter pursuing the implementation of the "Action Plan" prepared by the all the State Governments and UTs administrations for the purpose of prevention of pollution in various stretches of rivers in the concerned State/UTs. A Report was earlier prepared by Central Pollution Control Board (CPCB), in consultation with the SPCBs, which became the basis of identifying 351 "River Polluted Stretches" in India. The NGT has constituted River Rejuvenation Committee (RRC) under the Chief Secretary of the concerned States/UT Administration. The NGT while pursuing the matter and monitoring the "Action Plan" prepared by the State Governments/UTs Administration, during the hearing held on 22.06.2020, considered the 'Remedial Action for Rivers' Pollution', and *inter-alia* mentioned that diversion of river waters for various purposes is affecting e-flows.

The Action Plan for restoration of polluted river stretches has to be executed through two-fold concepts viz (i) enhancement of river flows through interventions in water sheds/catchment areas for conservation and recharge of rain water (for subsequent releases during lean flow period in a year),(ii) regulation and enforcement of standards in conjunction with available flow in rivers /streams and allocation of discharges within stipulated norms. The NGT, amongst other, directed the State Governments and UTs Administrations to prepare "Action Plan" to include components like *maintaining minimum environmental flows* of river, irrigation practices etc. The Chief Secretaries of the State and UTs Administrations have been held accountable for failure to formulate Action Plans. Besides, it has been mentioned that the State Governments and UTs Administration shall also be liable to pay environmental compensation for the delay in execution of the "Action Plan", beyond the specified time lines set by the NGT.

[Reference: NGT's Order dated 22.06.2020-OA No 673/2018- In Re: News item published in The Hindu/authored by Shri Jacob Koshy, titled *More river stretches are now critically polluted: CPCB*]¹⁷

6. CONCLUSION

- (i) The river flow oscillate widely to meet competing and sometimes conflicting demands, there is need to regulate /balance the river flows in such a manner so that the human needs are fulfilled and as well as the riverine ecosystem is not threatened. There should be harmony in maintaining the river-fed environmental regime.
- (ii) The Government of India's notification No S.O. 5195 (E), dated 08.10.2018 & as amended vide notification No S.O. no.3286(E) dated 14.09.2019, issued by the NMCG Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, is a statutory requirement mandating the compliance of the same. The NGT has also directed the Central Water Commission (CWC) to regularly monitor e-flow of River

Ganga specifically during lean season at various places specifically between Hardoi to Kanpur, this direction of the NGT has to be followed up. The CPCB and the SPCBs should regularly monitor the e-flows and display the monitoring data in the public domain. As per the NGT's direction it must be ensured that the quantity of water in the normal channel of the river is maintained equivalent to 20% on an average monthly basis during lean months of the River Ganga at Haridwar.

- (iii) Besides CPCB and the SPCBs, some other independent agency should also evolve a protocol to monitor and audit the river water quality. The concerned States Governments – Uttarakhand, UP, Jharkhand, Bihar and West Bengal although have been directed by the NGT to take steps for ensuring the maintenance of e-flows in river Ganga, this should be done by other State Governments in respect of the other rivers as well in terms of the order/direction in the matter of *OA no 673 of 2019 mentioned supra*¹⁶
- (iv) NMCG being the National authority to periodically obtain /seek reports from the State Governments/UT Administrations/ CPCB/SPCBs, the status of e-flows in all the rivers so as to ensure maintenance of e-flows norms.
- (v) NGT has directed the State Governments and UTs Administration to include components like; maintaining minimum environmental flow of rivers in their "Action Plans" prepared for ensuring that the Rivers are free from pollution, the compliance of the same requires to be monitored and status furnished to the CPCB/NMCG and also on public domain.

[Reference: order dated 22.06.2020 (uploaded on 29.06.2020) in *OA No 673/2018*]¹⁷

[* Reference: NGT's order dated 12.12.2019 (uploaded on 18.12.2019) in the matter of *OA no 200/2014-M.C. Mehta vs Union of India & Ors.* & order dated 22.06.2020 (uploaded on 29.06.2020) in *OA No 673/2018- In Re: News item published in The Hindu*" authored by Shri Jacob Koshy, titled *More river stretches are now critically polluted: CPCB*]¹⁷

- (vi) Maintaining minimum Environmental flows can sub-serve, as an important link between environmental conservation and mainstream the environment -especially freshwater ecosystems in national development planning processes, health of river and conserving biodiversity.

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