Exploitation and Rejuvenation of River Ganges: Policies, Institutions and Governance

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Abstract

The river Ganges (or Ganga as it is well known in the Indian sub-continent) has forged significant economic, social, environmental, religious, political and cultural values in India for several thousand years. However, over the years, rapid population growth, improved standards of living and exponential growth of industrialisation and urbanisation within the basin has subjected the river to various forms of degradation. This ultimately has limited the opportunity to access clean and safe water by the populace who rely on the Ganges. Records indicate that since 1979 the Government of India has taken numerous steps to rejuvenate this river. However, nurturing the Ganges back to life and creating a safe and sustainable ecosystem in the river basin area has so far been a seemingly daunting task. In order to achieve a viable solution to the problem, clear understanding of the socio-political, economic, environmental, technological and institutional aspects of this mighty river at the micro levels is vital. This paper discusses the current understanding on the state of Ganges in terms of its pollution and degradation and relevant management interventions that have been undertaken to improve its condition during the last three decades.

Keywords: River Ganges, pollution, water diversion, management, institutions

1. INTRODUCTION

The river Ganges (or *Ganga* as it is well known in the Indian sub-continent) has been the centre of civilisation in the Indo-Gangetic plains of India for several thousand years (Das and Tamminga 2012). It has forged significant economic, social, environmental, religious, political and cultural value in India. River Ganges is the longest river in India, originating in the Himalayas and flowing into the Bay of Bengal through Bangladesh, traversing a course of more than 2,525 km through the plains of north and eastern India. It serves as one of India's holiest rivers and thus its cultural and spiritual significance transcends the boundaries of the basin. It is arguably the most sacred river in the world and is deeply respected by the people of India, Bangladesh and Nepal. It has sustained the physical and spiritual needs of the Indian civilisation for millennia. To the Indian mind, River Ganges is felt as the living Goddess (personified as *Ma Ganges*) (CGF 2014; IIT 2013).

However, over the years, rapid population growth, increased standards of living and exponential growth of industrialisation and urbanisation within the basin has subjected the river to various forms of degradation. Untreated sewage and industrial waste discharge, reduced flow and extensive underground water withdrawals affect millions of people who depend on the Ganges's water (Trivedi 2010; IIT 2013; Rai 2013). The various reasons of pollution in Ganges can be attributed to both point and non-point sources. Majumder (2006) accounts that the negative externalities in polluting the river Ganges are grouped into various categories which include: urban liquid waste; industrial liquid waste; surface runoff from agricultural lands carrying fertilizers and pesticides; surface runoff from areas on which urban and industrial solid wastes are dumped; wallowing and bathing of cattle; and disposing of dead bodies.

'Ganges pollution' has been an issue of great concern for at least the last three decades from the local to the central government levels of India as well as to the relevant people and groups in the rest of the world (Figure 1). Several studies observe that the previous efforts of cleaning the river had succeeded

in receiving political support at the highest level in the Central Government, although the outcomes were insignificant compared to the funds and administrative time invested for this purpose (Majumder 2006; Das 2014; Jagannathan 2014). However, some reports argue that positive outcomes have been achieved from Ganges clean-up efforts (WRPC 2009; Rai 2013; Hasan 2015).

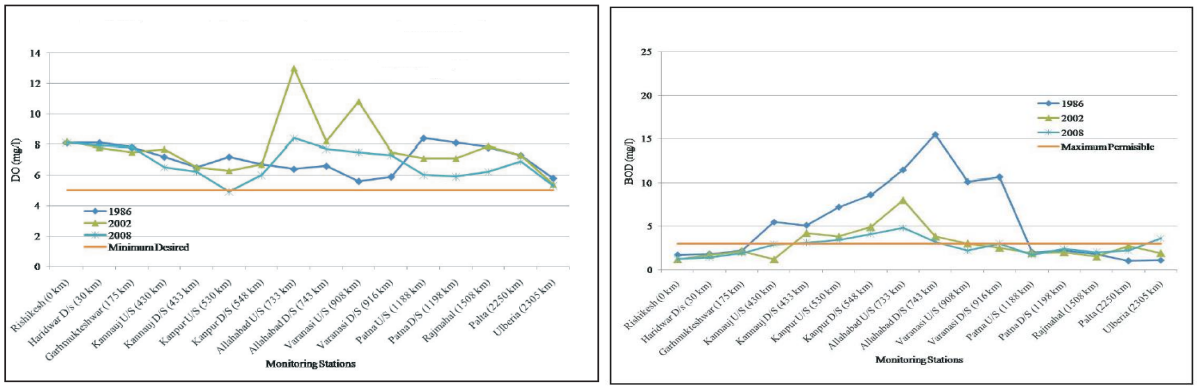

Figure 1. DO and BOD values (summer average) along the River Ganges (Adapted from NRCD 2009)

The purpose of this study is to understand and review the state of Ganges in terms of its pollution and degradation and relevant management interventions that were undertaken to improve its condition during the last three decades. The study will provide further knowledge and insight on the complexity and the dynamics of the problem and will contribute in developing perceptions on future management options. The report has been prepared through reviews of literature and content analysis, which is based on the secondary data available in the form of journal papers, news articles, web pages and government and non-government reports on the issue of pollution and degradation of the river Ganges.

2. PHYSIOLOGY AND HYDROLOGY OF GANGES

The Ganges basin area covers 11 states of India and the river supports 29 big cities, 23 mid-level cities, 48 towns and thousands of villages in India (Srivastava 2010). Mishra (2014) reports that the average annual discharge of Ganges is 493,400 million cubic meter (mcm), while Das (2011) and Hasan (2015) report it as 525,023 mcm. On an average, each square km of the Ganges basin receives 1 mcm of water annually as precipitation. Thirty per cent of this is lost as evaporation, 20 per cent seeps to the subsurface and the remaining 50 per cent is available as surface runoff (NMCG 2015).

The environmental flow (E-flow) of Ganges has been interrupted due to construction of many dams and barrages, which break the longitudinal connectivity of the river and alter river water and sediment flows (Das 2011; IIT 2013; Das 2014). Mishra (2014) accounts that there are 12 dams and reservoirs on the Ganges's route and each has negative impact on the river. For example, IIT (2013) observes that the Farakka barrage in West Bengal on the Ganges has altered the spawning and the breeding behaviour of Bengal Hilsa fish (*Tenualosa ilisha*) since its construction.

Nearly 63,736 mcm of annual flow of Ganges have been diverted and utilised through construction of dams and barrages and a further 30,617 mcm are under planning consideration (Hasan 2015). Despite this situation, CWC (2004) claims that the water diversion projects still leave a huge balance in the flow of Ganges, while Das (2011) argues that the official statistics hardly present a realistic picture of Ganges and its tributaries. Das (2011, p. 124) claims that 'reliable information regarding the flow and health of the river is practically unavailable'. Many of the water diversion structures built within the Ganges basin were carried out without conducting cumulative environmental assessment (Das 2014). Moreover, as the river is hydraulically connected by ground water flows, excessive water withdrawals from ground water aquifers in different regions of the basin are also affecting the flow of the river (IIT 2013).

3. MAJOR CONCERNS REGARDING GANGES

IIT (2013) identifies that uncontrolled anthropogenic activities have posed as a major cause of environmental degradation in Ganges in recent times. These degradations have been grouped under five main categories which include: (a) over-extraction of fresh water (both surface and ground water) from the basin (b) pollutant discharge into aquatic environment (c) decrease in water-holding capacities and regeneration rates into water bodies, aquifers and ecosystems (d) damage of rivers (within Ganges basin) through piecemeal engineering activities and (e) changes in geological factors prevailing over aquatic systems.

Srivastava (2010) observes that at Kanpur in Uttar Prodesh (UP) the river has become a dumping ground for garbage, especially polybags and its water has been so polluted that it even stinks during monsoon when the river is flooded. At the same point, in the lean period (summer) as the flow of the water reduces, the river becomes muddy and blackish. Mishra (2014) explains the state of pollution along its flow in terms of the faecal coliform count at Assi (the point where Ganges enters Kanpur City) which was 60,000 MPN/100 ml but it shot up to 1.5 million MPN/100 ml at the tail end. Studies reveal that the river has become so polluted due to high Biological Oxygen Demand (BOD) and Faecal Coliform (FC) from Kannauj to Trighat (especially along the city limits of Kanpur, Allahabad and Varanasi) and below Kolkata that it has gone beyond human use (bathing and drinking) and in some sections beyond use of even animals (Trivedi 2010; Das 2014).

Local communities and religious devotees have often held protests demanding a clean river Ganges (Pandey 2014). During major religious festivals (like *Kumbh* and *Magh Mela*) the *sadhus* (saints) protest against the governments for their negligence in cleaning the Ganges and threaten to boycott the ritual bath (Srivastava 2010). Several citizens' groups, NGOs, CBOs and social media have been active and committed in raising the voice of the common people to pressurize successive governments to keep the Ganges clean.

Climate change and global warming pose further threats on the Ganges basin (Das 2011; Hosterman *et al.* 2011). Das (2014) discerns that the melting of Himalayan glaciers would initially increase runoff in Ganges, but as the glaciers shrink over time, the natural flow of the river will further reduce, especially during winter months.

4. EXTENT OF POLLUTION IN GANGES

During the long course of Ganges, wastewaters (sewage) from large urban settings, industrial effluents and pollutants from many other non-point sources are discharged into the river. Das (2014) reports that 1.3 billion litres of sewage, 260 million litres of industrial waters, and runoff from 6 million tons of fertilizers, 9,000 tons of pesticides used in agriculture, as well as large quantities of solid wastes are daily discharged into the river (NMCG 2015).

Volume wise industrial pollution contributes about 20 per cent of the total pollution discharged into Ganges but due to its toxic, carcinogenic and non-biodegradable nature, this has much higher implication (NRCD 2009; IIT 2013; Das 2014). For example, the presence of toxic heavy metals in wastewater discharged into Ganges at Kanpur and Varanasi amount to Cadmium (Cd) 0.05 and 0.16 (2.0); Chromium (Cr) 6.45 and 8.12 (2.0); Copper (Cu) 0.88 and 0.16 (3.0); Iron (Fe) 8.80 and 3.32 (3.0); Manganese (Mn) 0.55 and 0.47 (2.0); Nickel (Ni) 0.22 and 0.14 (3.0); Lead (Pb) 0.19 and 0.15 (0.1) ; Zinc (Zn) 1.82 and 1.58 (5.0) mg/L respectively which indicates the extent of industrial pollution (the figures in the parenthesis indicate maximum allowable discharge levels as per CPCB) (Markandya and Murty 2000).

Besides, cremation grounds located along the river add a significant amount of pollutants into the river on a regular basis. For instance, the two cremation grounds- Harish Chandra and Manikarnika *ghat*-

dumps 33,000 bodies, 300 tonnes of half-burnt bodies, 16, 000 tonnes of ash and 1,000 tonnes of floral offerings annually into the river (Das 2014; Mishra 2014).

Moreover, bathing by over two million people and animals per day in the river and open defecation along the river further contribute to pollution in Ganges (Powell 2013; Das 2014). Das (2014) further reports that nearly 100 million people take holy dip in the Ganges at Sangam in Allahabad during *Kumbh Mela* and at Varanasi (a popular *hindu* religious site) the city generates 250 mld of sewage waters against its treatment capacity of 100 mld. The pollution problem has further been aggravated as the ability of the river system to transport its burden is decreasing annually because of water diversion for irrigation, power and drinking purposes (MoEF 2009).

5. MANAGEMENT INTERVENTIONS

Records indicate that since 1979 the Government of India (GOI) has taken numerous steps to rejuvenate Ganges. However, nurturing Ganges back to life and creating a safe and better ecosystem in Ganges basin area has so far been a seemingly daunting task. Das and Tamminga (2012) appraises that a public outrage regarding pollution in Ganges has led to the formulation of Ganga Action Plan (GAP) in 1985.

The first phase of GAP (originally there was no plan to have the second phase) was launched in 1986 and completed in 2000 with a delay of 10 years (NRCD 2009; NMCG 2015; Hasan 2015). The main objective of GAP was envisioned to clean the river and abate pollution through interception, diversion and treatment of domestic sewage, toxic and industrial chemical wastes from identified heavily polluting units entering into the river (Majumder 2006; IIT 2011; NMCG 2015). Here the effort was concentrated on solving the problem primarily through top-down, technocratic solutions by installing sewage pipe networks and treatment facilities along the Ganges as well as by putting pressure on polluting industries to police themselves by enforcing threats of fines and litigation (Majumder 2006; Trivedi 2010; Das and Tamminga 2012).

The second phase of GAP was started in stages between 1993 and 1996, when the implementation goals of GAP-I were not even reached half way (IIT 2011). The components of GAP-II were along similar lines of GAP-I, with an extension of GAP-I where two more States, viz. Uttarakhand and Jharkhand were included within the projects. It was targeted to develop sewage treatment facilities for 1,912 mld (277 mld as per NRCD 2009) of wastewater through GAP-II by 2001 (NMCG 2015) while the achievement was only 130 mld (NRCD 2009).

The choice and design of the components of GAP were developed solely based on the survey of CPCB (IIT 2011). To achieve the objectives of pollution abatement, the GAP took up both core and non-core schemes. The core sector schemes targeted to tackle point source pollution, incorporated interception and diversion schemes and construction of Sewage Treatment Plants (STP). Non-core schemes addressed non-point source pollution, which consisted of low cost sanitation schemes, river front development schemes including *ghats* (landing stations), electric and improved wood crematoria and promoting public awareness and participation. Critics have argued that public participation in the GAP was more symbolic rather than practical and functional (Das and Tamminga 2012). A large portion of the budget was planned for the 'hardware' part disregarding adequate participation of the local communities whose livelihood directly or indirectly depend on the river (Jagannathan 2014).

6. INSTITUTIONAL ARRANGEMENTS

The GOI has concentrated efforts to establish institutions at all government levels including Central (Union), State and Local (i.e. towns and cities) to implement and monitor the GAP. The Ministry of Environment and Forests (MoEF) within the union/central government was put in charge of the overall design and implementation of GAP. During the launch of GAP-I, Central Ganges Authority (CGA) came into existence under the Environment Protection Act-1986, headed by the then PM Rajiv Gandhi. The Chief Ministers (CMs) of the concerned states, union ministers and secretaries of the

concerned central ministries and experts constituted its members. An additional agency called Ganges Project Directorate (GPD) was set up, strengthened with financial and administrative powers in order to implement projects under GAP-I. As GOI subsequently decided to expand its program to all major rivers in India through GAP-II, the GPD was later transformed into National River Conservation Directorate (NRCD), along with transformation of the CGA into National River Conservation Authority (NRCA) in 1995 (IIT 2011).

At the state level, State River Conservation Authorities (SRCA) were set up in all the relevant states. These authorities were mandated to function mainly as coordinating and monitoring agencies for GAP. State Departments were involved to implement drainage interception and diversion work, as well as to conduct erection, commissioning and operation and maintenance of STPs. State Pollution Control Boards, Regional Commissioners and District Magistrates were also involved in monitoring activities. In addition to different government agencies, autonomous academic institutions (such as IIT Kanpur and Patna University) were appointed exclusively for the monitoring purpose of river-water quality and performance of STPs. However, this arrangement came into effect at a very late stage after GAP activities had already commenced (IIT 2011).

At the local (cities and towns) level, the responsibilities of respective implementation, operation and maintenance were vested on the local offices of the State Departments. For example, in Kanpur, the local office of the UP *Jal Nigam* was renamed as Ganges Pollution Control Authority. Monitoring of industrial pollution was the responsibility of the regional offices of the State Pollution Control Boards (SPCBs). Formation of Citizens Monitoring Committees were an important part of the institutional arrangement for monitoring of STPs and sewage related issues of pollution (IIT 2011).

In order to further increase the significance of the Ganges river, it was declared as the 'National River' of India by the then GOI in 2008 (IIT 2013). Subsequently, GOI established National Ganges River Basin Authority (NGRBA) which is chaired by the PM of India and its constituting members include the concerned Union Ministers and the Chief Ministers of the States through which Ganges flows (NMCG 2015). The Ministry of Water Resources, River Development and Ganges Rejuvenation (MoWR, RD & GR) is the nodal Ministry for the NGRBA. NGRBA has been constituted as a planning, financing, monitoring and coordinating authority to strengthen the collective efforts of the Central and State governments for effective control of pollution and conservation of river Ganges. Further, 'Cleaning of the River Ganges' has been a national mission announced in 2014 General Elections Manifesto of Bharatiya Janata Party (BJP). Accordingly, the present Indian PM Narendra Modi pledged that Ganges clean-up will be one of the top priorities of his Government (Pandey 2014).

Recently, under the National Mission for Cleaning Ganga (NMCG) as part of the *Namami Gange* project, an ISRO-backed GIS tool has been introduced to ensure real-time data on predefined 20 parameters and public monitoring of Ganges river surface pollution on ground situations. The CPCB has been assigned the task of installing real-time monitors at 118 locations on Ganges where a *nallah* (natural drain) meets the river. Further, the government is set to launch a Bhuvan Ganges app whereby real-time images of Ganges can be captured by the public through smartphones and uploaded right away to check for any river surface pollution. These are innovative solutions which could positively impact on and ensure accountability and public involvement in the cleaning of Ganges.

Also, Ganges Knowledge Centre (GKC) has recently been constituted within NMCG in order to nurture and develop adequate knowledge base, analytical tools, targeted research, and awareness building on Ganges and to enhance the quality of implementation of the NGRBA program. This entity has been conceptualized as a premiere and autonomous knowledge based institution which would integrate system characterization, innovation and stakeholder participation in order to optimize the investments of NGRBA (NMCG 2015).

The consortium of seven Indian Institutes of Technology (IITs) has prepared a Ganges River Basin Environment Management Plan (GRBEMP) for the NGRBA with the objective of taking comprehensive measures for rejuvenation of the Ganges ecosystem and improvement of its ecological

condition, with due emphasis on the issue of competing water uses in the river basin (IIT 2013; NMCG 2015). Within this plan the wholesomeness of the river has been encompassed in terms of four defining concepts: *aviral dhara* (Continuous Flow), *nirmal dhara* (Unpolluted Flow), Geologic Entity and Ecological Entity. IIT (2013) has recommended the requirement of coordinated efforts and co-operation of government and non-government institutions, key stakeholders (such as local residents, NGOs, environmentalists, saints, priests, pilgrims, representatives of scientists, social workers and all related academic and technical bodies) and civil society to rejuvenate Ganges.

7. GOVERNMENT EXPENDITURES FOR GANGES

The total expenditures for the GAP has been reported as US$ 308.6 million (IIT 2011). The GOI has further planned to invest US$ 2.4 billion to implement the activities as pledged through NMCG (NMCG 2015).Pandey (2014) reports that although the GOI allocated over Rs. 20,000 crore (US$ 3.14 Billion) over the last three decades for Ganges restoration, only Rs. 967.3 crore (US$ 152 Million) has so far been actually spent. However, there are reports regarding discrepancies on utilisation of funds and corresponding progress of cleaning activities. CAGI (2000) reveals that by the year 2000, the GAP had only achieved 39 per cent of its proposed target for sewage treatment, while 91 per cent of its budget allocation was already spent by that time.

In order to mobilise the resources required to improve the condition of Ganges, recently, the current PM Narendra Modi has approved the establishment of 'Clean Ganges Fund' and an initial sum of Rs. 2,037 crore (US$ 320 Million) has been allocated for this purpose. The purpose of setting up the CGF is to attract voluntary contributions at the global level to increase people's participation towards the conservation of the river. A provision has been reserved for local Indian donors to the fund who would be eligible for tax benefits (CGF 2014).

8. PREDICAMENT ON THE CLEAN-UP EFFORTS

Several reports reveal that there has been little or no evidence on the improvement of the state of Ganges despite the effort of massive financial investment for restoration. Many observe that GAP is a failure due to unabated mismanagement, corruption and incompetence (Srivastava 2010; Rai 2013; Jagannathan 2014). The failure of GAP can be linked to many elements. Das (2015, p.5) notes that '…it (GAP) did not sincerely follow the basic principles and steps of the program planning process…'. During the course of its implementation, leadership and staff of GAP were frequently replaced, they worked without much vision and commitment and the assigned people often remained unfamiliar with the work done by their predecessors (Srivastava 2010). Pandey (2014) reports that the laxity in the efforts to clean up the river branches across the political spectrum being compounded by the bureaucratic red tape. Further, political differences among States and Central Governments have always been a hindrance in the progress of clean-up activities of GAP (Pandey 2014). This study also finds that in many cases there was no provision for allocating follow-up funding to run the operational costs for the treatment plants. As a result small problems often led to total shutdown of the STPs.

Questions have been raised regarding the appropriateness of the choice of technologies adopted by GAP for implementing the components. IIT (2011) claims that the technology used for the centralised STPs (activated sludge process) was not only incapable of removing pathogens and coliform bacteria from the water but was also unsuitable for improving the quality of water above the 'bathing class'. The bulk of the treatment facilities was powered by electricity, a risky dependency on an unstable power source as in many Indian cities it is quite common for the power supply to fail several times a day, often for prolonged periods, resulting in unabated drainage of total sewage of the city into the river (Das 2011). Further, during the monsoon season municipalities are forced to shut down many of the plants as they become overwhelmed (Pandey 2014). Jagannathan (2014) notes that the technologies for electric crematoriums and beautification of *ghats* were also unsuitable in the social context of India. He further observes that the lessons learnt from the technological mistakes of GAP-I could not be overcome in GAP-II which ultimately caused further unsatisfactory performance from the implementation of its components.

Many criticise that Ganges clean-up efforts have failed to effectively involve the immediate community they would affect (Alley 1994; Singh 2013; Jagannathan 2014). Also, the centralised planning process of GAP made it difficult for the local governments to perform their responsibilities (Das and Tamminga 2012). Alley (1994) argues that the Government groups have delegated independent agencies to deal with Ganges as they deemed suitable, ignoring the population to whom Ganges is a lifeline, and for whom Ganges has a greater significance than just being a mere source of water and a carrier of pollutants.

In 1987 the Environment Minister created a police task force in Varanasi to prohibit defecation, the disposal of debris and garbage, the dumping of animal carcasses into the river, and to monitor pollution along the banks of the river (Stille 1998; Das and Tamminga 2012). However, as this decision was made without public participation, it only aggravated an already tense relation between local government officials and the community (Stille 1998). Such activities secluded the community from pollution clean-up efforts rather than integrating them (Das and Tamminga 2012).

9. WAY FORWARD: REFORMATION OF CLEAN-UP ACTIVITIES

There has been criticism that the task of improving conditions within the GRB has typically involved only point-source at end-of-pipe solutions (technocratic approach). It is alleged that the causal relationships that exist between human needs and ecosystem health or the processes that control the evolution of water as it flows between ecosystem compartments have been largely ignored. This symptomatic approach does not provide policy makers the information required to formulate future management paradigms that could result in long-term improvement nor does it afford any permanent solution for the future generations (Powell 2013).

Das and Tamminga (2012) suggest that while dealing with point-source pollution in the Ganges, broader planning should be formulated to address the problem of the deficiency of urban environmental services such as water supply, sewage systems and solid waste disposal in cities along the Ganges. They have recommended that capital and energy intensive conventional sewage treatment technologies should be replaced by low-cost and more context-appropriate alternative technologies. One such technology could be the Advanced Integrated Pond Systems, which is being developed by the *Sankat Mochan* Foundation and the engineers at the University of California, Berkeley (Das and Tamminga 2012).

In order to reduce the pollution of Ganges, it is also important to put considerable emphasis on abating the non-point pollution sources through directly engaging people who reside along the river. Majumder (2006) estimates that along the seven km stretch of Ganges at Varanasi, the volume of non-point sewage pollution flow is 23.1 mld which also contributes to very high quantum of faecal coliform in the river. He postulates that such pollution can only be arrested if common people get involved through awareness building, motivation and sensitisation programs and through rewards for significant achievements in pollution control. In this connection, Das and Tamminga (2012) emphasize that interests of different groups of people (on the basis of class, caste, gender etc.) should also be identified and accordingly be meaningfully incorporated in clean-up efforts as they all share a different relationship with the river.

Moreover, while involving people, due attention should be given to the religious and the cultural sensitivity to Ganges. Reconciling the contradictions between ‘scientific’ and ‘traditional’ views of the river might be challenging, but could be addressed by using appropriate communication strategies (Das and Tamminga 2012).

Apart from the water quality and pollution issue of the river, Das and Tamminga (2012) also underscore the necessity of maintaining E-flows of the rivers at all times. Age-old practices like religious bathing by millions of people cannot be sustained without the required assimilative capacity of the river. This needs to recognise the value of ecosystems services of the river when undertaking

any activity which cause abstraction of water from Ganges and thus calls for setting boundaries and caps on water withdrawals based on good scientific knowledge (Postel 2005).

Studies show that general people have demonstrated little sense of ownership due to limited participation in formulating and implementing schemes for restoration work of Ganges (IIT 2011; Das and Tamminga 2012). Further, critics have pointed that arrangements could be made through keeping provisions of financial incentives in a business environment for the public to get them engaged in cleaning activities. This calls for developing an innovative system where a proper mix of incentives and disincentives would support an effective regulatory arrangements (IIT 2011; Jagannathan 2014).

Often the slow progress of GAP is attributed to inadequate funding and investment and it highlights the importance of continuous flow of fund for capital and operational costs (Singh 2013). This propensity increases the dependence on government funding and raises questions about the future sustainability of Ganges clean-up activities when government funding would cease. This calls for the requirement to develop an economic system through implementation of 'user fees' principle and to establish a 'treatment market' (IIT 2011) where there would be arrangements for buying and selling of sewage and other wastewater. Such systems could assist the Ganges clean-up activities to be economically self-sufficient and may establish incentives for pollution abatement in the long run.

The problems of the river Ganges is complex because of its multidimensional nature. Das (2014) suggests that it is not possible to achieve the objective of river cleaning and rejuvenation without taking into account the whole extent of environment, river morphology and flow, ecology, aquatic biota, landuse, geology, tectonics, climate, livelihoods, agriculture, wetlands, forests and industries in the basin. This calls for an interdisciplinary study on Ganges basin management plan including hydrology, anthropology, engineering, law, history, economics, culture and other influencing aspects. Brannstorm (2004) postulates that without due collaboration between the civil society and the local governments this challenge at hand cannot be overcome.

Therefore, considering the above issues, a multifaceted system for river rejuvenation could be developed, which should be effective not only in terms of environmental protection but also in terms of economic feasibility and social acceptability. This necessitates the formulation of an integrated approach where the role of multiple stakeholders are recognised and outlined through application of a combination of policy instruments and institutional innovations.

10. CONCLUSION

This study finds that with seeming political commitment the GOI has been slowly progressing through 'trial and error' to solve the issue of pollution problem in Ganges. However, incorporating the lessons learnt from the mistakes and accordingly structuring and restructuring the institutional arrangements have caused delays in Ganges rejuvenation activities in real sense. Evidence indicate that any further delay in curbing the pollution in Ganges may take the river beyond the limit of its environmental resilience and can cause ecological disaster in the basin area. Besides, possibly a single common plan for the whole Ganges River may not serve the purpose of rejuvenation and thus necessitates the importance of developing local level plans considering at least three important sections of the river viz., upper, middle and lower stretches of its flow.

Available reports and literature suggest that the intellectual think tanks have provided suggestions at the macro level involving multi stakeholders to curb pollution in Ganges. However, a practical, implementable and detailed work plan is yet to be developed at the micro level to elicit tangible and sustainable improvement of the state of Ganges. The main causes of the Ganges pollution should be divided into sub-causes so that each of the causes could be identified and supported with a practical solution (Das 2015). Hence, before making any further financial investment especially in terms of technocratic resolutions, a workable practical system considering the complex relationship between the river and the society should be developed with specific goal-oriented and time bound target achievements for Ganges rejuvenation.

In order to achieve a sustainable solution to the problem, clear understanding of social, political, economic, environmental, technological and institutional aspects at the micro levels is vital. There is no substitute to developing an integrated approach which would be interdisciplinary in nature. Besides, preparation and design of detailed implementation with monitoring and evaluation activities are vital for any future clean-up activities of the Ganges to be successful.

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