

IMPACTS OF KUMBH MELA ON PHYSICAL INFRASTRUCTURE OF THE CITY CASES OF PRAYAGRAJ, HARIDWAR, NASHIK, UJJAIN

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Abstract- The Kumbh Mela, a monumental religious event drawing millions of pilgrims to Prayagraj, Haridwar, Nashik, and Ujjain in India, poses significant challenges to the host cities' infrastructure. In Prayagraj, transportation networks and essential services face strain, prompting authorities to invest in upgrades, yet concerns linger regarding the sustainability of these improvements post-event. Haridwar confronts similar issues with overcrowding and resource strain, necessitating temporary infrastructure enhancements, although doubts persist about the long-term impact. Nashik experiences congestion and sanitation problems exacerbated by temporary settlements, highlighting both the event's potential for infrastructure improvement and the uncertainty surrounding its lasting effects. Ujjain grapples with congestion and environmental concerns due to makeshift facilities, prompting infrastructure investments while raising questions about their sustainability. The Kumbh Mela presents a unique opportunity for infrastructure development in these cities, but the challenge lies in ensuring the enduring benefits of these investments beyond the event. Balancing short-term needs with long-term urban development goals remains crucial for effective management and sustainability in the face of this extraordinary gathering.

Key Words: Kumbh Mela, Physical Infrastructure, Water Supply & Quality, Sewage & Sanitation, Solid Waste Management, Environmental Impact

1. INTRODUCTION

The Kumbh Mela, a sacred Hindu pilgrimage, is one of the largest religious gatherings globally, drawing millions of devotees to the banks of holy rivers in India. The event rotates among four main pilgrimage sites: Prayagraj (formerly Allahabad), Haridwar, Nashik, and Ujjain, with each hosting the Kumbh Mela once every twelve years. The event also occurs at smaller intervals at different locations, including the Ardh Kumbh Mela every six years and the Maha Kumbh Mela every 144 years.

The Kumbh Mela holds profound religious significance, rooted in Hindu mythology, where believers gather to bathe in the sacred rivers, believed to cleanse sins and bestow blessings. This spiritual journey attracts a diverse array of pilgrims, ascetics, and tourists, creating an unparalleled spectacle of faith and devotion.

However, the sheer magnitude of the event places immense pressure on the physical infrastructure of the host cities. Prayagraj, situated at the confluence of the Ganges, Yamuna, and mythical Saraswati rivers, becomes a focal point during the Kumbh Mela, transforming into a temporary metropolis accommodating millions. Haridwar, nestled along the banks of the Ganges in the foothills of the Himalayas, experiences a similar surge in pilgrim influx, straining its existing infrastructure. Nashik, located on the banks of the Godavari river, and Ujjain, along the Shipra river, also witness significant impacts on their urban infrastructure during the event.

The challenges posed by the Kumbh Mela include congestion, overloading of transportation systems, sanitation issues, and strain on water and electricity supply networks. Temporary tent cities spring up to accommodate the massive influx of pilgrims, adding further pressure on the already stretched resources. Despite these challenges, the Kumbh Mela serves as an opportunity for infrastructure development and improvement, with authorities investing in temporary and sometimes permanent upgrades to cater to the needs of the pilgrims and tourists. However, the sustainability of these improvements beyond the event remains a subject of debate, highlighting the complex interplay between religious tradition, urban development, and resource management in India.

2. NEED OF STUDY

Challenges - Land management, Traffic and transportation management, Safety and security management, Site and services management, Infrastructure needs, Tourism management, Ghats management. During the Period of Kumbh Mela- The Kumbh Mela has been studied from the perspective of Religion by many people around the world, but detail study of this event from the planning perspective is still lacking. The whole city has to face the consequences of the Kumbh mela due to the over spill from the designated area. During Kumbh Mela a large floating population required huge amount of urban services and facilities.

After effects of Kumbh Mela- Major challenges faced by the city as clean ganga initiatives are temporary, critical gaps in sanitation management, low effectiveness of temporary treatment facilities, overloading of existing STPs, disposal / reuse compromised, etc.

3. AIM

To conduct a study of the impact of Kumbh Mela in Prayagraj, Haridwar, Nashik, Ujjain on the fields of Physical Infrastructure.

4. OBJECTIVE

- To study relevant guidelines, rule and regulations related to the impact on physical infrastructure in the four cities conducting Kumbh Mela.
- To analyze and compare the condition of the four cities with respect to the issues in physical infrastructure facilities.
- To rank the four cities on the basis of gaps identified.

5. SCOPE AND LIMITATIONS

- To study, the condition of Water Supply and quality, Sewage & Sanitation and Solid Waste Management in physical infrastructure of the four cities- Prayagraj, Haridwar, Nashik, Ujjain.
- Land management, Security System, Law and Order, River Front Project, Tourism Facilities, Social Infrastructure, Environmental Impact, Funding, Governance. shall not be discussed.

6. DETAILED ANALYSIS OF FOUR CITIES

6.1. Location of Prayagraj Kumbh 2019

Prayagraj, is a metropolis in the Indian state of U.P. Prayagraj lies in the humid subtropical climate zone. It exhibits hot dry summer season from April to June, cool dry winter season from December to February as well as warm humid monsoon season from July to September. 2011 census Prayagraj has a population of 59,54,390 population density of 1,086 /Sq km. Decadal growth 2001-2011 was 20.6%.

6.2. Number of Visitors at Kumbh Mela

Year	Number of Visitors
1989	16 million
1995	25 million (56.25%)
2001	40 million (60%)
2007	70 million (75%)
2013	120 million (71.43%)
2019	150 million (25%)

Table 1 number of visitors at Kumbh Mela

6.3. Temporary Facility Provided in Kumbh Mela 2019

S.NO.	Services Provided	Numbers
1	Toilets	1,22,000 (1230 per toilet)
2	Dustbins	20,000 (20-35 m distance)
3	Tent City	4200 Premium beds for VIP

4	Electricity	40,700 L.E.D Lights according to Grid
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Table 2 temporary facility provided in kumbh mela 2019

6.4. Drinking Water Supply

The National Green Tribunal (NGT) had directed the Uttar Pradesh and Uttarakhand Pollution Control Boards to display the quality of water of the river Ganga at all important locations on monthly basis, to indicate whether the river water is fit for drinking. The UP government have taken responsibilities for supplying drinking water to the attendees at Kumbh Mela, 2019 by providing 5,000 stand posts, 800 km temporary pipeline, 200 water ATM's 150 water tankers (Ro technique), 100 temporary hand pumps. **8,000 cusecs of clean water were released dam** before every Shahi Snan to ensure clean water during the entire Kumbh Mela. Building materials company HIL Ltd., a CK Birla Group, with its roofing solutions brand Charminar had installed numerous water kiosks to serve clean drinking water to the devotees at Kumbh Mela, Prayagraj (The Hindu Business Line, 2019, Jan 31)

- 5000 stand posts * (50 liters per stand post per day) = 250,000 liters/day
- 200 water ATMs * (1000 liters per water ATM per day) = 200,000 liters/day
- 150 water tankers * (20,000 liters per tanker per day) = 3,000,000 liters/day
- 100 temporary hand pumps * (100 liters per hand pump per day) = 10,000 liters/day
- 800 km temporary pipeline * (500,000 liters per km per day) = 400,000,000 liters/day
- Total supply = 250,000 + 200,000 + 3,000,000 + 10,000 + 400,000,000 = 403,460,000 liters/day
- Total available supply = 403,460,000 liters/day
- Total required supply = 20,250,000,000 liters/day
- approx. 20 billion liters per day water supply shortage.

6.5. River Water Quality during Kumbh Mela Prayagraj 2019

- Sangam is among the top four highly polluted stretches in the longest Indian River, Ganga. The Central Pollution Control Board (CPCB) has recognized the water of river Ganga in Prayagraj as "Not Satisfactory". The main reason of water pollution in this city is lack of sewage system
- According to the Namami Ganga Project reports, 70% of the pollution of river is due to sewage, 20% is due to industrial waste and only 10% is due to non-point sources like throwing of garbage, open defecation.
- In December 2018, the Total Coliform and the Fecal Coliform (MPN/100ml) were decreasing towards the downstream of the region. indicating that steps were taken to improve the quality of River at Prayagraj.
- January month the BOD level was quite satisfactory for bathing. but for February and March months the B.O.D values were exceeding the permissible values, because of the important bathing events.
- But for each month during Kumbha (January-March) the total coliform and Fecal Coliform (MPN/100ml) were increasing towards downstream of the region.
- It shows that the quality of river was degrading during the Kumbha.

6.6. The quality of river was monitored regularly at monthly interval. The quality of river Ganga in Allahabad before, during and after the Kumbh Mela

Parameter	Dec 2018		Jan 2019		Feb 2019		Mar 2019	
	u/s	d/s	u/s	d/s	u/s	d/s	u/s	d/s
D.O(mg/L)	8.8	9.0	11.9	10.9	10.4	9.8	8.7	8.3
B.O.D(mg/L)	3.2	3.4	3.0	2.8	3.1	3.4	3.0	3.3
Total Coliform(MPN/100ml)	22000	21000	17000	20000	14000	17000	16000	20000
Fecal Coliform(MPN/100ml)	13000	11000	9300	11000	7800	9300	9200	11000

Table 3 River Ganga During and After Water Quality in Kumbh Mela 2019

6.7. Drain discharge into river Ganga

- National Mission for Clean Ganga (NMCG), State Mission for Clean Ganga (SMCG) and Government of Uttar Pradesh supported the treatment of drains projects in UP from December 2018 in light of Kumbha 2019.
- A total of 152 drains were being treated through different technologies which were polluting discharging wastewater into river Ganga and polluting it.

6.8. Drain discharge into river Ganga

Parameter	Inlet samples	Outlet samples	% reduction
pH	7.27	7.29	-0.275
DO	9.27	9.76	-5.258
TSS	233.3	91.0	60.99
BOD	63.5	27.8	56.22
COD	332.7	100.7	69.73
TOTAL COLIFORMS (MPN/100 ML)	69472.7	55154	20.61
FECAL COLIFORMS(MPN/100ML)	31064.8	21559.5	30.59

Table 4 Analysis Parameters Between Inlet and Outlet Drains Sample

6.9. Failure of Modern Technologies used

- Modern technologies like Bioremediation, Non-woven geo bags or geo tubes are used to reduce the discharge of waste into the river. But to some extent only they were effective.
- National Green Tribunal (NGT) stated that the use of Geo tubes was completely waste of money. The technology involves treatment of waste water with the help of activated carbon and polymers.
- It is introduced inside 50 meter or 25-meter bags commonly known as Geo tubes, where waste is filtered with the help of membranes. Then the solid waste gets collected inside these bags. But the Activated carbon and polymer reduces odor only, they didn't reduce the dissolved BOD of the waste.
- Moreover, the installation of Geo tube technology is done at only five out of the 85 drains flowing into the Ganga and even at installed stations they treat only some portion of the waste and the rest is discharged into the river untreated.

6.10. Solid Waste Management

- Mela area metal dustbins used each sector for garbage collection by spatial distribution of solid waste collection points. These dustbins were of single type and were used disposal of all types (mixed) of solid waste without segregation.
- 40 Compactor vehicles were engaged to collect the garbage from dustbins.
- Transported to the Common Solid Waste Management site near Baswar village, Prayagraj. (Baswar Waste Processing Unit)
- Medical facilities, Health Department made 11 temporary hospitals. A Common Bio-Medical Waste Treatment Facility (CBWTF) namely M/s Ferro Build Hards (I) Pvt. collection, transportation and processing of BMW. only central hospital follows the color code dustbin.

Location	Avg. Generation (MT per day)	Remarks
Kumbh Mela Area (130 mn population)	150 MT	On bathing dates generation of solid waste was increased, ranging from 300 - 500 MT.
Other than Kumbh Mela Area	600 MT	Collected from the city.
Bio-medical waste	8-10 kg (central hospital) 8 kg (general hospital)	On main bathing dates generation of BMW increased

Table 5 waste Generate During Kumbh Mela at Prayagraj



Figure 1 Liquid waste and Organic Waste

6.11. According to SWM rule 2016

- Segregation: Not followed at source.
- Transportation: Transfer station is located in the center area of the mela.
- Processing: 20% out of total waste is been handled manually. No processing for segregation of material is done hence the waste stays unmanaged for years.
- Disposal: All the unsegregated solid waste is loaded in the compactor and dumped at 15 KM far away from the mela area at Baswar dumping site where opening dumping. which lids to distorting the land and polluting the environment.

6.12. Impact of Disposal Site in Surrounding Area

- In Prayaraj 2 major dumping site Baswar and Khuldabad area 62 acre approx.
- Water, air and soil resources get extensively depleted and degraded due to the over imposing pressure of the human activities during these religious events. As a result of this, the entire region faces acute risk of health and hygiene.
- In competencies and inadequacies in management of solid waste management will prove to be more severe factors as the population pressure visiting the Kumbh melas increases manifold over the future years.

6.13. Sewage and Sanitation

- The Sanitation activities involves installation of about 1.2 Lakh Mobile Toilets with proper management and disposal of waste, placement of about 15000 Manpower so to keep the streets and Mela area clean.
- According to a report by Centre for Science and Environment (CSE), New Delhi, the amount of waste generated during the 55-day long Kumbh was about 18 times more (4824MLD) than what the district produces daily.
- The existing sewage treatment capacity of the district was about 268 MLD was not able to treat half of the generated waste. This result in lying of the waste at the banks of river Ganga, thus making it more polluted (Down to Earth's,2019,).

7. Location of Haridwar Kumbh 2021

Haridwar has very moderate subtropical climate which can be high on humidity. Annual amount of rain falls 1174 mm. 2011 census Haridwar has a population of 1,890,422. population density of 817 /sqkm. decadal growth 2001-2011 was 30.63%. Haridwar kumbh always very challenging –arrangement, transportation, crowd management because circulation area is very limited, exit-entry is very limited. Haridwar kumbh area has in urban area. Having such a large settlement on its banks in Haridwar, the river is also exposed to contamination. A recent study by the Doon University on the pollution levels in the Ganga establishes that in the stretch from Rishikesh to Haridwar the river was high on pollutants due to the pilgrim bathing load and urban waste effluent flow. The Haridwar kumbha Mela had happened from 1 April to 30 April in the year 2021 amidst the COVID-19 pandemic and making it “a super spreader event”.

7.1. Floating Population During Kumbh 2021

Year kumbha	No of pilgrims
1986	5.5 Million
1998	10 Million (81.82%)
2010	16 Million (60%)
2021	20 Million (25%)

Table 6 Floating Population During Kumbh 2021

7.2. Temporary Facilities Provided in Kumbh Mela 2021

S.NO.	Services	Numbers
1	Toilets	1603 mobile toilet,10602 FRP(T&U) (1639/toilet)
2	Dustbins	5780, 10,000 liner bags
3	Tent City	20000 public accommodations
4	Electricity	40,700 L.E.D Lights
5	Drinking Water	200 Water ATMs (approx. 2.7 billion liter per day shortage)

Table 7 Facility Provided in Kumbh Mela 2021

7.3. River Water Quality at Haridwar Kumbh 2021

Parameter	during kumbha	Post kumbha
pH	7.77	7.79 (0.20)
DO	5.8	8.90 (3.1)
BOD	4.5	5.5 (1.0)
COD	14	16 (2)
TOTAL COLIFORMS (MPN/100 ml)	110	130(20)
FECAL COLIFORMS(MPN/100ml)	80	100(20)
Conductivity(μ s/cm)	138	545(407)

Table 8 River Water Quality at Kumbh Haridwar

- Main source of river ganga pollution is 7 Grossly polluting industries drains, and, domestic sewage-22 drains, illegal disposal of solid waste-along the river bank and flood plain zone and floating population. This in turns leads to health concerns, environmental degradation etc.
- River Ganga traversing from Haridwar to Sultanpur has been identified as a polluter stretch of priority IV (3-6 BOD level) in Haridwar district.
- In Jan-Feb 2021, BOD, pH, DO value was exceeding the permissible value because of important bathing and municipal drainage.
- During Kumbha (Jan-Feb 2021) the total coliform and Fecal Coliform (MPN/100ml) were increasing It shows that the quality of river was degrading during the Kumbha.
- Changing the color of water because of waste water. & increase the conductivity value showing the pollution of river.

7.4. Pollution Drain Due to Drains

BOD, TSS value was exceeding the permissible value because of drainage.

Total Coliform and Fecal Coliform (MPN/100ml) Were Increasing It Shows That the Quality of River Was Degrading.

Parameter	Haridwar & Rishikesh
pH	6.8-7.0
TSS	31 -135 mg/l
BOD	5.9-13mg/l
COD	26-62 mg/l
TOTAL COLIFORMS (MPN/100 ML)	1,60,000-2,20,000
FECAL COLIFORMS(MPN/100ML)	93000 – 140,00,000

Table 9 Pollution Drain Due to Drain at Kumbh Mela Haridwar

7.5. Solid Waste Management

- Mela area 5780 Nos twin dustbins are 10L and 60L capacity used for garbage collection by spatial distribution of solid waste collection points. where 255 covered bins used but dustbins were of single type and were used disposal of all types (mixed) of solid waste without segregation.
- Municipal Compactor vehicles were collecting the garbage from dustbins by cleaning volunteers.
- Transported to the old dump sites at Sarai village near Chandi- Ghat in Haridwar city. Around 12285 MT legacy waste is present in the old dumpsite of the ULB.

- To provide medical facilities to pilgrims, Health Department made 150 beds temporary hospitals in Kumbha Mela-2021.
- Dustbins having assigned color coding for collection of biomedical waste.
- Common bio-medical waste treatment and disposal facility is being operated by the private entrepreneur. Private party collects, transports, treats and dispose bio-medical waste.

Location	Avg. Generation (MT per day)	Remarks
Kumbha Mela Area	100+ MT	On bathing dates generation of solid waste was increased, ranging from 100 - 300 MT.
Other than Kumbha Mela Area	150 MT	Collected from the Haridwar city.
Bio – medical waste	12kg-15 kg	BMW increased 4 times during Kumbha. (healthcare facility, quarantine centers)

Table 10 waste Generate During Kumbh Mela at Haridwar



Figure 2 Liquid waste and Organic Waste at Haridwar

7.6. According to SWM Rule 2016

- Segregation: Not followed at source segregation.
- Processing: No processing for segregation of material is done hence the waste stays unmanaged for years.
- Disposal: All the unsegregated solid waste is loaded in the compactor and dumped at 8.2 KM far away from the mela area at Sarai village dumping site where opening dumping.

7.7. Impact of Disposal site in surrounding area

- Sarai village in big trouble that's because of this pile of garbage.
- In 2016 when the Haridwar municipal corporation decided to dump all its garbage here. there was no discuss about this and their farming land was taken by the municipal corporation.
- Dumping site area - 600 bigha of agricultural area.
- Kumbha and city (28 days) Approx. 7500-ton garbage dump in site. approx. 5 lakh MT legacy waste old dumped already at Sarai village.
- Kumbha and city's unsegregated waste is causing harm not only to land but also to 1.5 lakh people nearby. like dirty farming, smell, and increase disease.
- Water- dump waste can move through the soil and end up the ground water, Soil, air, pollution. has also increased a lot. Garbage catch the fire because summer has come and there is so much smoke that on cannot sleep whole night.

7.8. Sewage and Sanitation

- In Haridwar Kassawan Nalla, one of the biggest drains that is contaminate the river.

- The Sanitation activities involves installation of about 10602 FRP toilets, 1603 mobile toilet, 6674 FRP urinals, with management and disposal of waste, placement of about 5500 Manpower so to keep the streets and Mela area clean.
- According to a report by National Mission for Clean Ganga (NMCG), the amount of waste generated during the 22-day long Kumbha was 2160 MLD.
- The existing 7 sewage treatment capacity of the district was about 145 MLD. Result is over loading existing STPs, Gaps on sewage and sanitation management. This result in lying of the waste at the banks of river Ganga, thus making it more polluted (EPH,2022 report).

8. Location of Nasik & Trimbakeshwar Kumbh 2015

Nashik district covers an area 267 Sq. km and lies is a city in the northern region of the Indian state of Maharashtra. Nashik has hot semi-arid climate which can be high on humidity. Annual amount of rain falls 678 mm. 2011 census Nasik has a population of 1,486,053. population density of 393/sqkm. decadal growth 2001-2011 was 22.33%.

Until 1789, the fair was held only at Trimbakeshwar, but after a clash between Vaishnavites and Saivites, the Maratha Peshwa segregated the Vaishnavites to the Nashik city. The city of Nasik planned for Kumbha as an extension of the city development plan itself thus planning simultaneously for both the Kumbha and the city

8.1. Floating Population during Kumbh Mela 2015

Year Kumbha	No of pilgrims
1992	5.5 Mn
2003	10 Mn (81.82%)
2015	30 Mn (200%)

Table 11 Floating Population During Kumbh At Nasik

8.2. Temporary Facility Provided in Kumbh Mela 2015

S.NO.	Services Provided	Numbers
1	Toilets	10400 mobile toilets (230 /toilet)
2	Dustbins	15,000
3	Tent City	1900 Plots ,3,00,000 Sadhus
4	Electricity	25,000 L.E.D Lights
5	Drinking Water	2145 Stand post Taps, 32 Km pipeline (4.0billion litter/day)

Table 12 temporary facility provided in Kumbh At Nasik

8.3. River Water Quality at Nasik Kumbh 2015

- Nashik city received piped water from two sources: Gangapur dam and river Darna.
- Godavari River are under increasing stress due to urbanization and other activities leading to their over exploration and degradation-domestic pollution is the biggest polluter of river Godavari 82% and 18% industrial pollution.
- City river are polluted mainly due to the discharge of untreated industrial effluents and domestic sewage, agriculture run off, solid waste and pilgrimage related wastes.
- Rapid and unplanned growth of human settlement along both side of the riverbank. Present river area is highly polluted by the sewage water. polluter stretch of priority 1 in Nashik. (>30 BOD)
- Nasardi Nalla catch the 17-lac people drainage and sewage water which meet the Godavari river.

Parameter	During Kumbha	Post kumbha
pH	7.40	8.88 (1.48)
DO	9.68	10.82 (1.14)
BOD	5.5	7.45 (1.37)
COD	29	64 (35)
TOTAL COLIFORMS (MPN/100 ml)	210	1200(990)

FECAL COLIFORMS(MPN/100ml)	280	1600(1320)
Conductivity(μ s/cm)	0.34	0.193(0.147)
color	turbid	turbid

Table 13 River Water Quality Pre-Post Kumbh At Nasik

- pH and DO value increase not permissible for drinking and bathing purpose & Not desirable for existent and growth of fish and such aquatic life.
- In Aug-Sept 2015, BOD value was exceeding the permissible value because of important bathing and municipal drainage.
- During Kumbha (Aug-Sept) the total coliform and Fecal Coliform (MPN/100ml) were increasing It shows that the quality of river was degrading during the Kumbha.
- Changing the color of water because of waste water. & increase the conductivity value showing the pollution of river.

8.4. Solid Waste Management

- Mela area 15000 dustbins used for garbage collection.
- Municipal 50 Ghanta Gadi van vehicles were collect the garbage from dustbins by 1,300 sanitary workers.
- 100% garbage collection has not yet been achieved. during the Kumbha Mela is once again facing garbage issues in many areas.
- According to the information provided by NMC, the Ghanta Gadi carry the solid waste to Solid waste management site at Pathardi.
- To provide medical facilities to pilgrims, Health Department made 20 temporary hospitals in Kumbha Mela-2015.
- Dustbins having assigned color coding for collection of biomedical waste.
- The waste is generated on site prior to disposal and each of the medical facility is having linkage with CBMWTF.
- During kumbha + city total waste dumped in site 50000 MTD approx.

Location	Avg. Generation (MT per day)	Remarks
Kumbha Mela Area	150 MT	On bathing dates generation of solid waste was increased, ranging from 200 - 500 MT.
Other than Kumbha Mela Area	750 MT (apx)	generated from the Nasik city.
Bio – medical waste	5kg-8kg	During kumbha

Table 14 Waste Generated During Kumbh At Nasik



Figure 3 Waste in Kshipra River

8.5. According to SWM Rule 2016

- Segregation: Source segregation of waste is a statutory requirement as per MSW rule 2000.
- Disposal: All the unsegregated solid waste is loaded in the compactor and dumped at 8.2 KM far away from the mela area at Pathardi dumping site.

8.6. Impact of Disposal in Surrounding Area

- Sudden increase the waste dumping in disposal site 500-50000 MTD of NMC. where big challenge of SWM and treatment. Segregation of waste MSW is only 34.68%.
- Nashik is the third most industrialized city in Maharashtra the solid waste generated is greater than 3 lakh MT/Y which is very huge quantity of waste generation.

- Kumbh and city’s unsegregated waste dumping is causing harm not only to land but also people nearby. like dirty farming, contamination of soil and groundwater, increase smell, and increase disease-like Chalaria, dengue, increasing mosquito in area. Water, Soil, air, pollution. has also increased a lot.
- Source segregation of waste is a statutory requirement as per the MSW (M&H) Rules, 2000. As mixed wet and dry waste loses value and makes it very difficult to handle the waste or to segregate it further.

8.7. Sewage and Sanitation

- In Nashik Godavari river pollution load due to drain BOD level 30 mg/L, BOD value was exceeding the permissible value because of chikhali & Nasardi Nalla, one of the biggest drains that is contaminate the river and Open defecation in slums located at the banks of river.
- The Sanitation activities involves installation of about temporary 1-4800 toilets and 6000 bathrooms, 2-5600 toilets and 7000 bathrooms, 25 mobile toilets, with management and disposal of waste, placement of about 10000 Manpower each so to keep the streets and Mela area clean.
- According to a report by National Environmental Engineering Research Institute (NEERI) report, the amount of waste generated during the 55-day long Kumbh was 3240 MLD.
- The existing sewage treatment capacity of the district was about 350 MLD. Result is over loading existing STPs.



Figure 4 Waste disposal & overflowing STPs

9. Location of Ujjain Kumbh Mela 2016

Ujjain city covers an area 151.83 km² and It is the fifth-largest city in Madhya Pradesh. Ujjain has humid subtropical climate. 2011 census Ujjain has a population of 5,15, 215. population density of 817 /sqkm decadal growth 2001-2011 was 30.63%. The Ujjain Simhastha started in the 18th century as an adaptation of the Nashik-Trimbakeshwar Simhastha. Water scarcity is a major issue in Ujjain city. Over the year’s river lost its regular nature and now runs dry for a period of 5 to 6 months per year. 96% of city water supply is catered by the Ganbhir dam and only 4% is dependent of Undasa irrigation tank. The water supply coverage in the city is around 50% which is much lesser than the national average.

9.1. Floating Population During Kumbh 2016

Year Kumbha	No of pilgrims
1980	5.5 Mn
1992	10 Mn (81.82%)
2004	25 Mn (150%)
2016	50 Mn (100%)

Table 15 Floating Population in Ujjain Kumbh Mela 2016

9.2. Temporary Facilities Provided in Kumbh 2016

S.NO.	Services Provided	Numbers
1	Toilets	36000 mobile toilet, 20-unit Sulabh permanent, 1790 urinal (1000 / toilet)
2	Dustbins	25,000
3	Tent City	4500 tents
4	Electricity	30,000 L.E.D Lights
5	Drinking Water	1000 Stand post Taps (6.7 billion / day)

Table 16 Temporary facilities provided in Ujjain Kumbh Mela 2016

9.3. River water Quality in Kumbh 2016

- Shipra is now dry in long stretches and wherever one finds water it’s all mixed with solid waste, sewage and silt.

- A Central Pollution Control Board report in 2016 proved that water at the four ghats — Gaughat, Siddhwat, Ramghat and Triveni Ghat —waters have turned blackish and are already unsafe for bathing and drinking purpose.
- Acharya Satyam says they have been raising concerns for several years now but the river is getting more polluted with each passing day.
- Shipra river Bit by bit, the river is dying every day due to pollution, sand mining and encroachment in its catchment area.
- Sewage and other types of wastewater start flowing in through the open drains and 13 nullahs of the town.
- According to research conducted by scientists of Vikram University, in 2015 the biochemical oxygen demand of these four Ghats was recorded to be above 40-60 mg/l.
- Scientist RD Wagh of Madhya Pradesh Pollution Control Board, however, says that after the Narmada-Shipra linking project, the water flow of Shipra river has improved.

Parameter	during kumbha	Post kumbha
pH	7.98	8.79 (0.9)
DO	8.0	11.26 (3.26)
BOD	3.12	5.23 (2.11)
COD	20	55 (35)
TOTAL COLIFORMS (MPN/100 ml)	200	1500(1300)
FECAL COLIFORMS(MPN/100ml)	300	1800(1500)
Conductivity(μ s/cm)	0.75	0.99(0.24)
color	Turbid	Turbid

Table 17 River quality at Ujjain Kumbh

- According to Central pollution control board (CPCB) pH and DO value increase not permissible for drinking and bathing purpose
- In (Jan – April), BOD value was exceeding the permissible value (<3PPM) because of important bathing.
- During Kumbha (Jan – April) the total coliform and Fecal Coliform (MPN/100ml) were increasing It shows that the quality of river was degrading during the Kumbha.
- Changing the color of water because of waste water. & increase the conductivity value showing the pollution of river.

9.4. Solid Waste Management

- Mela area 25000 dustbins used for garbage collection.
- Municipal vehicles were collecting the garbage from dustbins by 1,500 sanitary workers.
- The solid waste is collected and dumped in Pandia khedi at present no treatment is done of waste.
- Dustbins having assigned for collection of biomedical waste.
- The waste is generated on site prior to disposal and each of the medical facility is having linkage with CBMWTF owned by M/s. Bio Medical waste Management system Pvt. Ltd.

Location	Avg. Generation (MT per day)	Remarks
kumbha Mela Area	180 MT (apx)	On bathing dates generation of solid waste was increased, ranging from 200 - 500 MT.
Other than kumbha Mela Area	300 MT (apx)	generated from the Ujjain city.
Bio – medical waste	9kg-11kg	During kumbha

Table 18 Waste Generated During Kumbh At Ujjain

9.5. Impact of Disposal Site in Surrounding area

- The disposal of municipal waste in Ujjain Nagar Nigam is haphazard. And the people living near these areas were highly affected by the different diseases.
- It's unfortunate that large religious events like Kumbh Melas can have significant environmental impacts, including the depletion and degradation of water, air, and soil resources.

9.6. Sewage and Sanitation

- At present, Ujjain city lacks the Sewerage network.

- Therefore, the untreated over flowing from soak-pits and draining into the city’s drainage system tends to pollute the water considerably apart from emanating foul smell into the atmosphere.
- All the sewage thus generated in the city flows through the open drains and discharged to nallahs and ultimately to the river Kshipra.
- The Sanitation activities involves installation of about temporary 36000 mobile toilets, and disposal of waste, placement of about 2000 Manpower so to keep the streets and Mela area clean.
- According to a report by Central Pollution Control Board (CPCB) report, the amount of waste generated during the 55-day long Kumbha was 5400 MLD. The existing sewage treatment capacity about 150 MLD. Result is over loading existing STPs



Figure 5 Waste Disposal River Side and Flowing Drain

10. Conclusion

The detailed study and analysis have resulted into the conclusion where the condition of the components of physical infrastructure – water supply, storm water drainage, solid waste management, sewage and sanitation have determined the ranks of the cities based on the level of priority to be given. Based on the analysis of the issues, Ujjain has been ranked I, Haridwar has been ranked II and Nasik has been ranked III. The issues faced during the period of Kumbh mela have been identified as well. It can be seen that the Kumbh Melas have similar background, significance and long-term planning urgency in all cases. Thus, it can be concluded that it is not only important to analyze and conduct these events properly due to the fact they are close to the religious sentiments of the masses, but also because they offer tremendous opportunities for the host city and the state to leverage its potentials to be used as triggers for urban development and transformation.

10.1. Waste Supply and River Water Quality

Comparative Analysis			
Prayagraj (U.P) 2019	Haridwar (Uttarakhand)2021	Nasik & Trimbak (Maharashtra) 2015	Ujjain (M.P.)2016
Solid waste management			
Average waste generated – 250 MTD approx.	Average waste generated – 100 MTD approx.	Average waste generated – 150 MTD approx.	Average waste generated – 180 MTD approx.
Single type dustbin use for collection without color code.	Twin type dustbin, covered bin use for collection.	Single type dustbin use for collection.	Single type dustbin use for collection without color code.
No segregation of waste.	No segregation of waste.	No segregation of waste.	No segregation of waste.
By compacter vehicle collection the garbage.	By compacter vehicle collection the garbage.	By compacter vehicle collection the garbage.	By compacter vehicle collection the garbage.
100% garbage collection has not been achieved. All unsegregated waste dumped in the disposal site.	100% garbage collection has not been achieved. All unsegregated waste dumped in the disposal site.	100% garbage collection has not been achieved. All unsegregated waste dumped in the disposal site.	100% garbage collection has not been achieved. All unsegregated waste dumped in the disposal site.
Dustbins Assign color coding for collection of Bio medical waste, which are collected by CBMWTF collection, treatment and disposal.	Dustbins Assign color coding for collection of Bio medical waste, which are collected by CBMWTF collection, treatment and disposal.	Dustbins Assign color coding for collection of Bio medical waste, which are collected by CBMWTF collection, treatment and disposal where open dumping.	Dustbins Assign color coding for collection of Bio medical waste, which are collected by CBMWTF collection, treatment and disposal.
where open dumping major issue	where open dumping major issue	Processing of waste-pre-sorting unit, aerobic composting unit, Inert processing unit, Leachate treatment plant, RDF, Animal carcass Incinerator, sanitary landfill.	where open dumping major issue

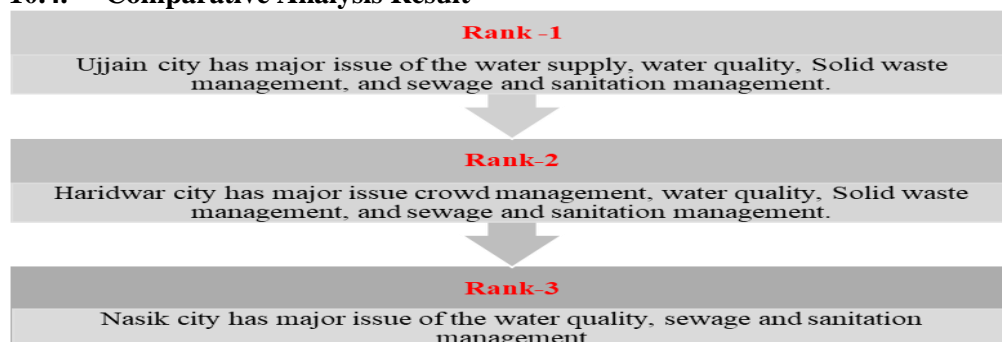
10.2. Solid Waste Management

Comparative Analysis			
Prayagraj (U.P) 2019	Haridwar (Uttarakhand)2021	Nasik & Trimbak (Maharashtra) 2015	Ujjain (M.P.)2016
Water supply & River Water Quality			
Prayagraj kumbh mela 1 st largest kumbh mela event.	Haridwar kumbh mela 2 nd largest kumbh mela event.	Nashik kumbh mela 3 rd largest kumbh mela event.	Ujjain kumbh mela 4 th largest kumbh mela event.
Mela stretch is very large compare to other three cities. Also number floating population is high.	Haridwar kumbh mela stretch is very small compare to other three cities.	Nashik kumbh mela stretch is small compare to two cities.(prayagraj ,Ujjain)	Ujjain kumbh mela stretch is 2 nd largest area.
Water supply shortage according to population	Water supply shortage according to population	Water supply shortage according to population	Water supply shortage according to population
Used RO technique for drinking water, water kiosks serve drinking water.	--	--	--
Water quality is not suitable for drinking and bathing because of industrial drainage, domestic drainage and solid waste disposal, bathing population.	Haridwar water quality also not suitable for drinking and bathing, same issue of prayagraj causing of river pollution, using the partially tapped drainage,	Nashik water quality also not suitable for drinking and bathing, source of pollution Nashik sewage.	Ujjain water quality also not suitable for drinking and bathing, source of pollution sewage and industrial waste from Karad and Sangli.
Failure of modern technologies used- Bioremediation, Geo tubes.	Also Used Geo Tubes Technology.	--	--
Prayagraj comes under the polluter stretch of priority V (BOD 3-6mg/l)	Haridwar comes under the polluter stretch of priority IV.(BOD 6-10mg/l)	Nashik comes under the polluter stretch of priority I.(BOD 30mg/l)	Ujjain comes under the polluter stretch of priority III.(BOD 10-20mg/l)

10.3. Sewage and Sanitation

Comparative Analysis			
Prayagraj (U.P) 2019	Haridwar (Uttarakhand)2021	Nasik & Trimbak (Maharashtra) 2015	Ujjain (M.P.)2016
Sewage and sanitation			
According to CSE report amount of waste generated during kumbh mala about 18 time more.(7500 MLD)	According to NMCg report amount of waste generated during kumbh mala about 15 time more.(2160 MLD)	According to NEERI report amount of waste generated during kumbh mala about 9 time more.(3240 MLD)	According to NMCg report amount of waste generated during kumbh mala about 36 time more.(5400 MLD)
Existing STP capacity- 268MLD	Existing STP capacity- 145 MLD	Existing STP capacity- 350 MLD	Existing STP capacity- 150 MLD
Existing STP was not able treat half of waste generated cause of over flowing of existing STP during the Kumbh mela.	Existing STP was not able treat half of waste generated cause of over flowing of existing STP during the Kumbh mela.	Existing STP was not able treat half of waste generated cause of over flowing of existing STP during the Kumbh mela.	Existing STP was not able treat half of waste generated cause of over flowing of existing STP during the Kumbh mela.

10.4. Comparative Analysis Result



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