REDUCTION OF TOURISM INDUCED INDIRECT WASTE: A CASE OF RESTRICTED TEMPLE ZONE IN AYODHYA, UTTAR PRADESH

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Abstract

Urban tourism is a source of economy with linkages towards the service sector or tertiary economy which inherits attributes characterized by non-agricultural based economy such as administration, manufacturing, trade and services. The COP26 UN Climate Change Conference served as the official unveiling of the Glasgow declaration. It suggests a coordinated tourism strategy to meet its emissions reduction goals of reducing to half by 2030 and going net zero by 2050 globally. The tourism industry both contributes to the emission of greenhouse gases (GHG), which contribute to global warming, and is extremely vulnerable to climate change. Therefore, accelerating climate action in the tourism industry is crucial for the sector's resilience. Climate action is defined as the actions taken to monitor, assess, and reduce GHG emissions as well as to improve capacity for adaptation to climate-related impacts. Around the world, 8% of greenhouse gas emissions are related to tourism. This paper analyses the city of Ayodhya which is expected to generate significant quantum of solid waste which is assumed for the year 2031 and addresses ways to collect, segregate and treat the waste and reducing the long term impact on the climate and tackle climate change.

Keywords: Urban Planning, Urban Design, Waste, Carbon reduction

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Introduction

Urban tourism is a subset of tourism that takes place in urban areas and is distinguished by its location in nodes of transportation and its non-agricultural economy, which includes administration, manufacturing, trade, and services. The COP26 UN Climate Change Conference served as the official unveiling of the Glasgow declaration. It suggests a coordinated tourism strategy to help the world meet its emissions reduction goals of greenhouse gasses (GHG) by 2030 and going net zero by 2050. The tourism industry is a major contributor of GHG, which contribute to global warming, which makes it extremely vulnerable to climate change. Therefore, accelerating climate action in the tourism industry is crucial for the sector's resilience. Climate action is defined as the actions taken to monitor, assess, and reduce GHG emissions as well as to improve capacity for adaptation to climate-related impacts. Around the world, 8% of greenhouse gas emissions are related to tourism.

According to the CPCB's most recent statistics on dumpsites, 3,159 of them persist in use in India. Around 609 locations are in Uttar Pradesh, which makes up the majority. landfill gas (LFG) is a byproduct of landfill sites. Methane, the main component of natural gas, makes up around 50% of LFG, along with 50% carbon dioxide (CO_2) and other gases. Methane is a powerful greenhouse gas that traps heat in the atmosphere over a 100-year period at a rate that is at least 28 times greater than CO_2.

Due to growth in urban tourism, the potential cities are observed to generate higher quantum alternate induced waste. Alternate induces waste is defined as the indirect waste which is generated for the purpose of tourism. The average amount of waste produced daily by foreign visitors is 5.5 kg, compared to 3.5 kg for visitors from within India. When compared with standard household waste accounts an average 10% of the waste generated by tourists. The focus of the study is to establish ways to reduce the alternate waste while re-establishing the fact of the culture of reuse in Indian society.

1 City profile and infrastructural overview

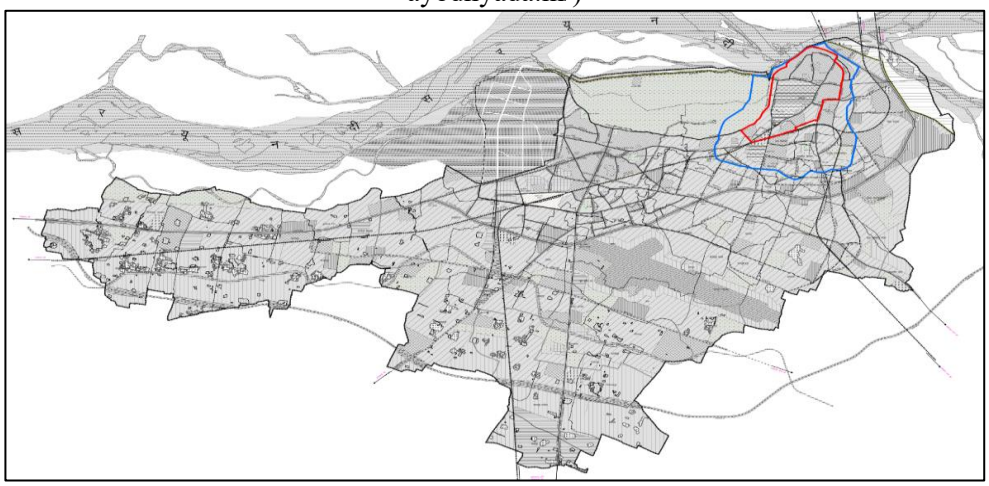
Ayodhya is a of town religious importance in present Indian context. in the district of Ayodhya previously Faizabad. The classic Indian epic poem Ramayana associates Ayodhya with the birth of Lord Rama and the rule of King Dasharatha, making it one of the seven holiest cities to Hindus. It is 93 meters (305 feet) above sea level on average. Ayodhya is situated in the state of Uttar Pradesh's geographic center. the city being situated on the south bank of the River Saryu and is an important part of the northern plains. Rail connections between Ayodhya and cities like Lucknow, Kanpur, Gorakhpur, and Varanasi plays a significant link for inbound tourists. It has an airport that is currently acquiring 600 acres of land to become an international airport. Ayodhya is around 636 kilometers from the National Capital city Delhi and 135 km from the State Capital city Lucknow.

The overall population of the Ayodhya Development Authority (ADA) urban area is 2,21,118, with men making up 53.06% (1, 17,325 Persons) and women accounting for 46.94% (1,03,793 Persons). According to the 2011 Census, the workforce participation rate (WFPR), which is calculated as the proportion of all employees to all population, was 31% (69,499 Persons) in Ayodhya.

Infrastructure is a component of urban structure that facilitates city growth and efficiency. For an adequate degree of economic growth and habitation area development, it involves the fundamental arrangement of technological facilities and its management institutions. Water supply, drainage, solid waste management, power, transport, and communication are all components of physical infrastructure. The focus of the paper is inclined towards Solid waste management.

Solid waste management is the process that oversees the generation, storage, collection, transport or transfer, processing, and disposal of solid waste materials in a way that takes into account all relevant environmental factors, including those related to public health, conservation, economy, aesthetics, engineering, and other environmental concerns. Currently, 93.50 tonnes of solid waste is collected daily in Ayodhya city, including waste from both urban and restricted tourist regions.

Figure 1.1 Figure showing Restricted Temple Zone 1 and 2 of Ayodhya municipal area (Source: https:// ayodhyada.in/)



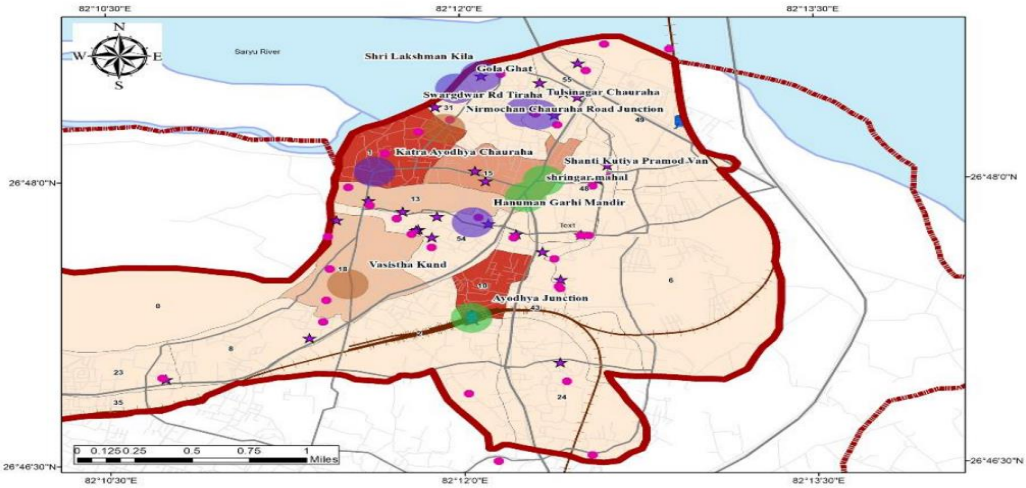
2 Tourism potentiality of Ayodhya

Urban governance is the process that directs and considers the numerous relationships among stakeholders, local governments, and residents as per The United Nations Educational, Scientific and Cultural Organization (UNESCO). It also encompasses both written and unwritten rules, processes, and decision-making of units that manage resource allocation within and across institutions. Heritage assets and sacred locations can be an intrinsic element of larger ensembles, such as historic cities, cultural landscapes, and natural areas. Heritage Inclusive Development (HID) policies are an essential characteristic of urban governance. Through cultural events and religious celebrations, the holy city of Ayodhya contributes significantly to the development of religious nationalism and the corporate identity of religious heritage.

Ayodhya's official tourist programme was launched as the Mokshadayini walk, also known as the "Heritage walk to feel salvation" in Ayodhya. This historical walk in Ayodhya begins at the Rinamochana Ghat, which is the western ghat in Ayodhya along the River Sarayu. It passes Jhumki Ghat, which has the name of a saint who was known to be a devoted worshipper of Sita (Lord Rama's wife). This walk also passes through the Korean Park, Lakshman Kila Ghat, Sheshavatara Temple, Chandrahari Temple, Nageshvarnatha Temple, and ends at the ghat where people can witness the evening river aarti.

The tangible and intangible heritage of Ayodhya attracts a number of tourists which has a steady incoming through the year and bulk tourism during the peak seasons.

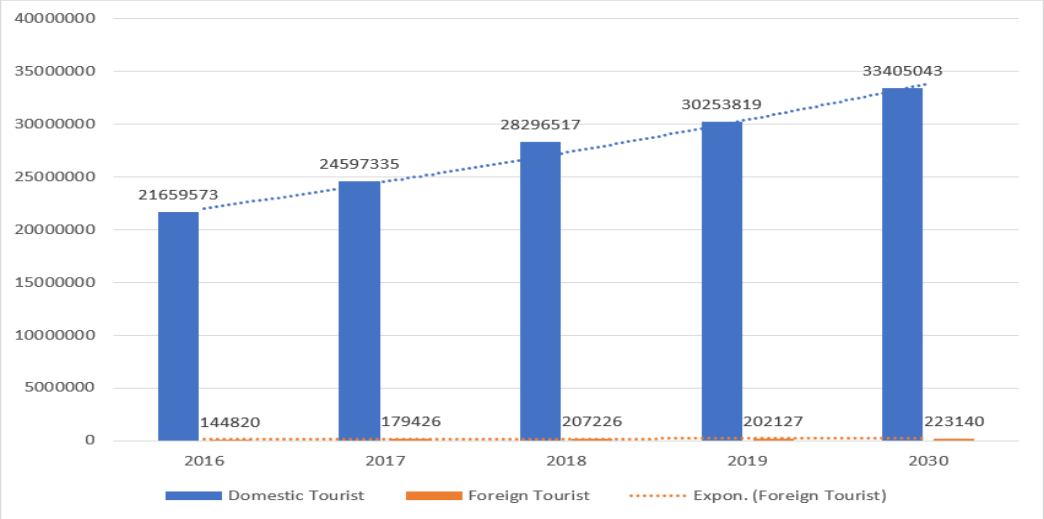
Figure 2.1 Restricted temple zone of Ayodhya with potentiality (Source: Author)



Ayodhya city increased its potential on the Nation's list of top tourist destinations by engaging in the Ram Van Gaman Yatra circuit and the Awadh Circuit. Ayodhya city is expected to have around

70,000 footfall or visitors per day Through the use of arithmetic progression, it is projected that 33.4 million domestic tourists and 0.22 million foreign tourists are expected to visit Ayodhya in 2030.

Figure 2.2 *Tourism Footfall in the Restricted Temple Zone in Ayodhya with respect to data received from tourism statistics 2017-18*



Ram-Navami Mela and parikramas that are two significant seasonal events which attracts large number of inbound tourists to visit various destination within the restricted temple zone .Ayodhya experiences peak season during September to April, which is the busiest time of the year for the infrastructure since it coincides with the Parikramas and important fairs and celebrations in the area.

3 Land-use, tourism and solid waste management

The land use study of Ayodhya Restricted Temple zone reveals that region near Ram Mandir shows dynamic growth in terms of commercialization and along the road stretch due to the projected upcoming development. Region near Mani parvat is influenced by low cost residential, hence the development of mixed land use. The mixed land-use in a tourism influenced regions calls for increased number of hotels and accommodation facilities. The hotel and F&B (Foor and Beverage) sector are the largest source of induced indirect waste generation of a individual tourist as the backend waste generation to deliver service is generally hidden in nature and this effects the quality of waste transferred to the landfills.

Figure 3.1 *Map showing the major tourism destinations in the City of Ayodhya*

As per URDPFI, the standard waste generation in urban area accounts 0.6 kg per capita per day for an average citizen. The following table shows the average waste generation per capita.

Table 3.1 *Per Capita Waste generation per person per day (Source: URDPFI Guidelines.)*

Sl. No	Land Use Type	Estimated waste generation
1	Residential refuse	0.3 – 0.6 Kg/cap/day
2	Commercial Refuse	0.1 – 0.2 Kg/cap/day
3	Street Sweeping	0.05 – 0.2 Kg/cap/day
4	Institutional Refuse	0.05 – 0.2 Kg/cap/day

Food scraps, food packaging, paper, cardboard, glass, metals & metal packaging, and plastics & plastic packaging are only a few of the solid wastes produced by tourist destinations. Among them, wastes related to plastic are considered to be among the most harmful pollutants and seriously pollutants effecting the ecology and marine life.
The average amount of garbage produced daily by domestic Indian visitors is 3.5 kg, compared to 5.5 kg per day by foreign tourists. The ratio of tourist garbage to resident waste is 10:1, which is a strategically significant conclusion that focuses on the 3Rs of sustainability, namely Reduce, Recycle, and Reuse. The future potentiality of tourism of Ayodhya is projected through past trends and shown in Table 4.2.

Table 3.2 *Projection of Inbound Tourists in Ayodhya*

Year	Domestic Tourist	Domestic Waste Generation (MT)	Foreign Tourist	Foreign Waste Generation (MT)	Total Tourist	Total Waste Generation
2016	21659573	75808.5055	144820	796.51	21804393	76605.02
2017	24597335	86090.6725	179426	986.843	24776761	87077.52
2018	28296517	99037.8095	207226	1139.743	28503743	100177.6
2019	30253819	105888.3665	202127	1111.6985	30455946	107000.1
2030	33405043	116917.6505	223140	1227.27	33628183	118144.9

According to the forecasts, 118145 MT of solid municipal waste will be produced in the year 2030, all of which will come from visitors and not from the workforce (the floating population and the municipal population). Concern would be raised about how to manage the volume of trash, which would mostly consist of metals, food waste, food packaging, paper and cardboard, glass, metals and metal packaging, and plastics and plastic packaging, with an assumption that more than half of it is non-biodegradable.

Non-biodegradable garbage can have a significant negative impact on the environment if it is not properly handled and non-scientifically disposed. Uncontrolled landfills, which might create an insalubrious atmosphere and spread diseases to those living nearby, may be one of the issues. Groundwater pollution and pipe clogs can be brought on by plastics and other similar garbage. Water bodies can also be contaminated by other garbage, including chemicals, biological waste, and plastics.

4 Analysis of future possibilities

The Planning Commission of India forecasted in 2014 that waste production would reach 165 million tonnes by 2031 and that landfill construction would take up 66,000 hectares of land, which is remarkable to say the least. However, the Swachh Bharat Mission has assisted the nation in making significant advancements in the management of non-biodegradable waste. It enables neighborhood trash collectors to gather recyclable non-biodegradable waste. There is provision for packing supplies including cardboard and plastics. Businesses that use non-biodegradable materials are required to collect and recycle this garbage.

To meet the objectives of solid waste management, several innovative approaches and solutions are now being developed. Composting is recommended as one of the most effective methods to manage organic waste and, recommended to be used at household's level. Non-biodegradable waste contains energy. Various scientific research, studies, and innovations are happening in this field to use this energy and replace fossil fuels with it. Due to Ayodhya being a tourism influenced region control over the Induced indirect waste is to be monitored and collected separately. This can be achieved at various stage of Solid waste management. As uncontrolled waste generation will impact the tourism sites and hence reduce the potentiality of the tourism zones which would

directly impact the footfalls of the tourists. The following methods should be adopted:

- The commercial waste should be collected (segregated) under 5 major head general, paper, plastic, metal, and glass.
- Incentives should be created to encourage waste and commercial producers to reuse and recycle more, developing the circular economy concept. This helps prevent the generation of waste and can help contribute to financing waste management activities. Incentives include both rewards and charges
- Increase in the frequency of waste collection form commercial and F&B Properties.
- Increase in on street waste collection. The Restricted temple zone should be provided with RFID based garbage collection dumpsters. This will help in monitor the waste and provide a better collection efficiency.

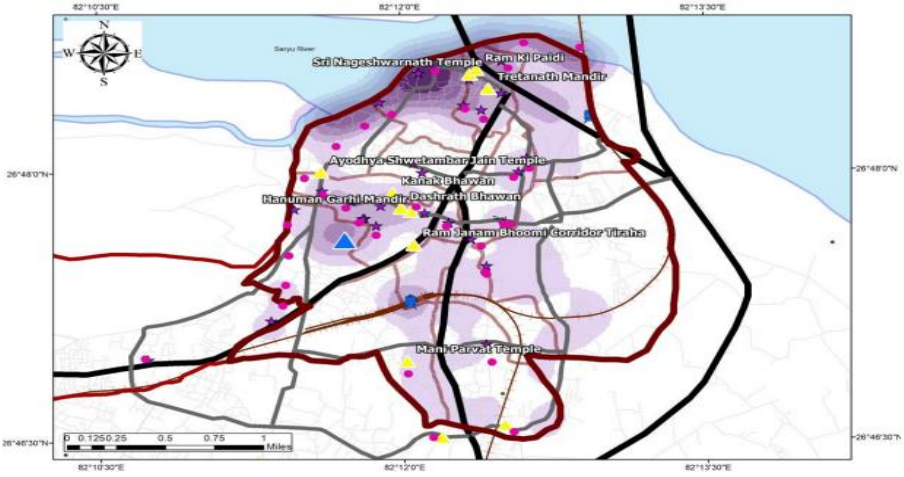
5 Recommendation

Climate change and material reuse are closely linked. The need for sustainable consumption and production was emphasized by India at COP 21 at the time of adoption of Paris Agreement in 2015. It has now become a part of the preamble of the agreement. This tends to the emphasis of circular economy. A production and consumption paradigm known as the "circular economy" emphasizes sharing, renting, reusing, repairing, and recycling old goods for as long as feasible. India being a society known for the capability of refurbishing and recycling existing materials. The following recommendation are framed for Ayodhya to cater induced indirect waste.

5.1 Tourism specific collection

For the preservation of the environment's quality, safety, and public health, proper solid-waste collection is crucial. It is a labor-intensive activity, accounting for approximately three-quarters of the total cost of solid-waste management. Ayodhya being an old city with narrow road stretches the accessibility of collection vehicles is an issue, Thus it is recommended to implement manual cart collection from such location.

Figure 5.1 *Solid Waste Generation in Ayodhya Restricted Temple Zone marked in purple (Source: Author)*



Due to the concept of Bread and Breakfast facility found in mixed-use property it is important to implement cart based collection. Refuse collection usually occurs at least once per week because of the rapid decomposition of food waste. Garbage grinders or garbage disposals can minimize the quantity of waste in a single household's trash.

5.2 Tourism specific segregation (transfer station)

If the final destination of the refuse is not near the community in which it is generated, one or more transfer stations may be necessary. A transfer station is a central facility where refuse from many collection vehicles is combined into a larger vehicle, such as a tractor-trailer unit. About 76 cubic meters (100 cubic yards) of uncompacted garbage can be transported in open-top trucks to a local processing or disposal facility. Community based transfer stations should be created at strategic locations to serve

During the segregation, the usable mass should be delineated and segregated for reuse. Community specific to the refurbishment industry should be empowered for collection and market should be provided for such goods.

5.3 Transfer to Landfill

Once collected, municipal solid waste may be treated in order to reduce the total volume and weight of material that requires final disposal.

Treatment changes the form of the waste and makes it easier to handle. It can also serve to recover certain materials, as well as heat energy, for recycling or reuse. Bio mining should be used in case of open dumpsites. A process called biomining, often referred to as landfill mining, is required to extract soil, metal, plastic, glass, combustibles, and other fine materials from a landfill (an open dumpsite). Alternatively, if the waste is separated into biodegradable and non-biodegradable at the source, the operation may be skipped. The biodegradable portion may then be sent directly to the bioreactor facility, while the non-biodegradable fraction can be further segregated into different components.

5.4Smart waste management

In order to transform the information collected in the bins into useful insights smart waste management can be used to improve waste management services, which employ analytics. IoT (Internet of things) smart sensors are the foundation of smart waste management. Waste container fill levels are monitored using advanced sensors. Every 15 minutes, smart bin sensors assess temperature, orientation, and fill level. They then utilize these data points to create 3D topological maps of the contents of the bins. The information below would be obtained

- Locations prone to overflow
- The number of bins needed to avoid overflowing waste
- The number of collection services that could be employed.
- The amount of fuel that could be monitored.
- The driving distance that could be reduced.

Waste collectors may utilize the intelligent waste management software to optimize their collection routes with a digital overview of the fill levels of bins. Instead of following predetermined collection routes, waste collectors might use the data insights to switch to dynamic routes. Instead of spending countless hours driving pre-planned collection routes and picking up every single bin, regardless of fill level, they just pick up bins that are in need of servicing.

In addition to tracking garbage, smart waste management will also maximize other resources, such as the frequency of collection trucks' trip, cost savings, cleaner streets, a better working environment, lower carbon emissions, and higher recycling rates.

5.5Recommendation at Local Government level

- Each local body is required to frame byelaws considering the provisions of the solid waste management rules, 2016.
- Each Local Body should appoint bodies to take on segregated waste collection, material recovery facilities, storage, and transportation at its own level. They carry out these tasks in addition to all other duties. However, each of these tasks allows for the participation of volunteer groups, NGOs, and contracting out or outsourcing. It is necessary to identify the garbage collectors.
- The local bodies also need to ensure that the city solid waste is do not get mixed with other streams of wastes like bio-medical waste, hazardous waste, C&D waste, E-Waste, etc.; and manage them according to their respective rules.
- Waste after transportation should reach the waste processing and disposal sites which should be developed at appropriate acceptable locations based on environmental clearances as required. The Waste processing and disposal services can be operated with private sector participation for which proper model agreement can be entered. Here the route optimization with assistance thought live traffic feed should be used to make the it more efficient.
  Enabling new ideas, innovation and startup technology time to time is recommended for the local bodies which will make the process more efficient and greener. Thus impact the carbon generation and control over GHG Emission.

6 Conclusions

It is observed from the above study that the tourism sector plays a major role as a contributor of solid municipal waste in a region which directly effects the natural carbon cycle. The accumulation of waste in landfills leads to emission of landfill gas which includes methane, one of the major contributors towards global warming. The analysis of the city of Ayodhya established a significant quantum of solid waste which is projected for the year 2031. Hence, the projected wastes would not only need a larger landfill to store, but may also lead to spreading of various nuisances withing the city. Hence, Steps are adopted to ensure to reduce the quantum of waste though segregation at transfer station. And further segregation through bio mining at landfill which would address the post segregated waste and legacy landfill. The segregated mass should be sent to the refurbishment industry for further process. This will not only be utilized as a part of reuse process

but also will create a number of potential jobs supporting the local economy.

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8 Credit Authorship Statement

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript. Furthermore, each author certifies that this material or similar material has not been and will not be submitted to or published in any other publication before its appearance.

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