

Ecological Footprint of Tourism at local Scale A study of Mysore

Samuel Paul Suchan ¹

Abstract

With the increase in population in recent years in Mysuru, and the ever increasing tourist inflow to the city of unique cultural and historical heritage, the concern of resources has seldom crossed the mind of an individual. This study addresses the problems that arises due to the ever increase in tourist inflow and what impact it has on the resources. The following parameters such as LWC (land required for water consumption), Carrying capacity and Waste assimilative capacity are targeted in this report. The study examined the ecological resource use of tourists and the industry that supports and exploits this resource use by using the Ecological footprint as a tool. The study has been more of causal relationship between the tourism and Ecological Foot Print (EFT) at local scale. The research questions which were the basis of the objective of the present study were how the tourism industry can become more ecologically sustainable, specific types of tourist behaviours and tourism infrastructure that are particularly unsustainable. The study concluded that there is need for the accommodation facilities to leverage their and community partners to create positive environmental opportunities, aim cost savings in waste to landfill to reduce ecological tourism foot print size. The study also looks into the use of *Digital Footprint* to assess the Ecological Footprint of Tourism.

Keywords: *LWC (land required for water consumption), Carrying capacity, Waste assimilative capacity, Land required for waste assimilation, Digital Footprint.*

¹ Research Scholar, samuelpaulsuchan@gmail.com.

Introduction

The growth of tourism in many regions of the world has ignored concerns of increasing ecological resource use. Hotels, attractions and other tourism-related infrastructure are now recognized as sites of resource over-consumption. Sustainable Tourism in fact is concerned with the identification of the carrying capacity of society and its ecological system. Indicators of Sustainable development of the tourism include waste generation, waste treatment and impact on ecological impacts of tourists' visits to different places; risk reduction measures by the accommodation facilities; and land use planning, zoning enforcement for tourism plant and machinery. The tourism development can put a pressure on the natural resources when it increases the consumption of the resources at an alarming rate especially in those areas where resources are already scarce.

The three main resources which are impacted by tourism activity: water, land and local resources. Direct impact on natural resources, both renewable and non-renewable, in the provision of tourist facilities is caused by the use of land for accommodation and other infrastructure provision, and the use of building materials.



Fig 1: Impact of Tourism on the resources that are present in the nature

The negative impacts of tourism as mentioned in figure 1, occurs when the level of visitor use is higher than the environment's ability to cope with this use within the acceptable limits of change.

Rationale of the study

Following is the rationale for the study:

- The quality of the environment, both natural and man-made, is essential to tourism.
- Many of these impacts are linked with the construction of general infrastructure such as roads and airports, and of tourism facilities, including resorts, hotels, restaurants, shops, golf courses and marinas.
- The negative impacts of tourism development can gradually destroy the environmental resources on which it depends.

Parameters to analyse the Ecological Footprint of Tourism

Carrying capacity analysis is a basic technique used in tourism to determine the upper limits of development and visitor use and optimum exploitation of tourism resources. Carrying capacity analysis is a basic technique used in tourism to determine the upper limits of development and visitor use and optimum exploitation of tourism resources. The concept of carrying capacity has emerged as a paradigm for addressing and limiting the amount of tourism development and use at a destination. While analyzing the carrying capacity, four types of carrying capacity - Physical Carrying Capacity (PCC), Economic Carrying Capacity, Social Carrying Capacity and Biophysical Carrying Capacity are considered. The important parameters considered for the study are **Tourism Carrying Capacity (TCC), Waste Assimilative Capacity of a water body, Water Footprint, Water Footprint,**

Literature Review

Purvis (2008) attached to a tourism context, in order to measure the sustainability of backpacker tourism. Her study indicated that backpacker tourism is more environmental friendly than other forms of travel. According to her the environmental impact of tourism varies greatly depending on the type of transportation used to reach a destination, the resources required maintaining accommodation facilities and whether the activities involved walking around the area or a guided bus was considered. According to the researcher most guests used less than 0.04 global hectares per day and the average footprint was 0.035 gha/day (with the exclusion of the outlier value), however a wide range of footprints existed from 0.004 to 0.36 gha/day. It was found that males and those who stayed for shorter periods of time had significantly higher ecological footprints than females and long-term hostel residents.

Patterson et al. (2007) beyond "more is better": Ecological Footprint Accounting for Tourism and Consumption in Val di Merse, Italy. They estimated and compared the consumption of energy and

materials by tourists vacationing in Val di Merse, a rural region of Tuscany, Italy. Then they compare tourists and local population by means of the ecological footprint. They came to assumption that the average tourist is often thought to consume more on vacation than at home, and often more than local residents, but for their estimate of the tourist footprint as an equivalent resident 5.28 gha (global hectares per capita) is similar to that estimated for residents (5.47 gha), excluding air travel. Planning and management considerations were discussed. Their findings include:

1. The EF for arrival transport Val di Merse totalled 0.48 gha per arrival, which translates to 32.8 gha per equivalent resident (or 86% of the total impact).
2. Accommodation accounts for 3% of the tourist, which in turn compares to .69 gha/year/capita for the local residents.
3. Waste EF totalled to be 1% of the tourist footprint.

Sonak (2004) used an indicator EFT Indicator which is used as one of the tools to gauge the sustainability activities. The researcher used the parameters such as Annual stay of tourist in an year, Length of stay in order to assess the ecosystem support areas required to support the demand for food, fibers and energy, demand for land (infra-structure), demand for water, assimilate waste generated; the land required under each category of demand by tourists as well as migrant workers associated with tourism activity was calculated in the research paper. In her research paper she targeted different parameters such as Land required for water consumption (LWC), Land required for the infrastructure development, Land required for the waste assimilation and Ecosystem support area required for tourism activity. According to the outcome of her research land required for water consumption was found to be .51 ha, while the total ecosystem support area was found to be 1.18 ha. Land required for waste assimilation was found to be 66 ha while Land required for the infrastructure development was found to be 456 ha.

Patterson et al. (2007) beyond "more is better": Ecological Footprint Accounting for Tourism and Consumption in Val di Merse, Italy. They estimated and compared the consumption of energy and materials by tourists vacationing in Val di Merse, a rural region of Tuscany, Italy. Then they compare tourists and local population by means of the ecological footprint. They came to assumption that the average tourist is often thought to consume more on vacation than at home, and often more than local residents, but for their estimate of the tourist footprint as an equivalent resident 5.28 gha (global hectares per capita) is similar to that estimated for residents (5.47 gha),

excluding air travel. Planning and management considerations were discussed. Their findings include:

1. The EF for arrival transport Val di Merse totalled 0.48 gha per arrival, which translates to 32.8 gha per equivalent resident (or 86% of the total impact).
2. Accommodation accounts for 3% of the tourist, which in turn compares to .69 gha/year/capita for the local residents.
3. Waste EF totalled to be 1% of the tourist footprint.

A study by **Sunlu (2003)** reconfirms that quality of environment both natural and man-made is essential to tourism. He came to conclusion that the relationship between the tourism and environment is complex. In his findings he stated that how the loss of biodiversity can reduce the productivity and destabilize the ecosystems and how deforestation can cause severe land disturbances. His additional work includes how he described the impact of tourism on global scale.

Objectives

The main objective of the study is to assess the ecological footprint of tourism at the city of Mysuru.

The specific objectives of the study are as follows:

- To examine the causal relationship between tourism facility operations and (i) water footprint, (ii) wastewater, and (iii) land.

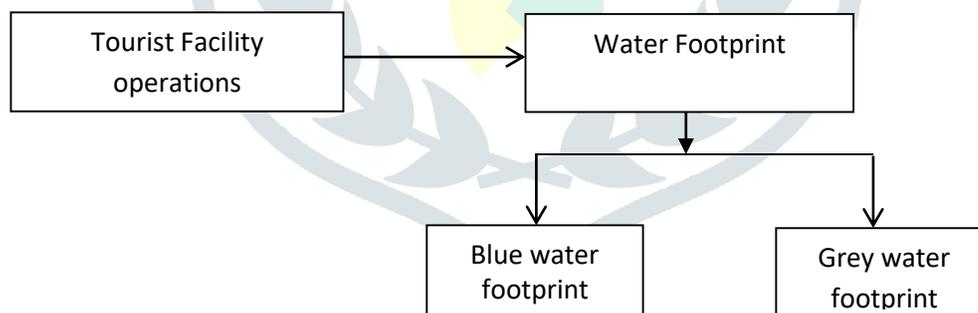


Figure 3: Conceptual Model

The conceptual model as seen in figure 3 explains about the water footprint which is the end product from the tourist facilities like hotels, resorts etc. There are different types of water footprint as seen in the above figure, blue water footprint and grey water footprint. The blue water footprint is nothing but the surface and the ground water which is consumed for recreational purposes and for drinking purposes in these star hotels. The grey water footprint

is nothing but how much amount of fresh water that is needed in mixing and diluting of pollutants in order to maintain the quality of water.

- To use Ecological Footprint Indicator (EFT) in order to assess the resource use and waste assimilation due to tourism activity at a local level due to inbound tourism.

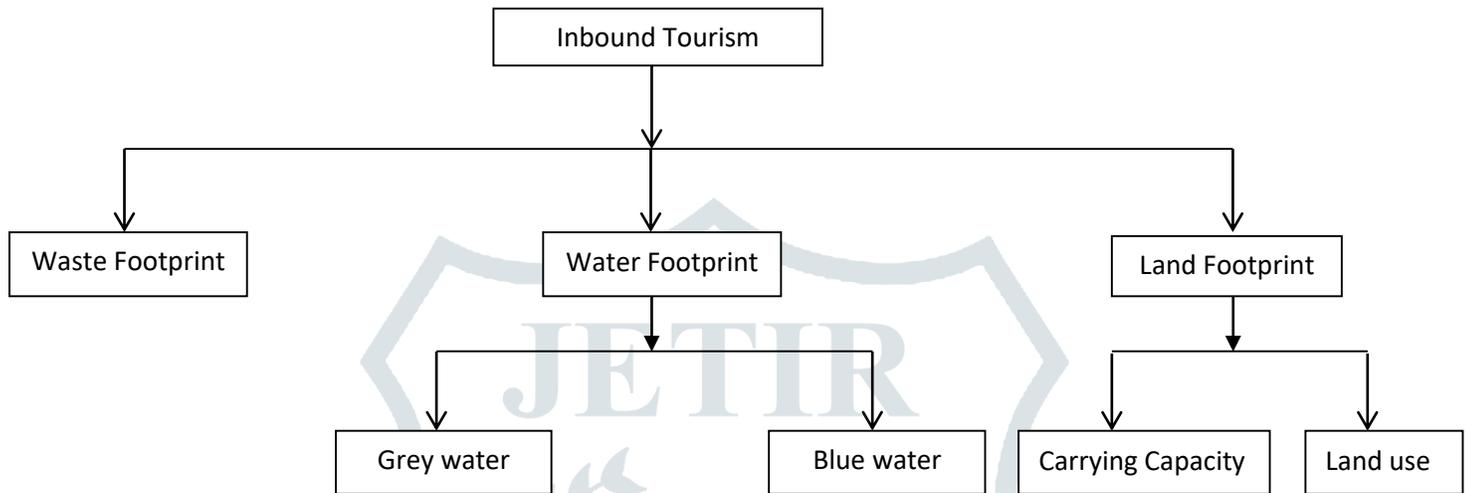


Fig 4: Flow diagram of the causal effect of inbound tourism on waste, water and land footprint

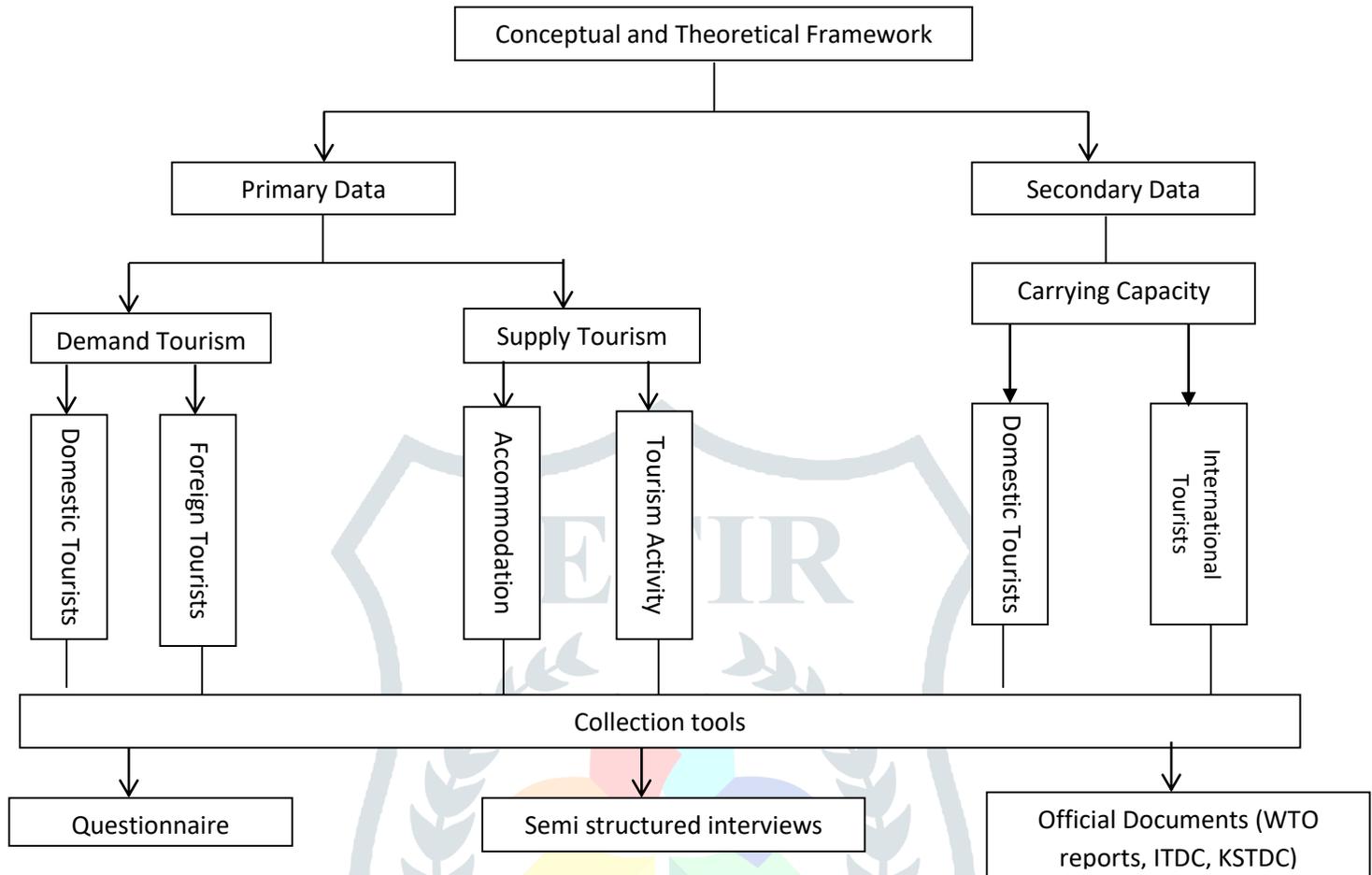
Figure 4 explains how inbound tourism can have a devastating impact on the environment and resources which they consume leaving behind various footprints such as land, water, waste generated. The land footprint focuses on carrying capacity, and the land use while the water footprint focuses on the water consumed by the star hotels.

- To estimate the water consumption by the star hotels and to come up with an efficient water management plan to prevent the wasting away of water.
- To estimate the Land Waste Assimilation (LWA) required by both tourists and migrant population and also to estimate the waste assimilative capacity.

Scope

- The ecological footprint helps to understand how much resource is consumed.
- The carrying capacity which is calculated for three consecutive years shows how much available capacity is left.
- The water footprint which is calculated shows the consumption of water by the star hotels and if their consumption has exceeded the benchmark or not.

Research Flow Chart



The above figure explains the purpose and the frequency of visit by the tourists to a particular place like some may come in form of a business tour or an holiday tour. If they visit a destination of their choice then what is their length of stay and what are the facilities provided for them to travel within a destination country of their choice and what are the expenditures that govern these facilities. In brief the statistical framework describes the background profile of a visitor to a destination place.

Statistical Framework

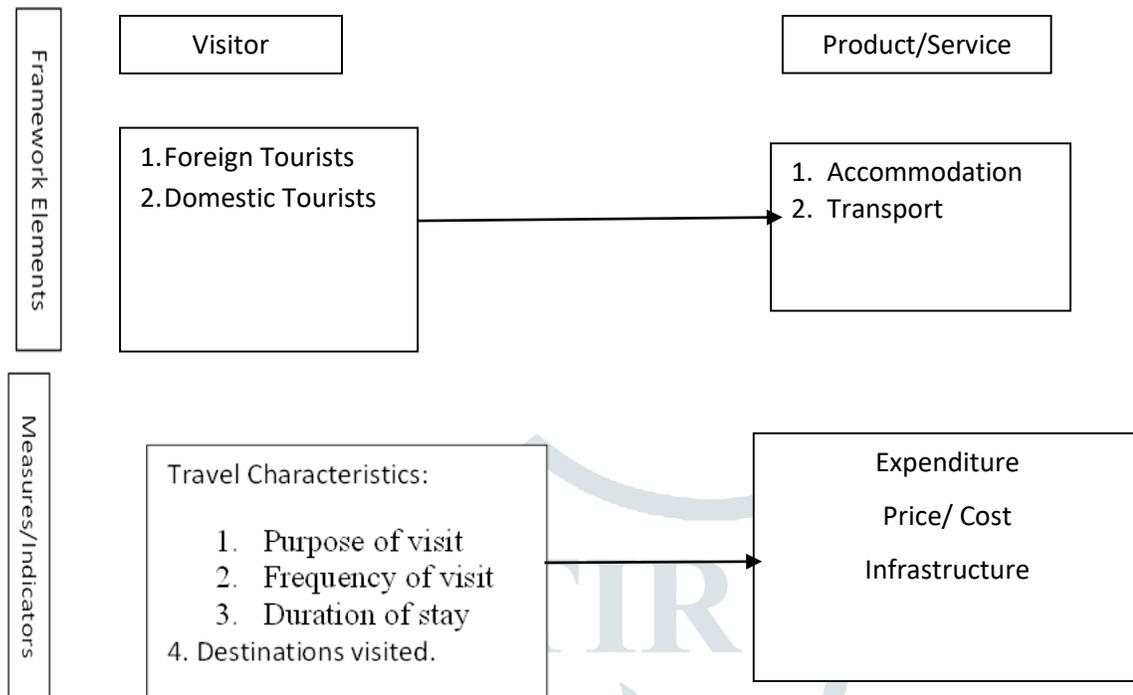


Fig 6: Statistical Framework

Results and Discussions

Located in the Indian state of Karnataka, Mysuru was the former capital of this region. A city of palaces, people and fragrance of jasmine and sandal, the princely city of Mysuru is worth a visit whatever the month or season. Mysuru is a dream city that never lets down the visitors with its clean, light and easy-going environment. Even with the growth of the city in response to modernization, Mysuru has acquired only a mild change of pace.

The city of Mysuru offers a visitor an insight into the lifestyles, cultures and traditions of its erstwhile rulers. The palaces and temples around the city speak volumes about heritage and architecture of the medieval times and the kind of patronage the city received from its rulers. The Chamundi Hills that towers over the city like a colossus houses a temple dedicated to the Goddess Chamundeshwari, the royal family's patron deity. About 15 km from the royal city of Mysuru lies the town of Srirangapatnam where the summer palace of Tipu Sultan is located. The Brindavan Gardens are world-famous terrace gardens bordered by watercourses. The Lalitha Mahal Palace, built in the 1930s, has now been converted into a prestigious hotel of the India Tourism Development Corporation. A visit to the places around Mysuru casts light on the region's rich heritage. The temples of Somnathpur (35 km), Belur and Halebid give an insight into Hoysala

dynasty while the Bandipur National Park and the Ranganathittu Bird Sanctuary showcase the region's bio-diversity.

Dussehra (September/October) in Mysuru is a sight to remember even after leaving the place. In order to make the travel tour to Mysuru even more joyful one need to choose just the right kind of accommodation for you and your family or friends in Mysuru. The various hotels packages in Mysuru offer the best of facilities. Tourists may take their pick from a range of luxury and budget hotels in Mysuru besides the star categorized accommodation hotels around the landmarks of Mysuru offer excellent view of the landmarks through their suites. Most of the places to stay in Mysuru are strategically located in the tourist centres or near the railway station (Countrywideholidays.net)

But despite the breath taking adventure which the traveller enjoys while visiting the vicinity of Mysuru, enjoying the luxurious accommodations provided by the hotel staff, has the concern of the resources which is being chipped off at an alarming rate being taken into account?

4.1 Data stack up, segregation and analysis

Tourist data was gathered from KSTDC as seen in Annexure 2. The data was collected for three years. After segregation of information from the parent data, it was observed that Mysuru City has nine tourists hotspot namely: Mysuru Palace, Art Gallery, Mysuru Zoo, Chamundi hill, Nanjungud Temple, Somnathpur, Talakadu, Suttur Mutt, Nagarahole wildlife, and new tourist hotspot know as Sri Rama Temple was added to the tourist destination in the year 2014. As a new entrant to the list of tourist destinations, it has been noted that Sri Rama Temple hasn't attracted any foreigners yet to its vicinity. The data collected is summarized in the table 5.

Table 4: Summarization of tourist statistical data

Year	During the month of December		Cumulative (Jan-Dec)	
	Domestic (No. of people)	Foreign (No. of people)	Domestic (No. of people)	Foreign (No. of people)
2012	14,27,409	11,277	2,59,83,513	4,53,107
2013	13,99,914	10,768	1,30,72,431	1,02,325
2014	21,34,125	10,972	1,44,62,267	1,05,660

It is noted that the inflow of tourist in the year 2012 is high; this may be due to the following reasons:

[A] Mysore Palace witnesses Earth Hour

Mysuru: Earth Hour, marking the fourth year of its journey in India this year, once again united the country for one hour, as Indians from various cities switched off lights at 8:30 PM.

Earth Hour is WWF's largest environmental campaign empowering individuals, organizations, institutions and governments to fight against climate change. Earth Hour 2012 aims to inspire citizens to take action for cities by switching off lights to make their city the Earth Hour Champion. Whichever city receives maximum participation from its citizens, organizations, institutions and government will be declared the Earth Hour Champion. That city will set an example of exemplary achievement and the power of individual action behind a common cause. For the first time ever, Mysuru Palace observed Earth Hour, by reducing the duration of illumination of the Palace on weekends from 15 minutes to 5 minutes. This symbolic gesture sent out a powerful message not only to the citizens of the city and country, but to the thousands of international tourists who visit the Palace to witness this magnificent illumination.

[B] The Christmas Celebration in 2012 December

The bond between Christmas and cake is well remembered in this city by some reputed hotels, which organize cake mixing events to maintain the warmth of the festival. The cake mixing ceremony is an age old ceremony and people of various age groups participate in it with enthusiasm. The religious worshipping of the festival is followed at ancient churches like St. Philomena's Church located on Ashoka Road. Other reputed churches being Saint George's Orthodox church at Nazarbad. Christmas preparations start fifteen days prior to the festival when markets start showing up with Christmas trees, cakes, masks, gifts and lots of decoration material. Incredible Christmas cakes are available at Sweet palace, Dolphin and Bake point. Christmas is a festival of merry making and enjoyment. The hotels and restaurants of Mysuru are on the forefront to welcome their guests on occasion of Christmas Eve.

But then it was observed that in the year 2013 there was great tourist dip in the tourist inflow, one investigation that could rule this out is that, when the city of Mysuru witnessed a loss of a great leader, a king of Mysuru Palace **Srikanta Wodeyar**.

4.2 Analysis of the Parameters

[A] Annual time spent by tourists

Annual time spent by tourists was computed from equation 1, here the length of domestic tourist stay and foreign stay was assumed.

Table 5: Annual time spent by tourists in each year (2012-2014)

Year	Total number of domestic tourist	T (length of stay) assumed	Total number of foreign tourist	T (length of stay) assumed	Annual time spent by tourists
2012	2,59,83,513	3	4,53,107	3	7,93,09,860
2013	1,30,72,431	3	1,02,325	3	3,95,24,268
2014	1,44,62,267	3	1,05,660	3	4,37,03,781

[B] Land required for water consumption

The Land area required for water consumption was computed from the equations 2, 3 and 4.

Table 6 Land area required for water consumption

Year	Annual time spent by tourist (1)	Water Consumption(Lpcd) (2)	Water yield (ltrs) (3)	LWC _i (ha) (4)=(1)×(2) / (3)	LWC _m (ha) (5) From eqn 3	LWC (ha) (6)=(4)+(5)
2012	79309860	135	11000000	95.17	0.8ha	95.25
2013	39524268	135	11000000	47.4	0.8ha	47.48
2014	43703781	135	11000000	52.4	0.8ha	52.48

Note: In order to find the migrant population, calculate the number of rooms from the four hotels, and multiply it by .7 since 70% of the room is assumed to be occupied by migrant population, hence the migrant population is computed as 2196.63 and the average length of stay was assumed to be 3.

Land required for water consumption by migrant population means the people who have migrated to a particular town and have become residents of that particular town and who are depend on the water for their daily chores.

[C] Carrying capacity, available capacity, existing load.

The area of Mysuru city is 128.4 km² which is 12840 hectares. The following is how the Carrying Capacity was found out:

Normalizing density = $10 \times N_i = 10 \times 10 = 100$ pph (From the Normalizing Index)

Carrying Capacity Density = Upper Limit Density (From table 2) + Normalizing Density
 $= 150 + 100 = 250$ pph

Carrying Capacity = Carrying Capacity Density \times Area of town in Hectares..... (21)
 $= 250 \times 12840 = 32,10,000$ Pop

Hence the carrying capacity of the city of Mysuru is 3210000, which means Mysuru can hold so many numbers of people. In other words its carrying capacity limit is 3210000 Pop/ha.

Next the available Capacity was found out, along with the Domestic tourist density and the foreign tourist density. The Existing Load was also found out. The Existing load and the available capacity are dependent on each other.

Table 7: Calculation of Carrying Capacity and Available Capacity

Year	RPD (1) from eqn 5 (Pop/km ²)	β DT (2) from eqn 8 (Pop/ha)	β FT (3) from eqn 11(Pop/ha)	APD (4)=(1)+(2)+(3)	Existing Load (5) from eqn 13	CC (6) (Pop) from eqn 21	AC (7)=(6)-(5) (Pop)
2012	69.1	10.7	.084	79.88	10,256.592	32,10,000	31,99,743.41
2013	69.1	10.5	.081	79.68	10,230.912	32,10,000	31,99,769.09
2014	69.1	16.08	.082	85.26	10,947.384	32,10,000	32,08,905.62

Based on the table 8, it is seen that in the year the 2014 the domestic tourist inflow is high, this is due to the new tourist attraction which is called Sri Rama Temple which was inducted in the year 2014 as one of the Mysuru tourist destination, thus resulting in the increase in existing load. The existing load is nothing but the number of people that an area can carry. The available capacity depends upon the existing load. It has been observed that in the table based on the calculations done that the existing load is increasing and if the existing load increases then the available capacity will shrink and the resources will get exhausted. A graph showing Carrying Capacity Vs Available Capacity is plotted in figure 8.

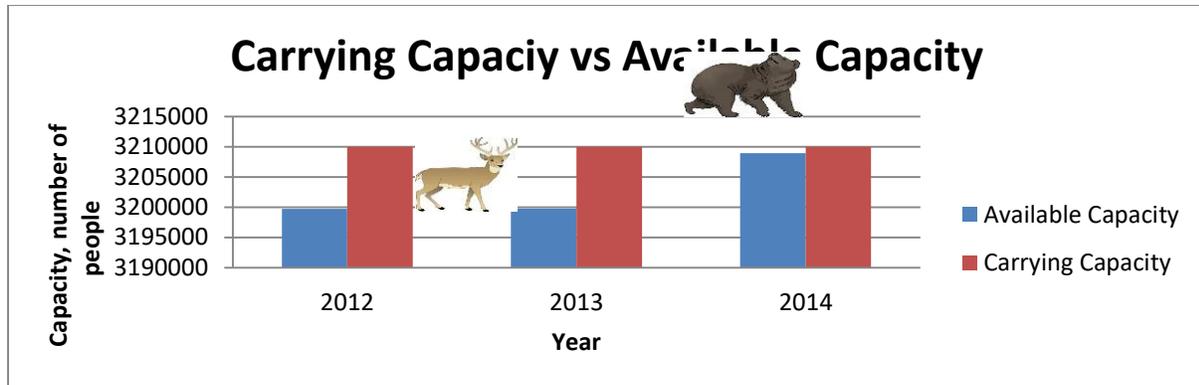


Fig 8: Carrying Capacity vs Available Capacity

Consider the deer as the resources that are available, like food, water, land which are essential for survival and the bear as the extinction of resources due to over consumption. As the resources are devoured continuously without remorse by the incoming tourists think about what will be the fate of future generation.

[D] Water Footprint at the star hotels

Water Footprint was done in order to check for the consumption of water by the star hotels based on the questionnaire format that was eyeballed from the survey conducted at these popular star hotels located at different areas within the vicinity of the city of Mysuru. Survey was conducted at the following hotels:

- ✚ Hotel Pai-Vista
- ✚ Royal Orchid Metropole
- ✚ Hotel Siddhartha
- ✚ The Windflower resort and spa

Survey Results

Survey 1



First survey was done at Hotel Pai-Vista; which was established in the year 2007, and is located in the city area of Mysuru. Bases on the survey done at Pai-Vista first and foremost it was observed that it is not a green building. The size of the hotel is medium. The occupancy rate at Pai-vista hotel is 50-60%. Number of rooms was 66 and it is in these 66 rooms there are 120 beds. Coming to Environmental Behaviour they recycle plastics, cardboards and they reduce wastes. They even use environmental friendly light bulbs as well. Swimming pool is present, and backwash of the pool is done every day. They don't have provision for waste water treatment. The level of Environmental concern is Average at Hotel Pai-vista. Per day water consumption at hotel is 50,000 lts, its monthly consumption is about 15,00,000 lts and annual consumption of water is 1,80,00,000 lts. The mean stay of domestic tourists at hotel Pai vista was 67% and that for foreign tourists was 11%.

Survey 2



The second survey was conducted at Royal orchid Metropole; which was established in the year 1920, and is located in the city area of Mysuru. Bases on the survey done at Hotel Royal Orchid Metropole first and foremost it was observed that it is a green building. The size of the hotel is medium. The occupancy rate at Pai-vista hotel is 50%. Number of rooms was 30 and it is in these 30 rooms there are 75 beds. The Length of stay is just 2 nights. Coming to Environmental Behaviour they recycle plastics, cardboards and they reduce wastes. They even use environmental friendly light bulbs as well. Here based on the survey, they compost rest rooms. Swimming pool is present, and backwash of the pool is done every day. They don't have provision for waste water treatment. Their level of environment concern is high. They Support environmental friendly business. Per day water consumption at the Royal Orchid Metropole is 1000 lts, Monthly consumption is 300000 lts, and annual consumption of water is 365000 lts. The Average number of Hotel guests is 37.5.

Survey 3



The third survey was conducted at Hotel Siddhartha; which was established in the year 1982, and is located in the city area of Mysuru. Bases on the survey done at Hotel Siddhartha first and foremost it was observed that it is a green building. The size of the hotel is large. The occupancy rate at Pai-vista hotel is 50%. Number of rooms was 74 and it is in these 74 rooms there are 150 beds. The Length of stay is just 2 nights. They have very good Environmental behaviour as they recycle cardboards, plastics, collect rainwater, and also reduce wastes. They even use environmental friendly light bulbs as well. Swimming pool is not present. They don't have provision for waste water treatment. They are somewhat concerned about the environment. They Support environmental friendly business. Per day water consumption is 10,000 lts, monthly consumption of water is 3000000 lts, and annual consumption of water was found to be 5000000lts. The Average number of hotel guest at Hotel Siddhartha was found to be 75%.

Survey 4



The fourth and the final review was conducted at Wind flower resort; which was established in the year 2006, and is located in the city area of Mysuru. Bases on the survey done at Windflower resort and spa, first and foremost it was observed that it is not a green building. The size of the hotel is large. The occupancy rate at Windflower resort and spa is 80%. Number of rooms are 39 and it is in these 39rooms there are 78 beds. The Length of stay is just 2 nights. They reduce waste, collect rain water for harvesting and support environmental friendly business. They even use environmental friendly light bulbs as well. Swimming pool is present. They have provision for waste water treatment. Per day water consumption is 65000 lts, monthly consumption of water is1950000lts, and annual consumption of water was found to be 71175000lts. The Average number of hotel guest was found to be 62.4% and the mean stay of Domestic and Foreign tourists was found to be 57.4 and 33.8 respectively.

Next the comparison was done regarding water consumption at these hotels to see if the water consumption at these star hotels have exceeded the bench marks or not and what suggestions would be given if these have exceeded the bench marks. These are the water consumption bench marks set up for the different star hotels (**Saliba, 2012**)

Hotels 3* – 199 lt per g/n

Hotels 4* – 292 lt per g/n

Hotels 5* – 462 lt per g/n

From the graph given below we can come to know, if the water consumption by these star hotels have exceeded the bench mark or not.

Table 8: Water consumption by star hotels in Mysuru

Hotel name:	Pai Vista	Royal Orchid Metropole	Hotel Siddhartha	Windflower resort
Bench Marks(L/g/n)	292	292	199	462
Water consumed (L/g/n)	252.2	11.1	45.04	555.5

From the table 9, we can see that Hotel Siddhartha and the Royal Orchid Metropole is well within the bench mark. Coming to Hotel Pai-vista we see that the water consumption is about to cross the bench mark limit, this may be due to the wasting up of water or they might be using water more than what is required per day. But windflower resort has exceeded the benchmark limit. This may be due to like the size of the resort and various other facility in resort for which the water is being used like for ponds, gardening, swimming pools and so on.

This can be one of the reasons why Mysuru faces water scarcity. Thus compromise cannot be drawn on fact that due to no rain, residents of Mysuru Face water scarcity, rather the management authorities at resorts must and should be extra careful. A graph showing the water consumption by the star hotels based on table 7 is shown in figure 9.

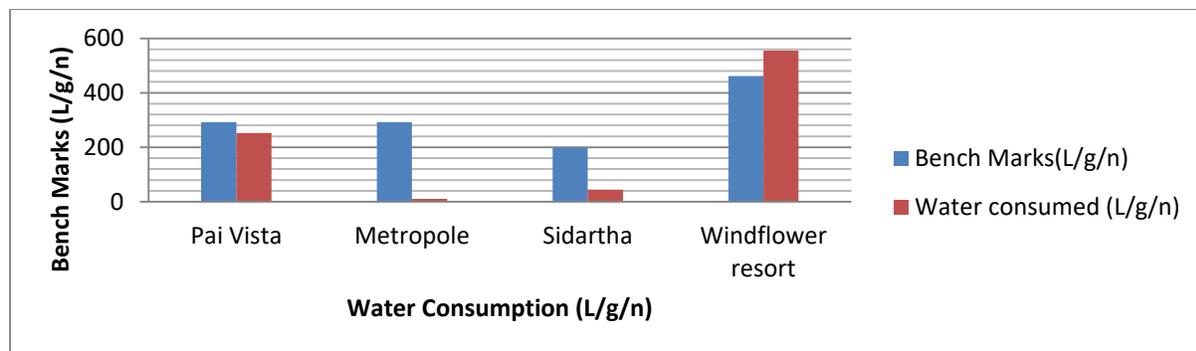


Figure 9: Water consumption by the star hotels

[E] Land required for the waste Assimilation and the Waste Assimilative Capacity done for some of the Major Pollutants in the river.

Land required for waste assimilation

From the table below we see that in the year 2012 the Land required for waste assimilation was more, this might be due to the fact that the inflow of both domestic as well as foreign tourist is high in the year 2012. It is also noted that the LWA is high for the tourist than the residents who stay in the area. Ring a bell? The visitors who are pouring at a disturbing rate have a tendency to create more waste than the living populace.

Table 9: Land required for waste assimilation

Year	Tourists (domestic and foreign) ha	Resident Population ha	Total LWA ha
2012	1,982.75	11.5	1,994.24
2013	988.11	11.5	999.60
2014	1,092.59	11.5	1104.09

Waste Assimilative Capacity done for some of the Major Pollutants in river

Table 10: Waste Assimilative Capacity

Parameters	AC kg/day from eqn 17	C final mg/l from eqn 19	%AC from eqn 20
BOD	19310918.4	273.12	90.4%
Phosphates	1316003.328	20.06	90%
COD	174096000	1035.16	97.41%
Nitrates	11507204.6	34.0	89.7%

From the above we see that for 19310918.4 kg/day of (Biological Oxygen Demand) BOD 90.4% of it is absorbed, which means that the river body which carries 19310918.4 kg/day of BOD has no threat of whatsoever when it does not pass through the treatment units as 90.4 % of BOD is absorbed. The same goes for Chemical Oxygen Demand (COD), Nitrates and Phosphates.

Findings

The following are the conclusion drawn based on the calculations done for the land required for water consumption, Carrying capacity, Water footprint and Waste assimilative capacity.

[A] Land required for water consumption

As seen from the table 6, the land required for water consumption was more in the year 2012, this was mainly due to the annual time spent by the tourists was high in the year 2012. Due to this the city of Mysuru faced water scarcity in the year 2013. Times of India 2013, records the following complaint:

A section of residents from Paduvarahalli, one of the city's oldest localities, in 2012 blocked the Mysuru-Hunsur Road for about an hour in the morning. The agitators withdrew their protest after Mysuru City Corporation chief P G Ramesh visited the spot and assured them supply in tankers. He also directed the officials to drill a new bore well in the locality. The land required for the consumption of water should not exceed 50ha.

[B] Carrying capacity

From the analysis done in table 7, no doubt Mysuru is one of the tourist eyeballed destinations because of its unique features that magically draw the visitors each year, but at the same time concern arises about the resources. If with the population growth and the tourists pouring in, will it be able to meet the needs of future generation? From the data and the calculations, right under the noses of Mysureans the resources are gradually becoming used up, as we see only 11% of it is available and if the carrying capacity limit is reached in the future then Mysuru can be extinct within the next few decades. The city of Mysuru can accommodate just 32,10,000 persons and not beyond. This calls for measures to reduce the Tourism Ecological Footprint.

This calls for a management plan. Stopping visitors from visiting Mysuru is not a solution. There is a need to maintain the available capacity to be at least 103% without seeing it decreasing further. The following measures can be taken up to ensure that the available capacity does not exceed the carrying capacity:

Eco-tourism

It can bring chance to protect local heritage or to revitalize native cultures, for instance by regenerating traditional arts and crafts. Apart from that, the visitors can enjoy unspoiled nature and landscapes, environmental quality of goods or services. However, green tourism is different from eco-tourism, whereas, eco-tourism is part of green-tourism.

Implementation of strict law and Diversification

The marine environments and its natural resources should be managed more efficiently in order to minimize the environmental effects on coral reefs, mangroves and all other threatened habitats. It is important to diversify their countries product range by opening up new adventures. This is to achieve a better distribution of tourist activities throughout the country. In addition, to reduce some of the environmental issues created at tourism hotspots.

Reduce tourist's numbers in some areas

To reduce tourist numbers in some areas by putting limitations to the number of tourists allowed visiting a specific area per year. Moreover, the government should also double the entry fees. This can maintain the income from these areas. Despite that, the limitation in the number of visitors per year also means to reduce the environmental impacts on the natural eco-system.

[C] Waste Assimilative Capacity

The waste assimilative capacity is nothing but the ability of the water body such as rivers or lakes to take care of the pollutants itself before passing to the treatment unit. Four parameters (BOD, COD, Phosphates and Nitrates) were taken and the waste assimilative capacity was carried out. Hence from table 10 we see that, when it comes to BOD and phosphates, 90% of the concentration is absorbed before passing to the treatment unit, and remaining 10% is treated. In COD we see that 97.41% of the concentration is taken care by the river while the remaining 3 % is treated. Finally for Nitrates 89% is absorbed by the river while the remaining 11% is treated.

To sum it up, no doubt Mysore is a unique city that draws many international tourists to its vicinity but, the concern of the resources must be kept in mind as well as the waste generated by the tourists both domestic as well as foreign as we see that the land required for waste assimilation is high in the year 2014.

Conclusion

During the study the researcher found that there is little knowledge available on the spatial behaviours of urban tourists, and yet tourists generate an enormous quantity of data (Big Data) when they visit cities. These data sources can be used to track their presence through their activities. The researcher proposes to use three sources of data to reflect different tourism activities in cities: Panoramio (sightseeing), Foursquare (consumption), and Twitter (being connected). Tourist density in the three data sources is compared via maps, correlation analysis (OLS) and spatial self-correlation analysis (Global Moran's I statistic and LISA). Finally the data could be

integrated using cluster analysis and combining the spatial clusters identified in the LISA analysis in the different data sources.

Tourism is one of the fields in which Big Data offers the greatest opportunities. Since the official data sources do not provide detailed information on the places tourists visit in cities. Big Data supplies a large quantity of information to complement the traditional sources. Tourists leave a digital “footprint” in most of their activities, and these new data sources now make it possible to analyse tourists' behaviour in the cities they visit. They take vast numbers of photographs and upload them to photo-sharing services, they make payments with bank cards, they talk and send messages via their mobile phones, they are active on social networks, and so on. All this activity produces an enormous quantity of digital data (Big Data) which can be analysed to study behavior patterns

References

1. Barberan, R. P. Egea, P. Gracia-de-Rentería, M. Salvador (2013), Evaluation of water saving measures in hotels: A Spanish case study, *International Journal of Hospitality Management*, vol 34: 181 – 191.
2. European Environment Agency: What is an environmental indicator? <http://www.eea.europa.eu/help/eea-help-centre/faqs/what-is-an-environmental->(Jun. 29, 2009)
3. Essay M.P (2000), Water resource management: the need of the hour. < <http://www.yourarticlelibrary.com/essay/water-conflicts-essay-on-world-wide-water-conflicts-water-management/28159/> >
4. Erik Lundberg (2011), Evaluation of Tourism Impacts – a sustainable development perspective LICENTIATUPPSATS I FÖRETAGSEKONOMI
5. Global Footprint Network Website: http://www.footprintnetwork.org/en/index.php/GFN/page/ten_in_ten_campaign/ (Jun. 29, 2009)
6. Gössling S., Carina Borgström Hansson, Oliver Hörstmeier , Stefan Saggel (2002), Ecological footprint analysis as a tool to assess tourism sustainability: *Ecological Economics* vol 43 (2-3): 199-211.
7. Hoekstra A.Y. (2008), Water neutral: reducing and offsetting the impacts of water footprints March, Research Report Series No. 28, UNESCO-IHE Institute for Water Education, Delft, the Netherlands in collaboration with University of Twente, Enscheda, the Netherlands, and Delft University of Technology, Delft, the Netherlands.
8. Identification of tourism circuits across India: Interim report –priority circuit Karnataka (July-2012).
9. Kelly V. (2015), Use of Geographical Information System (GIS) to calculate the assimilative capacity of rivers to receive proposed discharges: Informatics and reporting, office of environment assessment.
10. MEDSTAT II: ‘Water and Tourism’ pilot study, 2009 edition, European Communities

11. Purvis L. C. (2008) the ecological footprint of hostel tourists in Ontario and Quebec: University of Waterloo Ontario, Canada.
12. Prof. Harry Coccossis, Dr. Alexandra Mexa, Dr. Apostolos Parpairis (2002), "Defining, measuring and evaluating carrying capacity in European tourism destinations" B4-3040/2000/294577/MAR/D2, Athens.
13. Peter Allan Johnson (2003), EXPLORING THE ECOLOGICAL FOOTPRINT OF TOURISM IN ONTARIO, Waterloo, Canada
14. Pantin (1999), rising to the challenge of sustainable development in the Caribbean: Feature address to SEDU's 10th anniversary conference.
15. Rees, W. E., (2000), Ecological footprint analysis: Merits and Brickbats. Ecological economics vol 32: 371-774.
16. Sonak, S. (2004), Ecological footprint of production: A tool to assess the environmental impacts of tourism activity: The Journal of International Tourism Studies vol 15.
17. Sunlu (2003), Environmental impacts of tourism: Environments and agriculture in the Mediterranean region. Bari : CIHEAM, 2003. p. 263-270.
18. Tatiana (2010), Ecological Footprint: An indicator of environmental (un) sustainability? A review and further analysis.
19. Trista M. Pattersona, Valentina Iccolucci, Sironne Astianoni (2008), Beyond "more is better": Ecological footprint accounting for tourism and consumption in Val di Merse, Italy: Ecological economics, vol 62: 747-746.
20. UNEP (2003), A Manual for Water and Waste Management: What the Tourism Industry Can Do to Improve Its Performa.
21. UNEP, (1999), Carrying capacity assessment for tourism development, Mediterranean action plan.

❖ Researcher