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ASSESSMENT OF WATER CONSUMPTION AND REUTILIZATION POTENTIAL IN HOSPITALITY SECTOR- A CASE STUDY OF DELHI

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Abstract— **Water use across various sectors in India is on the rise. Delhi being the capital city of the country attracts lots of migrant population which resulting pressure on required infrastructure particularly demand of water. Delhi as a capital city have rapidly expanding centre of government, trade, commerce and industry, therefore, it is an instructive location for studying the water recycles options by hospitality sector. In Delhi city there are about 37 five star hotels, 20 four star hotels and 44 resorts/motels. The hospitality industry consumes a large quantity of fresh water to provide and maintain hygiene and recreational standards as per guests' expectations. The Delhi city has been experiencing severe water scarcity in terms of supply and demand for a very long time. It is getting worse day by day due to increasing demand of water with the economic liberalization and globalization. This paper presents an estimate of water consumption and thereby analyzing the reuse potential by the hospitality industry. The study is helpful in formulating a framework for effective conservation & use of water as a natural resource using best water management practices including recycling options by the hospitality sector of Delhi. For this study data of water consumption and waste water generation is provided by the hospitality industry to the Department of Environment, Government of National Capital Territory (NCT) of Delhi. The study finds that around 18.5 mld of fresh water can be saved through suggested water management practices by the hospitality industry of Delhi which can be further utilized for water supply of around 1,37,000.00 population. The National Capital Region of Delhi is a water scarce region which can have sufficient water if suggested recycling options are adopted for water conservation and management. This is essential for the sustainable development of the region.**

Keywords— Water consumption, Water recycling, Hospitality sector, Hospitality industry, Hotels, Hotel industry, Water reutilization

I. Introduction

Water is a resource of nature, of such a kind which is not only an integral part of Earth's ecosystem for sustainability of life but also an important for proper functioning of a modem, developed and progressive society.

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The total water requirement of Delhi has been estimated to be 5181 MLD whereas the water requirement fulfilled by the

The National Capital Territory (NCT) of Delhi is the largest metropolis in north India which has substantial industrial units of hospitality leading to huge water demand

Delhi Jal Board (Government outfit responsible for managing supply of water in Delhi city) stands out to be 3573 MLD only (Economic Survey of India, 2012-13).

Moreover, as per 2011 census record of 3.34 million households, about 0.46 million households (approximately 14%) rely on groundwater for their water need. Hence, the nation's capital i.e. Delhi is perpetually in the grip of a water crisis, more so during the dry season. Therefore, as the demand-supply gap widens, more groundwater is being exploited.

In water supplied by the Delhi municipality, approximately 11 percent comes from groundwater reserves and remaining from the Yamuna River. In Delhi approximately 13 percent (Zerah., M Helene, 2000) households do not receive water every day.

With the increase in population coupled with urbanization, industrialization and rise in standard of living, the demand of water for various uses is increasing continuously. According to the Mckinsey Global Institute report, 2010 on urbanization in India projects Delhi's population in 2030 will be at 26 million against 16.7 million as per 2011 census. The Delhi city, which presently somehow manages its water demand is likely to face increasing water stress if required best water management practices are not adopted.

Hotels/Hospitality industries are a major & important component in tourism sector, and their role in water management become more relevant being major consumer of water. It becomes more vital when we take in account the very fact that it is at the verge of getting water scarce in near future. Generally, hospitality segment overuses water resources for their kitchen, swimming pools, laundry, washing and personal use by guests. Also, the water consumption is proportional to the quality of services provided by the industry, i.e., more the amenities to guests, more consumption of water. So, the hospitality industry is the major guzzler of water resources.

Over the years, tourism in India has registered significant growth, which is mainly due to rising incomes, increasing affordability, growing aspirations, increasing globalization, and a growing airline industry along with improvement in travel-related infrastructure. As per the estimates by the Federation of Hotel & Restaurant Associations of India

[FHRAI], India currently has over 200,000 hotel rooms spread across hotel categories and guest-houses and is still facing a shortfall of over 100,000 rooms. To meet the future requirements of hospitality sectors, there is an urgent need for improving water use efficiencies in all sectors of its use.

Consumptive water demand by hotel industries is more than three times than that of the average per capita water consumption. Moreover, a large quantity of water is also required for different non-consumptive water consumption like DG and HVAC Cooling, irrigation, etc. With the increase in the GDP and business opportunities, the hospitality sector is expected to grow rapidly in near future. Hospitality sector is an organized sector where the policies of regulatory authority can be effectively implemented and monitored. The concept of zero discharge of waste water can be easily put into practice. Therefore, keeping this in view, the hotels and resorts including motels have been selected for the present study.

II. Hospitality Sector Growth

The hospitality sector has emerged as one of the fastest growing sectors contributing significantly to economic growth and development. India has tremendous potential to become a preferred tourist spot globally because of its rich and diverse cultural heritage, abundant natural resources and biodiversity. India has 28 World Heritage Sites and 25 bio-geographic zones. India ranked 13th among 184 countries in terms of travel and tourism's total contribution to gross domestic product (GDP) in 2013. The sector's direct contribution to GDP is expected to grow at 6.4 per cent per annum during 2014-2024 vis-à-vis the world average of 4.2 per cent. Hotels are an integral component of tourism industry as they offer services and facilities of required high standard. In recent past, the government has put initiatives in place to encourage the tourism sector. The Centre and State Governments of India are also working to chalk out a PPP (Public-Private-Partnership) model to increase and building hotel capacity.

Over 6.8 million foreign tourist arrivals are reported in 2013. Foreign tourist arrivals (FTAs) increased at a compound annual growth rate (CAGR) of 7.2 per cent during 2005-2013. By 2024, FTAs are expected to increase to 13.42 million. Total foreign exchange earnings (FEEs) from tourism grew to US$18.1 billion in 2013. FEEs increased at a CAGR of 11.7 per cent during 2005-2013 (Figure1). In addition to this, domestic tourists also constitute a major chunk of the total tourist pie (Figure 2), and thus the segment is growing. The performance of the hospitality segment is directly correlated with global and local economic growth. Demand for business travel has remains relatively robust in recent year.

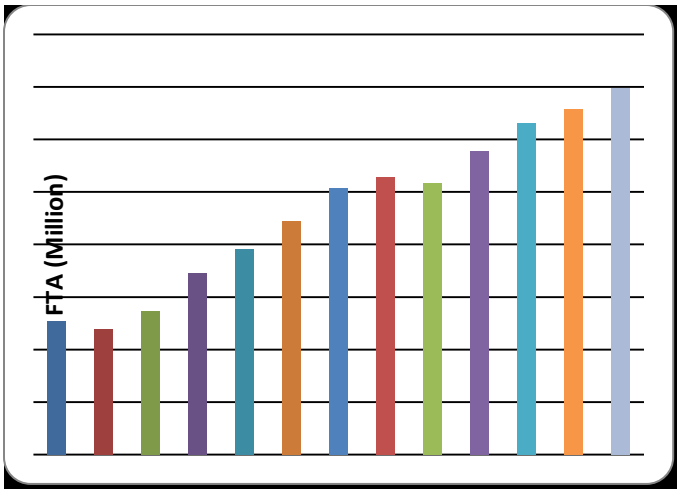

Figure 1: Growth of foreign tourist arrival (FTA) in India during past years (source Bureau of Immigration, India).

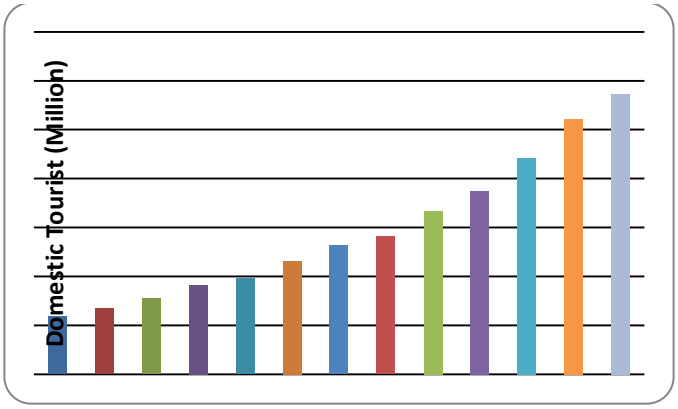

Figure 2: Growth of Domestic Tourist visits to States/Union Territories in India during past years (source Bureau of Immigration, India)

III. Criteria for Classification of Hotels

Ministry of tourism and Culture, Government of India has adopted some criteria for the classification of hotels into different categories. The criteria include area of single and double room as well as area of attached bathrooms, facilities and services provided. There are six star categories ranging from 1-star category hotels to 5-star-deluxe category. The minimum room area standards laid down by the Ministry of Tourisms for different star categories of hotels have been given in Table 1.

Table 1: Standard area requirements for different categories of hotels

Description	Star Category	Area of single room (sq. feet)	Area of double room (sq. feet)	Area of the attached bathroom (sq. feet)
City Hotel	5-star-deluxe or 5-star	180	200	45
4-star or 3-star		120	140	36
2-star or 1-star		100	120	30
Resort Hotel	5-star	180	200	45
	4-star	120	140	36

Source: Ministry of Tourism and Culture, Government of India

IV. Materials & Methods

In Delhi, there are about 37 numbers of five star, 20 numbers of four star hotels and 44 numbers of resorts/motels which are registered with Department of Environment, Government of NCT of Delhi.. However, it is estimated that around 60 unregistered resorts/motels are functioning in Delhi. Water consumption and wastewater generation is calculated from the data/information provided by the hospitality industry to the Department of Environment, Government of NCT of Delhi, India. In this study, we have not considered two or three star hotels since, the reuse opportunity in and around such premises is minimal. For estimating the population equivalent municipal water supply, an average of 135 liters per capita per day was considered.

V. Results & Discussion

Descriptive statistics of plot area and built up and water consumption pattern of five star and four star hotels and resorts/motels have been shown in table I and II respectively. Plot area of five star hotel varies from as low as 1250 Sq.m to as high as 85591 sq.m. Average plot size of five star hotel is 17952 sq.m. Minimum size of plot of four star hotel is 482 sq.m. which may be as high as 20000 sq.m. with average plot area size is 7467 sq.m. Plot size of resort/motels vary from 1416 sq.m. to 65000 sq.m with average size of 19339 sq.m.

Table II: Descriptive statistics of plot area and built up area of hotels and resorts.

	Five star Hotel		Four Star Hotel		Resorts/Motels	
	Plot Area (sq.m.)	**Built up area (sq.m.)**	**Plot Area (sq.m.)**	**Built up area (sq.m.)**	**Plot Area (sq.m.)**	**Built up area (sq.m.)**
Minimum	1250	2495	482	975	1416	1000
Maximum	85591	95115	20000	91444	65000	107712
Average	17952	36987	7466	20649	19339	8633

There is a wide variation in water consumption pattern in five and four star hotels and resort. In five star and four star hotel non-consumptive water requirement account for about 50 percent of total water demand whereas in resorts domestic water demand account for only 39% whereas non-consumptive water demand account for 61%. Domestic water consumption in five star hotel varies from 50 KLD to 690 KLD with average water consumption of 190 KLD. In four star hotel domestic water consumption varies from 10 KLD to 245 KLD with average domestic water consumption of 87 KLD. Water consumption is widely varied in resorts and motels on account of varying occupancy and associated facilities with it. However, non-consumptive water demand in resorts and motels is high in comparison to consumptive water demand.

Table III: Descriptive statistics of water consumption pattern of hotels and resorts.

	Five star Hotel			Four Star Hotel			Resorts/Motels		
	Dom. (KLD)	**Process water (KLD)**	**Hort. (KLD)**	**Dom. (KLD)**	**Process water (KLD)**	**Hort. (KLD)**	**Dom. (KLD)**	**Process water (KLD)**	**Hort. (KLD)**
Min	50	0	0	10	0	0	1.5	0	0
Max	690	30	455	245	134	231	414	84	480
Avg.	190	56	141	87	19	55	23	6.8	23

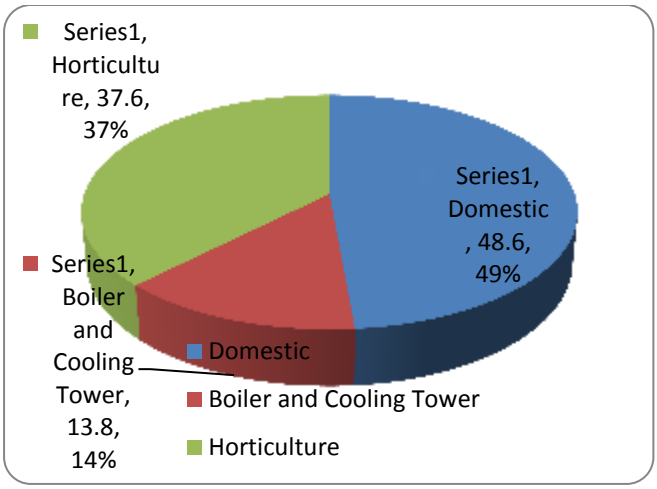

Figure 3: Water Consumption Distribution in Five Star Hotel

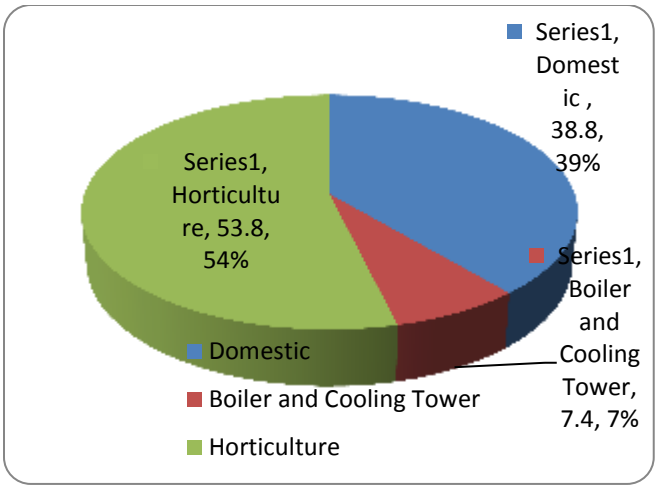

Figure 5: Water Consumption Distribution in Resort/Motel

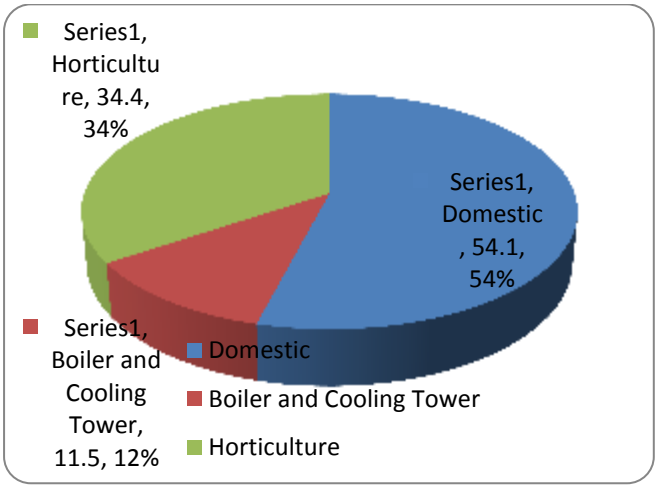

Figure 4: Water Consumption Distribution in Four Star Hotel

It was estimated that about 18.54 mld wastewater is generated from these complexes. In absence of proper regulation/monitoring either they are discharging untreated or even though treated wastewater discharge directly in the drain without recycling. However, wastewater generated from these complexes is equivalent to water supply for 1,37,000 population. If this wastewater is reused in the hotel complexes it can reduce the burden on water supply agency simply by meeting non-consumptive water demand of these complexes. Moreover, if recycling in the complexes is not feasible totally, it may be recycled for irrigation of city parks or other green areas of the Delhi city.

VI. Conclusion

Delhi is a water scarce region. Out of the total supply by Delhi Jal Board approximately 11 percent comes from ground water. Already many Delhi areas (districts) have been declared as 'critically overexploited' by Central Ground Water Authority. Moreover, there are many households where still proper water supply network has not been reached. In one hand Delhi as a city has an urgent need to increase the water supply network to ensure adequate water supply for every house hold, on the other hand there is unprecedented increase in its population particularly due to large number of migrants from different parts of the country as well as being capital city of the nation. Under these circumstances an intense water resource management strategy is a must for Delhi. If, the wastewater generated from the hospitality sector is reused for non-consumptive purposes the available water can be utilized for drinking water supply. Moreover, Delhi has about 20,000 parks covering approximately 8000 ha of area. As per the information obtained from Delhi Park and Garden Society running under the Department of Environment, Government of NCT of Delhi on an average water requirement for irrigating parks is about 12 KLD per acre on alternate day of irrigating. In most of the city parks source of water irrigation is ground

water. 8 000 ha of green area of Delhi has a water requirement of 119 MLD. Treated wastewater from hotels and resorts/motels can fulfill approximately 15 percent of water requirement of watering green areas of Delhi. Therefore, with an option of reuse of treated wastewater from hotels and resorts/motels can reduce dependence on ground water which is already depleted to a critical level in many parts of the city. This can reduce fresh water consumption of the Delhi city. It can further used for improvement of water supply scenario.

VII. Acknowledgment

The authors would like to thank Department of Environment , Government of National capital Territory of Delhi and Ministry of Tourism, Government of India for accessing the data and relevant information available with them.

References

[1] http://cgwb.gov.in/gw_profiles/st_delhi.html (DOA: 07.02.2015)

[2] https://www.dnb.co.in/Travel_Tourism/Indian_Hospitality_Industry.asp DOA: 04.02.2015)

[3] http://www.fhrai.com (DOA: 05.02.2015)

[4] Grenoble, Zlata; Zhang, Chunlong (Carl); Ahmed, Sirajuddin; Jeffcoat, Stuart B.; Karanfil, Tanju; Selbes, Meric; Kaplan, Sehnaz Sule; Begum, Shaista; Ahmad, Rasheed ((2007) "Physico-Chemical Processes" Water Environment Research, 1228- 1296

[5] http://hostsindia.in/index.php?option=com_content&task=view&id=18&Itemid=32 (DOA: 07.02.2015)

[6] IHEI, 2005. A quick guide to bench mark hotel. Retrieved May 4, 2005 from http:// www.benchmarkhotel.com.

[7] Karagiorgas, M., Tsoutsos, T., Drosoua, V., Pouffary, S., Pagano, T.,Lara, G.L., et. Al. (2006). HOTRES: Renewable energies in the hotels. An extensive technical tool for the hotel industry. Renewable and Sustainable energy reviews, 10(3), 198-224.

[8] Karanfil, Tanju; Yadav, Abhishek; Zhang, Chunlong (Carl); Ghosh, Suman; Ahmed, Sirajuddin (2006), "Physico-Chemical Processes." Water Environment Research, 1193- 1260

[9] Mckinsey Global Institute report, 2010 , India's urban awakenning: Building Inclusive Cities, sustaining economic growth.

[10] Ministry of Tourism and Culture, Government of India http://tourism.gov.in/(DOA: 07.02.2015)

[11] Nordic Ecolabelling, 2002. Nordic ecolabelling of hotels and youth hostels. Criteria document, October 3rd 2002 – September 30th 2006, Version 2.0. SIS Miljo"ma" rking, Stockholm, Sweden.

[12] http://naiyerjawaid.com/indian-hotel-industry-optimistic-about-future. (DOA: 06.02.2015)

[13] http://www.researchandmarkets.com/reports/1948962/hotel_industry_in_india_20112015. (DOA: 07.02.2015)

[14] http://www.sustainabletourismonline.com/awms/Upload/PORTAL%20MICROSITES/YEAR%20OF%20WATER/EarthCheck_Water_2013.pdf (DOA: 07.02.2015)

[15] http://www.tripadvisor.com/PressCenter-i184-c1-Press_Releases.html. (DOA: 07.02.2015)

[16] Scandic Hotels AB, 2000. Annual report 1999. Scandic Hotels, Stockholm, Sweden.

[17] http://www.unep.org/resourceefficiency/Portals/24147/scp/business/tourism/greeneconomy_tourism.pdf(DOA: 07.02.2015)

[18] Zerah., M Helene, 2000,Water - Unreliable Supply in Delhi, French Research Institute of India