Summary and Conclusion
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Environmental deterioration is the by-product of the so-called industrial civilization. Explosive increases in the exponential forms of population growth and industrialization have jointly caused havoc for the human adjustment in the city environment. The phenomena of accelerated urbanization and industrialization is the main culprit, wherein besides bringing higher standards of living it has also brought problems of air, water, and noise pollution with a bonus of solid waste generation and growth of slums.

The supreme challenge before civilization in recent times has been to live in accord with our environment. The sanitary conditions in the cities are turning worse to worst with the increase in population per unit area. The consumption of resources is increasing not only with the increase in population but also due to increase in per capita demand. Solid waste is one of the most immediate and visible environmental pollution caused due to rapid rate of industrial growth and urbanization. Being humans we produce waste in nearly everything we do.

Problem of solid waste being faced by us has its roots in the 'Economic Boom' following the World War II, wherein the marketing experts set to work trying new tactics to get consumers to by and 'Stimulate Consumption'. The
market strategy was to increase purchasing capacity of the consumers with the nature of the product being use and throw. The last century was not only marked by scientific and technological developments but also by the serious environmental threats posed by the increased concentration of human population within limited spaces. Environmental pollution in the developing countries like India arises from the poor socio-economic status coupled with unplanned industrial and urban growth. The most striking feature of the urbanization trend in India is the growth of metropolitan cities in disproportion. Rapid environmental deterioration is due to this pattern of urbanization, accentuating urban problems, with a significant backlash effect on the rural urban settlements too.

Of the total population of India, more than one-fifth lives in urban areas. With the numbers ever increasing it is hard for the municipal authorities to keep up with the amount generated and proper disposal of solid wastes in the city. Around 60 per cent of the municipal authorities in India are able to collect only 40 per cent of the total waste generated daily. At least 28 per cent of the daily generated waste is left to putrefy and decompose along the roadside.

The present study has been carried out to understand and analyse the problem of municipal waste faced by Varanasi city. The municipal area of Varanasi, 78.5 Km², has been divided into 90 wards for proper administrative functioning. The study has been done keeping the municipal boundary of the city so as to analyse the spatio-temporal pattern of waste generation, collection efficiency of the municipal staff, physico-chemical properties of refuse and the
effect of solid waste upon human health and lastly, management. The present study has been divided into seven chapters.

The first chapter deals with the physico-cultural setting of the study area, Varanasi (25° 0' to 25° 16' N and 85° 5' to 83° 1' E). The city is situated along the holy bank of the Uttar Vahini, the river Ganga flows northerly instead of the usual south easterly flow has made the city so stable and enviable that it is amongst the few cities of the world which shows little shifting in its site. The nature and character of the bank of the river Ganga formed of Kanker ridge has made the position of Varanasi strong and stable. The physical character of the topography, due to both the rivers Ganga and the Varuna, has influenced the pattern of the urban spread in the city since early times. The city, situated in the Middle Ganga Plain, enjoys a sub tropical monsoon climate. Varanasi cherishes the extremes of summer and winter temperatures alternately in a year. The climate is moderately extreme type. The average range of temperature is about 30°C. The winter monsoon is typified by the westerly while the summer monsoon by the easterly winds. Normally the hot weather changes into a season of general rains with sudden burst of the summer monsoon usually by 22nd of June. The city joined the ‘million plus’ club of cities of the country in the year 1991 and has become the 22nd largest city of the country as far as population is concerned. According to the 2001 census (provisional) the population of the city is 13,25,087, wherein 2,97,268 persons were increased from the population of 1991. The number of wards in 2001 also increased from 40 to 90, while the total municipal area
remained the same, 78.5 Km², in response to the increasing population, so that the municipal authorities may provide better civic amenities to the populace. With a density of 16880 persons/ Km² coupled with complex activities has had its impact upon the landuse of the Varanasi city, wherein 72.4 per cent of the total developed area falls under the residential usage, which leaves only around 27.6 per cent of the developed area for all other uses.

The second chapter is devoted to study of solid waste and the various geographical concepts and approaches involved therein. Pollution has become the major concern in recent times with the accentuation of improper civic amenities. The ever-increasing pressure of urbanization and industrialization has resulted in massive exploitation of natural resources. Increasing population and the consequent process of achieving higher standards of living has adversely affected the delicate balance of the biotic and abiotic components of the ecosystem. It is the by-product of the industrial, technological and urban revolution. It is this non-directional affluence of uncontrolled industrialization and urbanization is the main cause of the present scenario of environmental pollution. The concept of environmental geography as a subject and its relation with solid waste as a problem, sources and types of solid waste have been discussed in this chapter and ecological, spatial and behavioural approaches have been used as a tool to analyse the pertinent problem of solid waste (generation, collection and proper disposal) and its management.
The third chapter presents the spatio-temporal pattern of solid waste generation, collection and disposal in the study area. The trend of solid waste generation in the study area reflects an increasing trend and goes hand in hand with population increase. The annual generation of solid waste in the city has gone up to 2,00,750 metric tones from 1,82,500 metric tones in 1997. The daily generation of waste in Varanasi city in the year 2002 was 550 metric tones. Out of the total 550 metric tones of waste generated in the city daily, the municipal authorities collect 400 metric tones of waste, thus having an efficiency of 72.7 per cent. The remaining 150 metric tones of waste remains as backlog that is cleared every third day by the municipal authorities. With the increasing population of the city the generation of solid waste has also increased. The per capita per day generation of solid waste is 0.15 kg. The study area enjoys the age old practice of disposing off the city’s refuse outside the municipal area, and burning it to reduce its volume. There is no authorized dumping site in or outside the city, the so called dumping grounds, in essence, along the roadsides and depressions is used by the municipal authorities. They still fulfill the age old saying that a hole is to fill.

The fourth chapter elaborates the physico-chemical characteristics of solid waste taking into consideration the physical parameters like papers, plastic, metals, glass, rags, fine earth and compostable matter. The waste generated in the city has also been analysed for chemical parameters like moisture content, pH, carbon, potassium, nitrogen and phosphorous. Samples for this purpose were collected from 20 collection sites so as to present a clear picture of the nature of
waste generated in the city. As the refuse traits depend upon socio-cultural milieu of the concerned populace, besides climatic factors, hence it was found that the compostable matter and fine earth, ash in the waste stream has supremacy over all the other constituents of solid waste generated in the city. The chemical analysis of the waste exhibits that the waste generated in the study area has a fairly good C/N ratio, whereupon the waste is suitable for composting.

The fifth chapter evaluates the cognitive perspective of the study area's populace towards the problem of solid waste, wherein 800 persons from different walks of life were interviewed. An analysis into the responses hence achieved establishes that the respondents were well aware of the problems caused by unattended solid waste. An interesting fact, which came out during the process of perception survey, was that the people, who are educated, have better occupation and hence good incomes, were the ones who were more aware of the menace of solid waste, ironically were the major waste generators as they can afford the 'use and throw lifestyle'.

The sixth chapter deals with the effects of unattended and improper solid waste disposal upon human health. The liaison of solid waste and human health has been intensively analysed. The various diseases caused due to unattended waste in the study area have been investigated. A set of three questions were asked to the civic staff engaged in collection and disposal who are at maximum health risk, and the perception of 800 respondents was also checked regarding the diseases caused by unattended solid waste. It was found that Gastro-enteritis was
the most common disease caused due to the unattended solid waste as the water gets contaminated during rainy season by surface runoff. Hospital waste has also been dealt with in this chapter.

The seventh chapter elaborates the management aspects of solid waste, with special emphasis on the trends of disposal practices in the study area. Management involves a careful planning keeping in view the site and situation of the area concerned as the properties of waste generated largely depends upon the functional characteristics of the cities. ‘Rational’ scientific equipments should support civic authorities and the manpower should be trained for the proper handling of wastes best suited for that area. Hence planning and management procedures ought to be area specific. Management of solid waste involves a complex set of parameters including the generation pattern, collection efficiency and proper disposal techniques. Collection, transportation and disposal practices should be done without disturbing the delicate balance of the urban surroundings. As the generation of waste is area specific in its nature and characteristics any method hence adopted must consider the functional status and the general locale of the city, so as to make the process of collection and proper disposal holistic. The old “dilute and disperse” concept of waste management no longer works, and the newer concept of “concentrate and contain” is giving way to a new concept called Integrated Waste Management (IWM), which is best defined as a set of management alternatives including reuse, source reduction, recycling, composting, landfill, and incineration. If the concept of triple R is applied religiously at both
personal and institutional levels the amount of waste reaching landfilling sites can be reduced to a considerable extent. Finally a conclusion has been drawn with a hope that the present work will help in the mitigation of solid waste disposal problem in the study area.