



Editorial



Current issue of the ITPI Journal contains seven papers. The first paper titled 'Land Use and Development in Urban Planning: Space for the Marginalized' is written by Sasmita Rout. Often contextualised conflicts and consequences in the literature revolve around the process of land development in the cities either through plotting or housing or allocation of land to different land uses. Most contested issues are acquisition of agricultural land, space for poor particularly the location of slums, and the provision of land for the Economically Weaker Sections, or the Low Income Groups versus middle and higher income groups in the plan. Ultimately this process explains who owns the city; how and who has the right to the city. Therefore, established unequal and uneven power relationships produce the differentiated urban space. Taking this into account the paper is focusing on the land use planning within the existing power structure to address the issues of marginalized in different urban space like inner city, slums and sub - urbs / peri - urban in Indian cities.

Kiran Sandhu and Hardeep Singh Sekhon have written a paper on 'Waste Management Interventions in a Developed Country: Australia and Lessons for India'. The authors argue that from being hidden and sidelined for decades, waste and its managements especially in the post liberalization times have surfaced to become one of the biggest environmental concerns in the world. While developed countries have been constantly moving towards evolving, adopting and improvising sustainable waste management methodologies, developing countries continue to lag behind, and are overwhelmed by waste generation and management crises. The paper examines both the Australian and Indian contexts and suggests consideration of some transferable aspects of the Australian Waste Management System while also cautioning against adoption, especially of technologies without an understanding of contextual waste conditions in India.

A paper on 'Analysis of Energy Consumption for Personal Transportation System in Jaipur City' is written by Nand Kumar and V. Devadas. Energy is one of the most important parameters, which decides the function of the System. Various authors have done research and established the relationship between energy and transport segment. The urban system in developing country consumes huge quantity of energy for mobility purpose and India is not an exceptional one. In India, public transportation system is not catering the requirement of transportation facilities in the urban system; as a consequence the people use personalized vehicles and intermediate transportation system to the larger extent. These personalized vehicles and intermediate transportation system consume huge quantity of energy compared to public transportation system on one hand, and generate huge quantity of carbon monoxide in air, the authors argue.

In the paper of Faiz Ahmed C. and Dr. Sekar S.P. titled '3D Volumetric Analysis in Urban Planning' the authors argue that urban planners envisioning an appropriate future for fast growing cities using conventional planning tools face colossal change. As most of the Development Plans are prepared as simple two dimensional maps that have no means of three dimensional visualization. This paper presents the 3D volumetric analysis of an urban space which could enhance analysis, planning and decision making processes. GIS tools were used to produce an information rich 3D model from the integration of data on land use, building use, and height with a floor space index and a water distribution



network. An integrated methodological framework for assimilating 3D volumetric analysis in planning processes has been presented by the authors.

Md. Danish and Dr. Taraknath Mazumder have written a paper titled 'Accessibility Level Planning of Health Facilities -A Case Study Patna'. Accessibility for health facilities has various dichotomies: spatial versus aspatial, potential versus revealed. On one hand, where spatial accessibility deals with distance or travel impedance of access to health care facilities, on the other hand, a spatial accessibility uncovers the affordability aspects of health care expenditure. This paper aims to study both the aspects of healthcare accessibility at Patna, supported by various models and techniques duly supported by case studies. Distance Impedance Function method has been adopted for calculating the accessibility scores of all the 72 Wards in Patna Municipal Area for various LOS-Dispensaries, Sub - Divisional Hospitals, Speciality Hospitals and Super Speciality Hospitals. This method was also replicated by the authors for calculating the accessibility scores of all the Hospitals for 72 Wards of Patna Municipal Area.

A paper on 'Land Management and Development Strategy for Urban Fringe of Faridabad' is written by Jai Parkash and Nauman Najamuddin. As cities grow and expand, urban fringes become part of cities and new urban fringe areas are formed. This phenomenon in India is creating sever problems in terms of infrastructure delivery both in fringe areas of cities and peri-urban areas. In India fringe areas require good governance like that expected for municipal areas as stipulated in the 74th Constitution Amendment while falling under jurisdictions of *panchayats* where major functions are planning for economic development and social justice and implementation of these plans as per the 73rd Constitution Amendment.

The paper titled as 'Sustainably Housing the Urban Poor: a Case of Uttar Pradesh Housing and Development Board' authored jointly by Prof. Subodh Shankar and Mukesh Ruhela underlined that Housing Urban Poor has always been a challenge to planners and architects, ever since this subject came in to the organized domain. HUDCO, being the premier housing agency of the country took the lead, and since its inception in 1970, formulated fiscal policies focusing the urban poor. This created an impetus to various housing agencies like Housing Boards and Development Authorities to frame their housing schemes / projects with an accent on housing the urban poor. This led to the amassing of huge housing shortage in lower income group segment. As per the GOI statistics, 96% of housing shortage exists in this category. The Government of the day wishes to provide liveable houses within sustainable environs to one and all by the year 2022. Undoubtedly, it is a welcome move, especially to the urban poor- as these are the people who need utmost care and state patronage.

Dr. Ashok Kumar
Editor



Content

<i>Land Use and Development in Urban Planning: Space for the Marginalized Sasmita Rout</i>	<i>1</i>
<i>Waste Management Interventions in a Developed Country; Australia and Lessons for India Kiran Sandhu, Hardeep Singh Sekhon</i>	<i>9</i>
<i>Analysis of Energy Consumption for Personal Transportation System in Jaipur City Nand Kumara, V. Devadas</i>	<i>28</i>
<i>3D Volumetric Analysis in Urban Planning Dr. Faiz Ahmed C and Dr. Sekar S.P</i>	<i>49</i>
<i>Accessibility Level Planning of Health Facilities - Case Study Patna Md Danish and Dr. Taraknath Mazumder</i>	<i>65</i>
<i>Land Management and Development Strategy for Urban Fringe of Faridabad Jai Parkash and Nauman Najamuddin</i>	<i>81</i>
<i>Sustainably Housing the Urban Poor: A case of Uttar Pradesh Housing and Development Board Prof. Subodh Shankar and Mukesh Ruhela</i>	<i>93</i>



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Land Use and Development in Urban Planning : Space for the Marginalized

Sasmita Rout

Abstract

Often contextualized conflicts and consequences in the literature revolve around the process of land development in the cities either through plotting or housing or allocation of land to different land uses. Most contested issues are acquisition of agricultural land, space for poor particularly the location of slums, and the provision of land for the Economically Weaker Sections, or the Low Income Groups versus middle and higher income groups in the Plan. Ultimately this process explains who owns the city; how and who has the right to the city. Therefore, established unequal and uneven power relationships produce the differentiated urban space. Taking this into account the paper is focusing on the land use planning within the existing power structure to address the issues of marginalized in different urban space like inner city, slums and sub - urbs / peri - urban in Indian cities.

1. INTRODUCTION

At the Bhubaneswar Development Authority (BDA) office, Bhubaneswar, on 2 June 2012, Mr. X (pseudo name) came to meet someone who can tell him why his land is marked in the 2010 Master Plan for the transportation purpose. Recently he came to know about his land from the website of BDA. He has many queries regarding his land acquisition issues. He waited long to get an opportunity to meet any official who can help him to do something by which he can save his land from the land acquisition by BDA. Finally after long waiting he got the chance to meet one of the town planners but he has to return home with the word that he will get compensation for his land. After a few minutes Mrs. Y (pseudo name) who works in the finance department of Government of Odisha and is close to her retirement time came to meet one of the officials to request for approval of her pending file. She has possessed a land somewhere in the city where only single story buildings by rule are allowed. But she is keen to do second story building before her retirement. Although norms and standards does not allow but she could manage to approve her file due to her strong influence and contact. Like Mr. X and Mrs. Y there are many unfolded stories in the process of land acquisition and disposition across the Indian cities. Many people do not understand all these processes of planning, city growth and land acquisition what they refer to and how they are part of the entire process. Planning has been restricted to

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a certain section of the people who have access to understand the ongoing changing dynamics in the city.

Signifying the growing population in current decades in cities across the world, it is important to understand the changing morphology, socio - economic and political structure and work practices and how these processes get modified in the process of city planning. Enormous literature criticized master plans of the Indian cities for its inability in addressing issues of the cities and in particular excluding a large mass of the public by restricting it to the elites and middle class population (Delhi Master Plan, 2007; Nallathiga, 2009; Chatterjee, 2006; Watson, 2009; Kundu, 2003 and 2004; Baviskar, 2003; Mahadevia and Joshi, 2009; Chandrasekhar, 1983; Bush, 1981). Master Plan is the legalized and statutory plan document prepared by the development authority and associated parastatal agencies of the concerned city. At present more than 2000 Indian cities have master plans (Ansari, 2004) and there is continuous increase in the number of master plans. For instance in Odisha among 132 cities 56 cities have approved master plan and 15 cities have draft plans (Directorate of Town Planning, Odisha, 2014). With increasing number and holistic nature of Plan making master plan is still significant but draws attention for modifications and change to be better and effective.

Master Plan has been criticized because of its comprehensive nature and incapability in addressing the citizen's need. Initially Master Plan was prepared with the intension of making physical plan of the city but recently it has been accommodating social, economic and environmental dimensions to the entire procedure. Thus, Master Plan is becoming more inclusive and opening up for changing nature of the city. Rejecting the idea of Master Plan is quite critical. Yet alternative to the existing master plan structure and process has to be developed. Centrally sponsored plan like City Development Plan (CDP) under JNNURM is basically focuses on infrastructure development and the development of the urban poor and at present it is restricted to only 63 Indian cities. Several such plans, policies and schemes have been implemented in the city but the whole idea is to fit those frameworks into the master plan in order to avoid duplication. Thus the significance and uniqueness of the Master Plan can't be simply neglected and most of the alternative suggestions come in the form of enhancing the existing master plan process rather than suggesting any complete alternative (Planning Commission in its Eleventh Five Year Plan 2007-2012, Watson, 2009, Ansari, 2004, Jain, 2003, Prasad et al, 1987).

Traditional Master Plans or modern plans all considers land use development an important aspect for the orderly development of the cities. In order to translate place / neighborhood specific issues Zonal Development Plans, action plans are in the process of plan implementation. But in reality often the planning engagements are addressing the immediate needs of the cities which again reduce the span of planning vision. Therefore, to make planning efficient and effective it is significant to



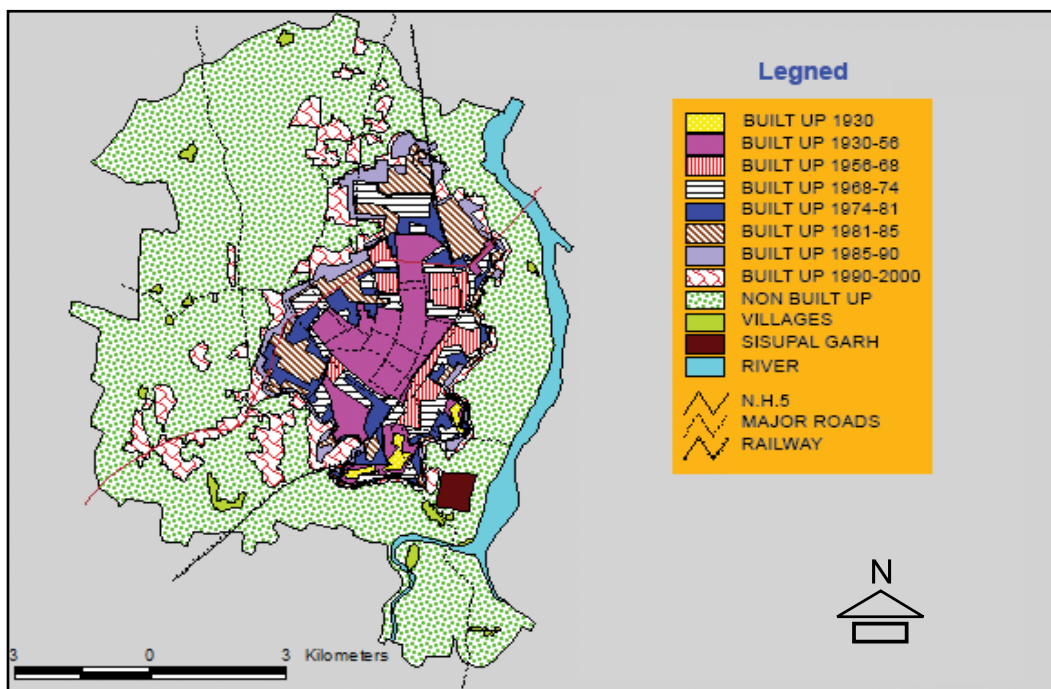
include people's perspective, their issues / concerns and use of the lands according to the requirement of the locals. And of course like plan preparation procedure, plan implementation procedure has to be structured and institutionalized.

2. SIGNIFYING LAND USE CLASSIFICATION IN PLANNING

As said major thrust of the Master Plan process is to prepare land use and infrastructure development plan of the city. Key questions in urban land use planning are: Who has the power of land development? How the authorities acquire lands and how do they develop land? Who are the beneficiaries of this whole process of land development? City Plan has a major function of preparing plans for land acquisition, development and disposition. Urban land development mechanism categorizes into two, such as land acquisition and land pooling mechanisms. Land acquisition mechanism enables government agency to acquire any land for public purpose against some fixed compensation to the owner. Land pooling deduced the land area of the owner (gives 40 percent of the original land which varies in practice) but the overall value multiplied several times with readjustment of the land for providing common urban infrastructure facilities. Most of the Indian cities have land acquisition system and a few like Ahmedabad has land pooling system. Planners' perspective has identified Ahmedabad as a successful and model city. Recent interaction (in November 2014) with the planners of Bhubaneswar city (of BDA, BMC and DTP) explains that they have interest in adopting the town planning scheme of Ahmedabad for an effective and better planning. They are now planning to experiment this land pooling scheme in the Jagasara and Madanpur areas of Bhubaneswar. Although the extent and degree of success is questionable yet it is one step ahead in mobilizing community engagement in the planning process.

Urban land use classification system in Indian cities is mainly based on the purpose for which land is being used for. In India traditional Nine-fold classification system is available but it does not meet the requirement in the urban planning system where urban land use comes within a framework of non-agricultural uses. Existing literature classified urban land use up to third level where residential land is classified in terms of high density, medium density and low density. At the same time residential land is explained in terms of high, medium and low class areas. Major land uses under third level are residential, commercial, industrial, recreational (includes parks, gardens, zoos, playground, stadiums, race course, museums, exhibitions and monuments), transportation, public and semi-public utilities (include education, institutions, and hospitals), agricultural land use (less important or marginal), water bodies (rivers, lakes, tanks, reservoirs, streams), waste land (Land with / without scrub, barren rocky land), vacant land, conservation zone, open space zone and others (several sub - varieties like grasslands, forest cover). For convenience number of sub - classes also increases in every modified classification system. Urban land is comprised of areas of

Fig. 1: Urban Sprawl of Bhubaneswar City 1930 - 2000



Source: Directorate of Town Planning, Bhubaneswar.

intensive use with much of the land covered by structures at the core of the city and land has less intensive use as progresses outward from the city centre. This can be explained through Fig. 1 where the pink / grid portion explains about the orderly developments in the central part of the Bhubaneswar city and with time sprawling of the city increased outward. So the intensive use has reduced outward. Agricultural land, forest, wetland, or water bodies in the fringe areas are included where they are propose to be developed for future urban development. With little or no variation Indian cities have such types of land uses. Residential land use is prominent amongst all, often converted from other forms of land uses.

Purpose of land use classification is subjective and city space specific. In newly developed and planned city like Bhubaneswar and Chandigarh land use was purely initiated with planed intensions of giving priority on residential land use development. But in any organically growing cities land use development basically follows the existing structure and later many modifications takes place according the prepared plan. Such kind of things also happens in the planned cities with time. It is a common phenomenon that within the central part of the city land use is very intensive and less subject to any change and modification. Most of the dynamic changes occur in the suburb or peri-urban areas of the city. Bhubaneswar has witnessed proliferations of numerous educational, medical and IT industries in its peripheries in last two decades. After acknowledgment of the rural as urban sudden transformations are found in every aspect of the



peri - urban landscape. Although it seems common but the most basic land use conversion is from agricultural or waste / fallow land to residential and other form of urban land uses. Besides land use change there is change in the organizational structure of the rural to peri - urban to urban. Many organizations set back (as they used to be the part of rural) and new organizations take part in the process of transformation of urbanization and planning. The dynamics of this transition has multiple landscapes: some ruptures in the social structures like loss of land with some amount of compensation and followed by sufferings of the people; some major changes in the form of rise of industries, high rises and coming up of many public / private institutions.

3. RESIDENTIAL LAND USE AND THE MARGINALIZED

Among the entire land use classes residential land use is the most significant one and all other land uses are to supplement the residential land use to maintain the balance in the city. Recent debates on the space for the poor and marginalized in the city space goes along the line of dualism on whether land less or marginalized have right on the city or not (Roy, 2009, Weinstein Liza 2014, Saxena and Vijayakumar, 2014). Partha Chatterjee (2006) in his "Are Indian cities becoming bourgeois at last" talks about civil society (citizen) and political society (population). He emphasizes on the 'political society' which is defined as the land less and un-propertied class groups. David Harvey's right to the city (2012) and Chatterjee's 'political society' explains who can be defined as the citizen of the city and that will ensure who can claim on the city. Although it is quite debatable but the dynamism associated with city space requires the poor and marginalized in order to maintain the requirement. Moreover, in recent years there is growing acknowledgement of slums and marginalized community in the form of informal sector development, labor requirement and their service to the city space. Thus, they are well recognized and become important in planning process. Here in next part the paper will discuss on where and how the marginalized get placed under which land use classification system.

4. SPACE FOR THE MARGINALIZED IN PLANNING

Modernist planning approach characterize city space as spacious, well organized, well structured, ordered in the form of different residential densities for different income groups, mono - functional land use zoning, less congestion and wide avenues with less traffic. Master Plan thus, emphasized on the aesthetic values and physical ordering of the city by guiding planned development of buildings, parks, gardens and roads. Reordering (meaning against the disorder) the city basically refers to how inner city space has been controlled by pushing the poor away from the city either by displacing, relocating them farther away. In the literature it has been established that the poor / marginalized are always been neglected and excluded from the planning process (Kundu, 2003 and 2004, Mahadevia and Joshi, 2009). The notion of "slum free city" has developed in



order to maintain the city environment clean, sanitize and healthy (Dupont, 2011, Ghertner, 2011). Slums which are formalized over a period of time also put questions of the newly developed slums and see them as 'other' on the public land (Ghertner, 2012). Now the question is who neglects the poor or marginalized and why? It is through the process of implementation slums has been displaced or relocated with the vested interest or may be for some public interest or for some private sector development. Whether it is slum or low income group or economically weaker sections of the people although they connotes different class groups they all belongs from the same fate. Because in the eyes of the planners planning the city ensures that they have to push out of the city. That means they are the least privileged and given less priority in the planning process. But in recent years planner's perspective is getting changed and multiple ways are opened up in accepting the poor into the planning process.

Recently Master Plans have reservation of certain percentage of land for the, economically weaker sections (EWS, Rs.3,300) Low income groups (LIGs, Rs.3,300-7,300) and middle income groups (MIGs). Draft Master Plan of Hyderabad Metropolitan Development Authority (HMDA) reveals that in the process of land pooling HMDA has a provision of 5 percent and 10 percent reservation of land for the purpose of providing housing accommodation for EWS and LIG respectively. So is in the Delhi Master Plan 25 percent of all residential land in the city was reserved for low income groups (Ghertner 2011). Many literatures have pointed out that Development Authorities are consistently failed to meet the provisions of master plan for these groups. Like Delhi Development Authority (DDA) has been far more effective in allocating land for middle and higher income groups, but has completed less than 10 percent of its low income housing projects (Ghertner, 2011). Readings of the annual plans of Bhubaneswar city prepared by BDA has most of the housing projects for HIG, MIG groups than the LIG and EWS groups. Last plan of Bhubaneswar i.e. CDP 2010 has acknowledged the significance for the planning of slums and urban poor. Even though the plan has already in its fifth year of continuation yet materializing those dimensions has to be done.

Baviskar (2003) has also recognized that there is no provision made for the poor in the plans and existence of the poor remains ignored. To quote, 'development of slums was not a violation of plans rather an essential accompaniment to it, its Siamese twin'. She blames the authority for creating situations where illegal practices could flourish. States monopoly over the land and inability to provide low cost land / housing creates conditions for the development of slums. We can take example of tenure security for the poor in Delhi where Kundu (2003) is talking about how the high and middle class do illegal regularization in the names of poor. He pointed out that in November 2002 union Minister of Urban Development declares all the unauthorized settlements developed before March 2002, would be regularized and no such settlement will be allowed in future.



These settlements came basically through the entrepreneurship of builders, colonizers and groups of high and middle income households through purchase of agricultural land. But only 15 percent of the entire settlements were poor. Many instances can be drawn how poor remained neglected in the planning activities. 'Bhagidari' scheme in Delhi is about Citizen Government Partnership basically focuses on the provision of urban services through the Resident Welfare Associations (RWAs). It excludes those areas which are residential but not approved by the Master Plan of the city called as unauthorized colonies (Ghertner, 2011). Thus, the scheme is for those who have legal properties and ultimately counts the poor are not belongs to the city.

Therefore, there are many instances of negligence of poor in the planning process. Even though there are provisions made but carrying out those policies, schemes or provisions is yet to be visible. Other perspective although claims that why poor or slums should be privileged when they don't belong to the city based on the ownership dimension. But ownership itself is a contradictory aspect. People who don't have land or house ownership but have ration card, voting card is also extent the very existence of the citizenship based on their political rights. People who don't have proof of residents or anything to claim over the city Solomon Benjamin (of NIAS) call them as invisible citizens. There are many ongoing debates on defining ownership and therefore claim on the city. What significant is to look for an effective and efficient plan to address the changing dynamics of the city. And most importantly priorities are where to place the burgeoning urban poor and how to address them in the planning process.

5. CONCLUSIONS

Master Plan again and again explains the justification of evictions by pushing the poor out from the city indicating poor has no place in the cities. Thus, planning in a way excludes poor and destabilizing them in the urban system. There is no legal provision for poor in the Master Plan but recently there is growing recognition of the poor on the rising importance in the economic system of the city. Land provisions for EWS and LIG has been grabbed by the HIG and MIG but who (and how) grabbed the land has to be well defined in the literature. Looking into the current changing dynamics community as an important dimension of the planning process needs to be given more priority. The notion of power is contested. Power leads to participation but restricts to a certain section and excludes powerless. But participation gives opportunities to the people to keep their views and interests and bridge the gap of powerful and powerless by legitimatizing poor as the part of city and their significance in decision making process. For which process of planning needs to be inclusive, transparent and effective in nature so that poor and marginalized can be well recognized in the city and its development. Thus, without restricting into only certain interest group planning could address a greater number of population.



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Waste Management Interventions in a Developed Country; Australia and Lessons for India

Kiran Sandhu and Hardeep Singh Sekhon



Abstract

The authors argue that from being hidden and sidelined for decades, waste and its managements especially in the post liberalization times have surfaced to become one of the biggest environmental concerns in the world. While developed countries have been constantly moving towards evolving, adopting and improvising sustainable waste management methodologies, developing countries continue to lag behind, and are overwhelmed by waste generation and management crises. The paper examines both the Australian and Indian contexts and suggests consideration of some transferable aspects of the Australian Waste Management System while also cautioning against adoption, especially of technologies without an understanding of contextual waste conditions in India.

1. INTRODUCTION

One of the biggest environmental concerns of the contemporary times is the manifold increase in waste generation and its sound management. Global statistics indicate a current generation rate of two billion tons annually and expected to touch seven billion tons by 2025 (Davies, 2008). Given the limited capacity of the eco - system and the detrimental environmental impacts of waste disposal on the same, increasing quantities of waste have become a grave problem seeking greater attention and debates than ever before in history. While developing countries as India struggle with their surmounting waste problems, developed countries like Australia are moving towards more sensitive environmental and waste management regimes and more appropriate management, waste control, recycling and material recovery systems. The ethos of the waste management hierarchy and the four R's (reduce, reuse, recycle, recovery) principle and its pursuit underlines the waste management directives in Australia. However, at the same time the challenge of growing quantity of waste and diminishing spaces for disposal and the dire need to find optimal and sustainable solutions tops the Australian waste management agendas echoed through its recent waste Governance and Management Policies.

Given the context, this paper attempts to provide an insight into the Australian waste management system from the point of analyzing and understanding the waste management dynamics of a developed nation, the nature of waste

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challenges it faces and sieve significant lessons in sustainable waste management for India, as an emerging and one of the fastest growing economies in the world.

2. WASTE MANAGEMENT IN AUSTRALIA

2.1 Australia: A Country Brief

Australia is the world's sixth largest country with a population of 21.8 million as of March 2009 increasing to 23.5 million in 2014. Australia's population grew by 1.5 percent per annum and natural increase and overseas migration contributed 43 percent and 57 percent respectively to total population growth for the year 2014 with all states and territories recording a positive population growth (ABS, 2014). Australia is highly urbanized, with over two-thirds of the population living in major cities (IGR, 2010). Australia's economy is consistently ranked among the strongest of advanced economies in the Organization for Economic Co-operation and Development. It is the world's twelfth largest economy and is one of the world's most multicultural countries, rich in indigenous and immigrant cultures, ranked second in the United Nations Development Program's Human Development Report 2014.

Australian economy has been experiencing continuous growth and relatively low unemployment, controlled inflation, low public debt, and a robust financial system. By 2012, Australia had witnessed more than 20 years of continued economic growth, averaging 3.5 percent annually. Demand for resources and energy from Asia and especially China has grown rapidly, creating a conduit for resource investments and growth in exports. The services sector is the largest part of the Australian economy, accounting for about 70 percent of GDP and 75 percent of jobs (DFAT, 2015).

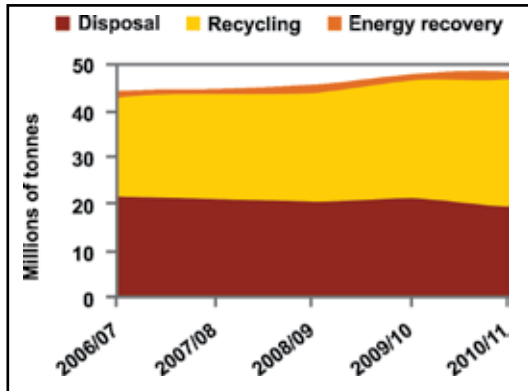
Australia has been described as being a high producer of waste when compared to other countries (DEHWA, 2009). Projections in the 2010 Intergenerational Report indicate that Australia's population could reach 35.9 million in 2050. Australia can be expected to have one of the highest population growth rates among developed countries, especially OECD countries, the future (IGR, 2010). Real national disposable income per person increased by an average of 2.8 percent per year between 1997-98 and 2007-08, a much faster rate than during the previous 20 year period (NWR,2010). Thus, rapidly changing demographic profile and rise in national incomes is expected to further exacerbate the consumerist culture and therefore, bring additional pressure on the Waste Management Systems thereby requiring a significant bent towards greater resource recovery and efficient waste management.

2.2. Waste Facts

According to NWR (2013), waste may be categorized according to its source e.g. Municipal Solid Waste (MSW), Commercial and Industrial (CandI) and Construction



Fig. 1: Waste generation and management trends (2006- 2011)



Source: National Waste Report, Australia, 2013

and demolition (C and D) wastes, its properties e.g. hazardous, solid or liquid, its composition, for example, organic or its context, including its final destination e.g. marine debris. DEHWA (2009) defines MSW in particular as the waste generated from domestic (household) premises; also usually includes council activities such as street sweeping, litter and street tree lopping; waste dropped off at recycling centres and transfer stations and construction waste from owner / occupier renovations.

Australia generated 22.7 million tons of waste in 1997 whereas by 2006-07, the national waste generation had increased by 35 percent. In 2006-07, Australia generated 43.7 million tons of waste in the municipal solid waste, commercial and industrial

waste, and construction and demolition waste streams. Of that waste, 22.7 million tons (52 percent) were recycled, with 21 million tons (48 percent) sent to landfill. Between 1996-97 and 2006-07, the volume of waste produced per person in Australia grew at an average annual rate of 5.4 percent. In 1996-97, Australians generated approximately 1.2 tons of waste per person. By 2006-07, this had increased to 2.1 tons per person annually meaning a generation rate of 5.7 kg per capita per day. Also between 2001 and 2007, the volume of waste disposed to landfill increased from 19.0 million tons to 21.3 million tons.

During more recent times, in the year 2010-2011, Australia continued to generate more waste as the population grew, with the generation increasing to 48 tons per year, an increase of 9.1 percent over, in four years. The total quantity of material recycled in Australia increased significantly from 21.4 tons to 27.3 tons per year or 6.3 percent per year. Australia's total energy recovery increased from about 1.32 tons to 1.52 tons per year amounting to a per annum increase of 3.6 percent. The country's total disposal tonnage decreased from about 21.5 tons to about 19.5 tons per year i.e. 2 percent per year. The resource recovery rate increased from 51 percent to 60 percent between 2006-07 and 2010-11 marking an increase of 9 percent. In terms of waste streams, municipal solid waste constitutes 14 million tons (51 percent) of the total waste generated in Australia (excluding paper and cardboard which constitute an additional 5 million tons). Projections indicate that by the year 2021 the total waste generation shall be 81 million tons. The projections are based on growth in the generation of 4.5 percent per annum considering trends of population growth and waste generation trends (DEHWA, 2010).

In terms of waste streams, MSW constitutes 29 percent of the total waste, C and D amounting to 38 percent and C and I waste at 33 percent. Recycling and waste management services are provided in most parts of Australia. In terms of recycling,



the national recycling rates in 2010-2011 placed MSW at 51 percent, C and D at 59 percent and C and D at 66 percent (NWR, 2013). In 2006-07, an estimated 11.9 million tons of municipal waste were generated of which 7.3 million tons were disposed of to landfill and 4.6 million tons recycled. Whereas by 2011 MSW had increased to 14 million tons annually. If this trend continues, Australia may have a municipal waste stream of up to 22.4 million tons in 2020 (DEWHA, 2009).

Waste disposal and recycling contribute to jobs growth. In 2008, waste management and recycling directly employed almost 29000 people (22 243 in recycling and 6695 in land filling) and indirectly 24 308 (18684 in recycling and 5624 in land filling). Recycling provides 9.2 jobs per 10 000 tons of waste recycled, whereas landfill disposal provides 2.8 jobs per 10,000 tons of waste land filled (DEWHA, 2010). The recycling and waste sector in Australia in 2006 was valued at between \$7 billion and \$11.5 billion. This was up to 1.2 percent of total Gross Domestic Product (GDP) in 2006. Despite making progress in waste recycling and recovery, 20 million tons of waste still finds its way into the landfills.

2.3 Waste Governance Insights

Waste Management practices may vary between states and local government. Almost all Australian residences in urban areas have access to kerb side collection services for waste and recycling, as well as periodic hazardous waste collection. A majority of local government councils operate this service, although outsourcing to private companies is significantly increasing.

Local Governments Councils play an important role in delivering household waste collection and recycling services, managing and operating landfills, providing education and awareness programs, and providing and maintaining infrastructure. They also contribute to aggregated approaches to waste management through Waste Levy Contributions and joint funding and operation of large scale infrastructure projects such as alternative waste treatment facilities. Local governments have compliance and enforcement roles in littering and the illegal disposal of waste. However, the quality and frequency of services provided, the types of bins and direct access to landfill facilities for excessive waste, varies between the Councils.

The management for domestic and municipal waste, largely arising from domestic premises, is the responsibility of local governments while the management of industrial, commercial and construction waste is the responsibility of the generator, however the end-of-pipe disposal of this waste is often under the control of local authorities, most of which own disposal facilities. The Local Governments in Australia are estimated to spend between \$2 to \$3 billion per annum on waste management (Qian and Burritt, 2007)

The Australian waste management operations comprises of private firms and government enterprises. Local Government is responsible for waste collection,



transport and providing landfill facilities, although some of these activities are outsourced and performed with private sector participation. Recycling is carried out predominantly by the private sector and often forms just one part of a larger business, for example, metal manufacturing companies usually also tend to recycle scrap metal. About 1700 organizations are delivering waste management services and these included companies in the private sector, government business enterprises and some operating entities of Local Governments. Local Governments run approximately 600 of those organizations. Within the remaining 1100 organizations (a mix of privately-owned and government trading organizations), a small number of companies have a dominant share of the waste market. There were 1,092 private businesses providing Waste Management Services in Australia and 74 percent of these employed four people or less (DEWHA, 2009). The five largest companies; Transpacific Industries Group, Viola Environment Services, Visy Recycling, Pacific Waste Management Australia (now SITA Australia), J. J. Richards and Sons Private Limited and Thies Services account for 42 percent of total market share. In 2002-03, waste collection and transportation was the largest component of the Waste Management Industry, followed by the processing, treatment and/or disposal sector. The National Waste Report 2010 states that 54 percent of the waste and recycling services market is dominated by less than 0.5 percent of all companies offering services in the sector (DEWHA, 2010).

The provision of waste and recycling services varies according to the type, nature and volume of waste. While some organizations provide services across more than one of the MSW, C and I and C and D waste streams, many specialize in one or two of those streams. Other organizations will focus on particular materials within the three streams, such as those processing recovered concrete, or collecting waste office paper. Hazardous wastes may be handled by general service providers (such as a landfill owner with a hazardous waste area on a landfill site), or by specialist firms with particular technology and expertise (such as with the handling of mercury containing wastes).

2.4 Waste Management Operations

As mentioned in the previous section, waste management is largely the responsibility of Local Government Councils and follows the typical operational mechanism elaborated as under.

Collection: For MSW in larger cities and metropolitans, usually a private sector service provider is contracted by Local Governments or State Government to provide kerb side collection of landfill waste, recyclable products and sometimes also a separate green waste collection. Local Governments themselves also may be the service providers in some cases. This segment is dominated by large private and public enterprises, providing collection, treatment, recycling and land filling services. Small businesses may also be contracted to provide services



direct to households. While intermediate secondary containers are not used, public place bins are positioned along busy streets, parks and tourist routes to prevent littering in such places.

Many of the large providers for MSW also provide services to commercial and industrial outlets. Some construction and demolition wastes from small-scale demolition or construction work (such as residential homes) may be disposed of in small to medium size skip bins. Skip bins are used to hold open topped loads of construction and demolition waste or other waste types. The size of a skip bin can vary from 4.5 cubic meters to 18 cubic meters, and can hold up to 10 tons' worth of waste. Some of this waste is also dropped off directly at landfill. Larger demolition jobs are likely to be serviced either directly by a construction and demolition waste processor, or indirectly through a waste collection services provider. There is also a provision for self-hauled or kerb side collection for large domestic waste and bulky items usually on a periodic basis.

Treatment and Disposal: Transfer stations are consolidation points in the waste logistics chain, where collected waste can be aggregated, sometimes compacted, and loaded to special purpose, long-haul vehicles or freight containers for transport to distant disposal sites. Australia has some 872 transfer stations in operation. These vary in scale and complexity. Many small-scale facilities have been established in regional/remote areas, often in lieu of a small landfill, where local communities without waste collection services can consolidate waste for bulk collection. Large-scale facilities in major cities are equipped to compress waste into long-haul vehicles to maximize transport efficiency. Treatment and disposal of MSW occurs in a variety of ways, often depending on whether there are AWT (Alternative Waste Treatment) facilities in a particular area. Alternative Waste treatment (AWT) is when mixed waste is put through at a treatment facility to recover the resources. This may be through extracting recyclables (such as metals and plastic), through extracting organics for composting (such as food and garden waste) or through extracting energy from the waste (through a process known as anaerobic digestion). There are many different treatment systems available for AWT. Most involve an initial mechanical sorting process, where recyclables and any hazardous items are removed, followed by a more biological treatment process. Some involve 'composting' mixed waste, while some accelerate decomposition through 'anaerobic digestion' (<http://www.penrithcity.nsw.gov.au>). If there is no AWT, the collection truck takes a compacted load direct to landfill.

Some newer large landfills use an off site staging area to dump wastes from the trucks, before separate vehicles such as front-end loaders move it to the tip face. If there is an AWT facility or similar in the MSW collection area, it will receive the landfill waste before it goes to the tip face. Generally speaking, AWTs require large amounts of capital and specialist expertise for setup and operation. As a result, they are usually not established by small to medium enterprises, but



Table 1: Australia’s Distribution of Waste Management Infrastructure.

Jurisdiction	Landfill	Resource recovery facility	Transfer station	Total
New South Wales	369	121	166	656
Victoria	92	233	239	564
Queensland	265	88	236	589
Western Australia	187	86	26	299
Southern Australia	117	247	133	497
Tasmania	19	14	67	100
Northern Territory	118	10	04	132
Australian Capital Territory	01	06	01	08
Total	1168	806	872	2846

Source: National Waste Report, 2013

more commonly by major companies such as SITA or Veolia, or by Governments (including government businesses, councils, and groups of Councils), sometimes in joint venture arrangements.

The 48 million tons of solid waste materials generated each year in Australia’s material intensive economy are handled through Australia’s waste management facilities (Table 1), which are generally grouped into transfer stations, resource recovery facilities and sanitary landfill.

Landfills lead the waste infrastructure stock for recovery and disposal and receive some 40 percent of Australia’s waste. They are the favored destination especially for mixed waste and the moderate cost of land filling in comparison with options to recover more resources. Currently two form of landfill systems are operational. In the first one, it is the Local Authorities who are the owner, operator and regulator while in the other system, Local Authorities may contract

Fig. 2: Sanitary Landfill, Brisbane and Recycling Centre, Helensvale



Source: Google Earth



their waste collection and disposal to the waste management private companies (Xu, Rudolph and Greenfield, 1999). Landfill facilities have been relocated away from the city and since the 1990s, new waste transfer facilities have been developed across Australia to facilitate landfill diversion to the extent possible.

Resource Recovery: The providers working with the MSW stream, create the capacity to separate, recover, and possibly process a wide range of materials (metals, glass, plastics, paper and cardboard). Some recovery businesses focus on a single material type out of a particular stream (such as paper from commercial buildings). Others may process several related materials derived from multiple streams (for example, windrow composting of recovered green waste and garden organics coming out of MSW as well as other waste streams). Many of the same facilities and processes can be used for recyclable materials extracted from MSW and C&I streams. Major organizations such as Visy have facilities that can process materials such as plastics or paper and cardboard into new products or into source materials for other producers. It is also important to note that some large organizations have business models stretching further upstream or downstream from the collection, treatment / disposal and resource recovery points. For example, a company such as Visy is involved in each of those three stages, but is also manufacturer of recycled content packaging.

Resource recovery facilities in Australia are designed to sort and process discarded materials using a range of mechanical, biological and thermal technologies. Investment in resource recovery technologies has been increasing substantially over the last decade and in 2010-11, 60 percent of waste generated was recovered and recycled.

2.5 Policy and Regulations

The early waste related legislation in Australia focused on the public health aspects of waste disposal, and protecting the environment from harm, rather than minimizing waste itself or emphasizing upon re-use and recycling. Since the 1970s, legislation and regulations have gradually come to emphasize waste avoidance, minimization, and ways of encouraging resource recovery. This change has been in line with a shift in attitudes and expectations across the national as well as in the international context and the focus on adopting elements of the waste hierarchy in waste management policies with waste avoidance being the most preferred option and disposal being the least. The waste hierarchy (also known as the 'waste management hierarchy'), first enunciated by the European Union in 1975,¹ is a guide for prioritizing waste management practices, consisting of avoidance, minimisation and resource recovery, with waste avoidance as the highest preference, followed by minimisation, re-use, recycling and re-processing, and finally disposal.



Australia is a signatory to a number of international conventions such as the Basel Convention, 1989 which Australia ratified in 1992 and agreements relevant to waste that have been reflected in national legislation, strategies and policy frameworks. Under the Australian Constitution, waste management is the primary responsibility of the States and Territories which regulate and manage waste in accordance with their respective legislation, policies, plans and programs. The Australian Government is responsible for national legislation, strategies and policy frameworks for waste, including measures that give effect to obligations under international agreements. Local Governments have responsibility for waste management within their local areas as laid down by the regulatory framework of each State or Territory. Some Local Governments have developed their own strategies and regulations on waste management, and programs to implement local sustainability and education outcomes. Therefore, all States and Territories in Australia are aiming to minimize their waste, and increase the percentage of waste that is recycled. This aim is highlighted in State legislations which is setting specific landfill reduction targets, impose landfill material bans and levies, or direct product stewardship. Product stewardship refers to an approach which acknowledges that all those involved in producing, manufacturing, selling, using and disposing of products have a shared responsibility to ensure the environmentally sound management of those products. Product stewardship schemes include take-back schemes, advanced disposal fees, deposit refund, etc. Product stewardship schemes that place primary responsibility on the producer are called extended producer responsibility (EPR) schemes and are based on the polluter pays principle. Under this approach, the manufacturers or producers bear the cost of managing the waste associated with their products.

The National Strategy for Ecologically Sustainable Development, 1992 underpinned the policies and programs related to all aspects of environment including waste. It states that in order to develop an effective approach, Governments will seek to develop an integrated approach to waste prevention and minimization, based on a hierarchy of measures at both the Government and industry level. These measures include actions to achieve cleaner production, reduced use of resources, recycling and reuse. In addition, attempts have been made to develop a common approach to waste management programs between various jurisdictions. The National Strategy committed Australia to improving the efficiency with which resources are used, reducing the impact on the environment of waste disposal, and improving management of hazardous wastes, avoiding their generation and addressing clean up issues. Subsequent to this, the National Waste Policy (2009) takes the step further to set directions for resource recovery and waste management targets to be achieved by 2020. It aims to reduce the amount of waste for disposal and manage waste as a resource to deliver economic, environmental and social gains. The National Waste Report (2010) emphasizes that resource recovery and recycling can generate employment, productivity and



other economic benefit across the Australian Economy and these benefits shall outweigh the costs associated with recycling. Also that Australia can derive a net economic benefit from better national co-ordination of arrangements for waste and recycling across the economy. This benefit will come from more efficient and effective markets, enhanced materials efficiency, streamlined Government Regulation, reduced business costs and new employment in waste and recycling.

In addition the National Environment Protection Council of Australia has also initiated the National Environment Protection Measures (NEPMS) to regulate waste. Another significant regulation to this effect will be the Carbon Pollution Reduction Scheme (CPRS) The Carbon Pollution Reduction Scheme (CPRS) was a proposed cap-and-trade system of emissions trading for anthropogenic greenhouse gases as part of the climate change policy of the Government. The same was to be introduced in July 2010 but postponed to 2012 largely due to the political debate surrounding the implementation of the CRPS and its implications. The CPRS applies to the waste sector, in particular to emissions from the landfills.

Coming specifically to the State levels, each state has a regulatory framework in place for solid waste management operations within its jurisdiction. Therefore, the role played by the Local Government Councils is largely underpinned by the regulatory framework existing at State level. In the words of Lane (2011,p.396), "a paradigm shift is underway from the previous approaches that treated waste as a hazard to both human and environmental health, to a new approach that treats it as a resource."

2.5 Challenges in Waste Management

Despite making significant progress, the Australian waste horizon is not without its share of challenges. The following are some of the main challenges in the way of effective waste management as identified by the National Waste Report 2010.

- The waste generation continues to rise in all streams and no significant effort has been made to reduce the growing per capita waste generation quantities across the country.
- Local Governments especially in large urban agglomerations are facing the challenge of growing quantities of waste and the decreasing space in recent years to landfill the same.
- The main constraints on landfill capacity, especially for those wastes which contain hazardous substances, are social (community acceptance), environmental and institutional. These findings are from the 2009 survey of 665 landfills by the Waste Management Association of Australia. This survey also shows that some of these maybe less well equipped to manage the hazardous components of the various waste streams.
- Instances of litter and illegal dumping continue. For example 9300 tons of litter and illegal dumping waste was reported in Queensland State in 2011-2012.



- A lack of information in some State jurisdictions relating to quality and quantity of supply of recycled and reprocessed materials and products hampers appropriate waste management.
- There is a lack of agreed national specifications and guidance relating to acceptable levels of contamination for recovered resources to provide certainty to the market that the product is of a consistent, recognized standard.
- The lack of opportunity for regional and remote communities to participate in recycling.

The inferences that can be drawn from above is: Australia’s Waste Management System subscribes to the waste hierarchy approach and the principles of sustainable waste management when it comes to waste recycling especially. More than 90 percent of the households are involved in segregating waste for kerb side recycling. The country strives to undertake waste management meticulously involving stakeholders from the public and private sector as well as the community.

In this context the National Waste Policy sets ambitious targets to be met by the year 2020 through its aims as; avoid waste generation and reduce the amount for disposal, manage waste as a resource, ensuring that waste treatment, disposal and recovery is undertaken in a scientific manner and contribute to reduction of greenhouse gas emissions, conserve energy, water efficiency and productivity of land. Based upon its aims, the National Waste Policy identifies six key areas to work on are indicated in Figure 3.

Fig. 3: Thrust Areas of the Australian National Waste Policy, 2009

Taking responsibility	<ul style="list-style-type: none"> • Shared responsibility for reducing the environmental, health and safety footprints of products and materials
Improving the market	<ul style="list-style-type: none"> • Efficient and effective markets of waste and recovered resources with local technology and innovation.
Pursuing sustainability	<ul style="list-style-type: none"> • Less and improved use of waste to achieve environmental, social and economic benefits.
Reducing hazard and risks	<ul style="list-style-type: none"> • Reduction of potentially hazardous content of waste with safe waste recovery, handling and disposal.
Tailoring solutions	<ul style="list-style-type: none"> • Increased capacity in regional, remote and indigenous communities to manage waste, recover and reuse
Providing evidence	<ul style="list-style-type: none"> • Access by decision makers meaningful, accurate and updated waste data and information.

Source: National Waste Policy, Australia, 2009



Thus, the regulatory framework for waste management is well documented, upgraded and in tune with global best practices on solid waste management and comprehensively underpins the operational practices in Australian context. The private waste management sector plays an important role in all stages of waste management starting from collection to resource recovery and final disposal. The private sector is well established and in position to provide efficient services towards Sustainable Municipal Solid Waste Management in Australia.

The issue therefore largely pertains to reducing the per capita waste generation of MSW in keeping with the principles of waste management and maximize resource recovery to the extent possible to adhere to state and national policy and regulations as also to Australia's policy on climate change and reduction of greenhouse gas emission targets.

3. WASTE MANAGEMENT IN INDIA

Moving on to India, the country's population increased from 1.02 billion in 2001 to 1.21 billion as per Census 2011, continuing its position as the country with second largest population in the world after China. With the annual population growth rate at 1.76 percent, India is predicted to have more than 1.53 billion people by the end of 2030, thus, overtaking China within the next two decades. The rate of urbanization per annum is 2.4 percent and India's 27.8 percent urban population lives in more than 5,100 towns and over 380 urban agglomerations. On the economic front, India is the second fastest growing economy in the world after China, growing between 7 - 9 percent per annum following liberalization policies and economic reforms in the early 1990s.

Despite the existence of legal rules and regulations such as the Solid Waste Management Rules 2000, constituted under the Environment Protection Act 1986 that direct the ULBs to take stringent measures to manage Municipal Solid Waste in urban areas, the Indian waste management scene continues to be quite miserable. As per estimates (CPCB 2004, FICCI, 2005 and SCUD,2010) Urban India currently produces between 37 - 42 million tons of waste and this figure is expected to touch an shocking 300 million tons given the current spate in the consumption patterns, post economic liberalization which has accelerated the per capita consumption and a higher rate of waste generation in our towns and cities. From a current per capita rate of 490 grams this is expected to touch 945 grams by 2047. However, the waste collection and disposal mechanisms of the Local Government continue to be alarming. Given the current state of affairs it is estimated that only between 30 - 60 percent (UN-Habitat, 2010) of the municipal solid waste generated in Indian cities is actually collected and disposed of by the municipalities.



In terms of waste resource recovery, only a fraction i.e, 7 percent is recycled through composting or WTE (waste to energy) measures and the rest 93 percent inclusive of the recyclable dry waste find its way into the dumping sites where it is then rummaged by the private informal waste collectors. Random and low rate recycling activity takes place largely as an informal sector initiative, estimated to be about 10 - 15 percent of the total recyclable waste going to the landfills. Generation of waste per capita increases 1.33 percent per annum and the quantities of plastic matter are now 70 times higher than in the 1960s. Annual increase in waste generation is estimated around 5 percent. About 5 - 25 percent of the Municipal Corporation budgets are being spent on Solid Waste Management wherein a city of 1 Million spends Rs 10 crore annually (CPCB,2004). More than 90 percent of the solid waste is disposed off indiscriminately in unsanitary and poorly located landfills thus, requiring around 1200 hectare of land every year with an average depth of 3 meters. If the disposal continues in the same pace, it is estimated that by 2,047, 1,400 sq km of land surface would be covered by landfills and dump sites (Technology Review,2010).

In terms of policy and regulation context, management of waste and primarily MSW was considered a mandatory function by the Municipalities under the State specific Municipal Acts. However, some of the first regulatory initiatives especially towards waste management pertain to the government facilitating composting facilities such as in the Fourth Five Year Plan(1969-74) having the provision of grants and loans to State Governments to help set up composting plants. In 1975, the first High Powered Committee for the review of MSW management was constituted. However, it was only after the bubonic plague in Surat City in 1994 that the Government became aware of the seriousness of the situation. Between 1994 - 1999 a series of Committees presented their reports and recommendations. All these efforts culminated into the formulation and passing of the MSW Rules 2000, under the Environment Protection Act of 1984. The rules comprise of four schedules to regulate the MSW practices in Indian cities. The rules were meant to be implemented by December 2003 and then extended to December 2008. However, the Standing Committee on Urban Development (SCUD) constituted in 2009 by the Government of India has highlighted in its report that the MSW Rules have not been implemented till now, largely due to lack of planning, absence of segregation of waste at source, inadequate house-to-house collection, transportation, treatment and disposal, lack of investment and infrastructure facilities. At present there is no tax / tariff on waste management services in most cities and towns. The SCUD (2010) recommends exploring ways and means to levying direct tax for waste management services.

The Model Municipal Law (2003) reinforces the duty of the municipality to manage waste and also creates a provision for levy of charge for provision of services though most municipalities have still to implement the provisions. The Model



Law also makes a provision for enabling private sector participation in delivery of MSW services. Based upon this provision many Municipalities are exploring and implementing the privatized models of MSW service delivery.

3.1 Waste Management Challenges in India

- The challenge posed by poorly managed waste has begun to become evident only in the last decade. Waste management has traditionally and even now typically assigned lower priority than water supply and sanitation. Hence the development of sustainable waste procedures and its implementation is still in an amateur stage.
- There is no reliable national level data on the technical or financial aspects of waste management in India, and figures are therefore approximations though the scale of the problem is quite apparent.
- The MSW Rules 2000, as also other waste related legislation have not been implemented till date in most Municipalities.
- The Municipalities have limited institutional, managerial or financial capacity for undertaking significant improvements in waste management.
- There are also a few examples of the application of technologies such as incineration, pelletization, gasification and bio - methanation but most of these have not found success in their applications largely due to the issues related with the component of waste itself and the adhoc manner in which the technology was transferred in the Indian context without accessing its actual suitability to the contexts (Saxena, Srivastva and Sammadar, 2010). The challenge is of adapting and implementing known technologies to specific local conditions.
- There are grey areas within the complete cycle of waste management starting from source storage and collection to disposal and resource recovery.
- The waste management hierarchy model of sustainable waste management does not appear to hold any significant application in the Indian context and source segregation is rarely practiced except for bricolage purposes where resalable items as newspapers or metal are set aside.
- Traditional and important stakeholder as the Informal Private Sector in waste management is sidelined by the city managers while taking decisions related to waste management.
- The current framework for private sector participation is weak and under developed. Considerable contracting of labour and transportation is occurring in municipal solid waste but there is very limited privatization in treatment and disposal.
- Currently the privatized model of municipal solid waste management is being considered as the 'ultimate' solution but there is hardly any robust study or evidence to suggest its rate of success.


Table 2: India and Australia Waste facts: A Comparative Perspective Comparative

Aspects	India	Australia	Remarks
Urban Population	27.8%	67%	Australia is highly urbanized while India is rapidly urbanizing.
Waste Generation per/capita/day	0.5 kg	5.7 kg	The per capita generation is much higher in Australian context.
Total annual (Urban)	37-42 million tones	43 million tones	The total waste generated in Australia is comparable with India, largely because of a much larger population in Indian context.
MSW	70-75%	29%	The MSW constitutes a much larger percentage in case of India largely due to lower C&D and C&I waste streams as compared to Australia where the waste % from these streams is much higher
Collection rate	30-60%	100%	The collection rates are lower in India largely due to the inability of the municipalities to provide for appropriate collection.
Landfill /dump disposal	93%	40%	Lack of AWT facilities lead to larger amount of waste in landfills in India
Resource recovery	7%	39%	Composting and recycling leads to some resource recovery in Australia whereas in India only 7% is recovered.
Total landfill diversion	7%	60%	Adding the Diversion from C&I and C&D in Australia.
Nature of Landfills	Unsanitary	Sanitary	The cost of constructing and maintaining a sanitary landfill is a big deterrent for India.
Waste Responsibility	Local Government- Municipalities	Local Government Councils	The Local Administration is the responsible body in both countries contexts.
Regulatory Framework	Municipal Solid Waste Rules,2000, Bio medical Rules 2009,etc	National Waste Policy 2009 State level regulations	India has a weak regulatory and implementation framework compared to Australia.
Private Sector participation	Formal and Informal private Sector	Corporate Private Sector; large and small businesses.	The private sector participation framework in waste management is still new and developing in India. In Australia it is well developed.
Private sector participation Challenge	Weak framework and lack of informal private sector integration	Private Sector is well established and integrated into the waste management systems	Adhoc and unstable institutional arrangements and procedures act as barriers to privatized operations in India.
Waste Challenge	All aspects of waste require attention	Increasing landfill diversion and reducing per capita waste generation require attention.	While waste concerns in India are primarily around appropriate management, the Australian context has widened and developed much more to incorporate waste systems in to its carbon pollution reduction scheme that the country hoped to implement from 2012.



3.2 Lessons for India from the Australian Waste Practices

India's dismal waste scene is largely an outcome of lack of education and awareness amongst the community and the poor and faulty design and procedures of waste management made worse by a perpetual and continuing resource crunch in Municipalities

As such, all stages starting from primary storage and segregation, collection and transportation, treatment, disposal and recycling and recovery practices are adversely impacted leading to a surmounting problem with every passing day. The Table 2 draws a comparative analysis of the waste facts and operational measures between India and Australia.

The inferences that can be drawn is that India still needs to go a long way to effectively manage its waste. The procedures and regulations need to be more clearly developed in keeping with the international practices as in Australia while at the same time contextualizing the applications. Some of the significant lessons that emerge for India from the discourse on Australian Waste Management are as follows:

- India still does not have a National Waste Management Policy as in Australia that heralds an efficient, holistic and sensitive approach towards waste management and resource recovery. It's time that India devised a national waste policy based upon contextual issues and requisites in waste management.
- The Australia Waste Management System seeks to reduce and recycle as much waste as possible in line with the waste management hierarchy principle that underpins sustainability in waste management. India needs to consciously adopt and adhere to this principle. While the MSW Rules 2000, were a step in the right direction in terms of managing municipal solid waste, they have not gone too far in achieving the sustainability paradigm and need to be remodeled. An attempt in this direction is already underway with the preparation of the Draft MSW Rules 2013 and Draft MSW Manual 2014 for suggestions from stakeholders.
- Landfill diversion of waste and its pursuit is the agenda in the Australian Waste Management paradigms and these needs to be consciously adopted in India as well, so as to reduce land under landfills and waste dumping. Ultimately most waste should be absorbed back into the use chain and a very small part of residual waste should be land filled.
- Kerb side Domestic Bin Collection Services Systems should be tried at least in places where collection vehicles can reach and positioning of intermediate secondary bins that are the usual place for litter and pilferage should be avoided.



- Instead, transfer stations with sorting facilities should serve as intermediaries and should thereby find place in the Indian Waste Management System as in Australia.
- The selection of technology for waste management should be contextualized to the physical and chemical characteristics of the waste and in this regard the technologies that work in a developed nation as in Australia might not be workable for Indian conditions due to its high organic waste content and low calorific value. In such a scenario, blind application and adoption of western technologies should not be practiced.
- The principles of Product Stewardship and Extended Producer Responsibility are widely incorporated into the Waste Management System in Australia and its time that these principles must be stringently adopted in India to make product producers accountable in waste management operations.
- Appropriate Waste Information Systems and data should be compiled and be readily available to researchers and policy makers, to make them able to design the most suitable operational systems for waste management.
- Enhancing community awareness to make them participate and sensitive towards waste reduction, segregation and littering as in Australia must be practiced.
- Incentive based litter reduction and recycling schemes is another lesson one can learn from the Australian example where for instance, beverage containers that are likely to be littered, a 10 percent refundable deposit is provided on containers returned to approved collection depots.
- Australia, as mentioned has a vibrant private sector involvement in waste management while the principle responsibility lies with the public sector. It may be seen that devising appropriate regulatory frameworks to enable private sector to deliver efficient waste services is a must where ever privatization of services is adopted. The formal private sector needs to be governed and monitored by well developed framework and regulations to enable it to perform efficiently.
- All related stakeholders should be involved in achieving effective and efficient waste management. However unlike Australia which does not have an informal waste sector, the other important stakeholder on the Indian waste management scene, i.e, the informal private sector cannot be sidelined from all three perspectives, social, economic and environmental. In creating long term solutions to waste management, the role and contribution of the informal sector should not be overlooked.

4. CONCLUSIONS

The above discussion has revealed the waste management practices in a developed country, taking the example of Australia. While the dialogue has



highlighted the strength of the Australian Waste Management System, it has also brought to fore the challenges currently encountered in managing its waste effectively, especially the fact of ever increasing waste and the dilemma to reduce waste generation in the light of increasing consumerism, a trait common even to India in the post liberalization times. However, a critical highlight is that waste in Australian context has moved on to being regarded as 'less of waste and more of resource' and therefore the clear focus on its recycling and recovery as in the National Waste Policy 2009. However, in India, this awareness and a positive approach to waste management is still lacking recognition and hardly any suitable interventions to undertake resource recovery from waste are operational. The lessons drawn from the Australian experience provide some thought for debate and directions for setting the ground for suitable, contextualized and viable waste management interventions in India to emerge. While the waste management rules in India pertaining to different waste streams as MSW, hazardous waste, bio - medical waste, etc; were established to guide waste management, their lack of implementation as well as the need to reframe them in the light of emerging global sustainable waste management paradigms has seen them not gaining much ground and application.

Exchange of viable and transferable best practices in waste management between developed and developing countries as India and Australia can help in dissemination of knowledge and explore possibilities of grounded interventions to take shape. The quest of this research paper was to explore and capture such possibilities. However it was also pointed out that contextual caution should be adopted to ensure that the local waste management systems are viable, operational and can actually contribute to the larger goal of sustainable waste management.

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Analysis of Energy Consumption for Personal Transportation System in Jaipur City

Nand Kumar¹, and V. Devadas²



Abstract

Energy is one of the most important parameters, which decides the function of the system. Various authors have done research and established the relationship between energy and transport segment. The urban system in developing country consumes huge quantity of energy for mobility purpose and India is not an exceptional one. In India, public transportation system is not catering the requirement of transportation facilities in the urban system; as a consequence the people use personalized vehicles and intermediate transportation system to the larger extent. These personalized vehicles and intermediate transportation system consume huge quantity of energy compared to public transportation system on one hand, and generate huge quantity of carbon monoxide in air, the authors argue.

1. INTRODUCTION

Accelerated urbanization is experienced in India since the plan era started in the year 1952. The urban population in India is growing at an average rate of around 3 percent per annum and India's urban population is expected to increase 377 million in the year 2011, and 500 million in the year 2021. As per the Census 2011, India has 50 metropolitan cities and of which 8 cities have crossed five million populations and 42.3 percent population is living in the metropolitan cities. The cities are the engines of the economic growth. In India, about 30 percent population lives in the urban system and this population contributes 80 percent of the GDP, and the rest are contributed by the rural system, where more than 70 percent of the population of the country lives. However, the Indian cities do not have adequate infrastructure services in general and transportation infrastructure in particular. The public transportation system never cater the requirement of the people who live in the system, as a consequence, the people were forced to use their personalized mode, such as 2 wheelers, cars and intermediate public transport mode, such as auto-rickshaws, tempos and taxies. The usages of more number of personal vehicles in the urban system would create traffic jams, usages of more quantity of fossil fuels, and in turn it generates more quantity of carbon monoxide, which leads to air pollution in the system, since the transportation infrastructure such as roads, signage's, drainages besides roads, etc., are not developed commensurate with increase in vehicles. The personal transportation system consumed huge quantity of energy and it is increased by 8 percent per annum during the year 1981 to 2005.

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Considering the aforesaid points the authors have collected extensive amount of literature and grouped them in to energy and transportation system, compact city, land use and travel behavior, transportation energy and emission and renewable energy and transportation and reviewed the literature, and presented subsequently. The authors conducted surveys in 684 households pertaining to energy consumption in transportation sector in Jaipur city and analyzed. Thereafter, multiple regressions technique was employed by considering energy consumption for personal transportation segment as dependent variable Y , and its associated variables as independent variables X_i . The results of the review of literature, data analysis and the multiple regression analysis are presented in the sequel.

2. ENERGY CONSUMPTION FOR TRANSPORTATION SYSTEM

In this present investigation, as earlier said the literature collected pertain to energy consumption in transportation sector is grouped into the following segments including energy and transportation system, compact city, land use and travel behavior, transport energy and emission, renewable energy and transport; reviewed thoroughly and the findings are presented in the sequel. They are discussed below.

2.1 Energy and Transportation System

Transportation subsystem functions as a catalyst for the development of the nation. If a nation has good transportation network with efficient transportation system, the country's economic growth would be phenomenal, since it is purely used for resource mobilization, and without resource mobilization it is not possible to achieve economic growth and development. In India, globalization and liberalization policies of the government in the year 1990-91 have increased the number of vehicles on road about 92.6 percent from 1980-81 to 2003-2004. Transportation demand in India would increase due to various factors, which include population explosion; steady economic growth; increase in employment opportunities, employment rate, standard of living, ownership of private vehicles and urbanization; modern social life with higher material dependence; inequalities in production, consumption of more goods and services, distribution of national resources; etc. In India, transport demand is increasing day by day on one hand, and the cities are facing acute transportation crisis due to population explosion, pollution, accidents, using obsolete transport infrastructure, rampant suburban sprawl, rising number of vehicles, deteriorating public transport services, inadequate roadways, scanty land use transport planning, etc., on the other. In India, the vehicular population has increased nine fold between 1980 and 2000, and some other reference reveal that it has increased from 5.362 to 81.5 million, i.e., about 15 times between 1981- 2005. The passenger traffic in India has increased at the rate of 7.75 percent during last two decades, and it is expected to increase at the rate of 6.72 percent per year during next two



decades, of which the share of road transportation would be 91.7 percent and the rest by rail of the total land based transportation.

Energy demand in transportation segment increases due to various factors, which include adoption of technology; socio - economic parameters, such as demographic pattern, population density, household structure, urban form (density), infrastructure, mode of transportation (mass transit), public transport, private vehicle, education, employment, income, fuel price, residential neighborhood, urban structure, location of jobs, form of urbanization, efficient land use planning, car ownership, etc. Further, it is also observed that transportation energy consumption is the function of density of population, functional mix, transit accessibility, parking management and walk-able distance of travelling.

Transportation segment consumes various sources of energy, which includes coal, diesel, petroleum and electricity. In India, transport energy accounted for 22 percent of total commercial energy consumption in the year 1996-1997, of which road and rail transportation consumed 81.3 percent and 15.4 percent respectively, whereas in passenger traffic road and rail transportation had the share of 77.8 and 21 percent respectively in the same period. In India, transport sector consumed about 17 percent (36.5 Mtoe) of the country's total energy 217 Mtoe consumption in the year 2005-2006, and it was increased to 595 (Mtoe) of energy in the year 2007. Indian railways consume 5.1 percent of total transport energy, of which 77.50 percent from diesel and the rest was obtained from electricity. Buses carry over 40 percent of public transport in Indian cities, and it is accounted for only 1.1 percent of the total Indian motorized vehicles (2002). As per the Ministry of Road Transport and Highways - 2003, public transport serves 80 percent in Kolkata, 60 percent in Mumbai, 42 percent in Chennai and Delhi cities, respectively. The parameters, which include the distance of vehicle travel, mode of travel, quality of the vehicle, congestion on road and the road quality are very much responsible for increase in energy requirement on road transportation. It is also observed that uses of private cars have higher energy intensity, whereas the rail transportation has the lowest energy intensity in passenger's transportation system.

Transportation segment has both spread and backwash effects in the society. The spread effects can be addressed in terms of resource mobilization and economic development, whereas the backwash effects can be expressed in terms of traffic congestion, accidents, noise and air pollution in the system. The backwash effect is also observed in import of fossil fuel to cater the demand of transportation segment, which drain India's exchequer since more quantity of fossil fuel is imported from abroad every year, and it causes adverse effects in Indian economy.



As already stated, transportation functions as the catalyst for economic development, and without it resource mobilization is halted. Transportation growth has direct link with economic growth of the nation. Population growth and economic growth are much responsible for many fold increase in transportation in Delhi and Mumbai city. Ownerships of cars and 2 - wheelers would increase 7 times in Delhi city and 5 times in Mumbai city in the year 2020, due to increase in population and economic growth. Passengers transport would increase in Delhi about 40 percent to 48 percent between 1997 and 2020. It has been observed that there is a strong correlation between economic growth and transportation energy demand in Delhi city, and in high Gross Domestic Product (GDP) growth rate scenarios, the transport system demands 1.7 times more quantity of energy in 2020 than the business as usual scenario between 1997 and 2020, whereas in the low growth rate GDP scenario, there would be drastic reduction in energy demand in the same period, i.e., about 72 million GJ against 137 million GJ in Business as Usual (BAU) scenario, which proves that transportation growth has direct link with economic growth. Further, it has been observed that in New Delhi city, 50 percent of travel is done by the public transportation system, whereas more than 40 percent of trips are done less than 5 km distance. This study suggested to undertake few important measures to control the vehicular population in Delhi city, which include promotion of mixed land use; promotion of non-motorized mode; promotion of lower commuting distance; reduction in numbers of trips; maximum use of public transport; introduction of affordable public transit for lower income group; develop the avenues for pedestrian and bicycle movements; and introduction of strict measures for protecting the energy conservation measures in the system, whereas, another study recommended to introduce Mass Rapid Transport System (MRTS), CNG based powered vehicles and Battery Powered Vehicles in the system to have energy conservation in the transport segment of Delhi city.

The following parameters, such as socio - economic factors, household income and fuel price are more or less responsible for travel pattern and travel behavior. More population density in the city has negative correlation in transport energy consumption since the population is jam packed where public transportation system is very much economical because they promote higher level accessibility, which leads to less quantity of per capita energy used in transportation system, whereas the dispersed population based city requires more quantity of transport energy for its survival, since it has more number of private car ownership. Further, in the dispersed populated city, public transportation is uneconomical since the population is scattered over the city and longer distance of travel is also required to cater the services of the entire population. It is also found that the per capita consumption of transport energy is much higher in the smaller cities compared to the big cities, since the population density is much lesser in these cities, and very less amount of population would prefer the public transportation system



compared to the thickly populated bigger cities. The high density cities are also facing transportation related challenges in many ways, which include very low road capacity, pollution, inadequate space for car and bus parking, etc.

2.2 Compact City

Various authors have studied the compact city concept and its association with energy consumption and published literature and observed that urban design reflected in population functions, jobs densities, and emerged as the most significant control parameter of travel pattern in cities around the world. Compact city promotes high density of population with mixed land use. Land use pattern, density of population, occupancy size, etc., determine journey to work, fuel consumption and living condition. Further, mixed land use, transit oriented development with efficient land use approach, pedestrian network system, etc., reduce energy consumption drastically in the compact cities. In compact city, higher urban density is observed, and thereby consumption of transport energy is very less compared to other cities since travel distance is very less, which resulted into reduction in polluted emission in the system. High density and mixed land use policy are the possible tools for reducing automobile dependence in the urban system, whereas, in contrast, the denser cities slow down the average traffic, which result into more frequent "stop- and- go" driving pattern and thus consuming more quantity of fuel for little distance of travel. Further, high density urban structure is more or less responsible for increase in purchase of small cars due to parking problems; and fuel consumption in small cars are very less, and thereby reduction in fuel consumption is observed, but accumulation of more and more number of small cars in the absence of efficient public transportation system (bus service) increasing the fuel requirements, since most of the small cars are used by the owner alone for personal purposes, which would not only increase the number of personal vehicles but also increase the consumption of higher quantity of energy (fossil fuel) in the system.

2.3 Land Use and Travel Behavior

Literatures pertain to land use and travel behaviors have been collected, and analyzed thoroughly and it is observed that the parameters, which include the land use policies of the Government and the local administration; effect of physical characteristics of urban forms; land use; socio - economic condition; increase in population density in the system, etc., change the travel behavior of the population of the system. Further, it is argued that the cities having higher density of population consume less quantity of transport energy compared to the city has less density of population with dispersed characteristics. When more number of population use the same vehicle (public transport like bus or mass transit system) per capita energy consumption turned into very less quantity. Therefore, negative correlation relationship is observed between residential density and transport energy consumption in the thickly populated cities. Further, Government policies



pertain to land use alters the automobile dependency of the cities. The city, which has mixed land use consume less quantity of transport energy, whereas, if the city has sector-wise developmental pattern, then it would consume more quantity of transport energy for its survival, since the travel demand of the population is increased in these cities. Further, it is observed that the cities, which are developed based on neighborhood design, consume less quantity of transport energy. Automobile dependency is also associated with socio - economic condition, wealth, climate, space; edge of the cities, health and social problems, lifestyles, people's aspiration, individual's attitudes and preferences, residential location, road lobbies, land developers, traffic engineering, urban planning, etc. The availability of physical infrastructure, spatial and non-spatial factors, micro climate conditions, etc., is also directly having heavy bearing on transport energy consumption. Therefore, comprehensive and integrated planning at the local level are recommended for sustainable development of cities, and this comprehensive and integrated planning should have the components of land use, households, human resource and its scale, transportation, commercial forms, energy, etc. Locally available control parameters, which decide the functions of the system, should be considered while evolving comprehensive plan, since these parameters would alter the functions of the system including the transport energy consumption.

Land use policy of the city influence household energy consumption, and neighborhood concept based developed cities conserve more energy by self-containment. Neighborhood concept based developed cities have many urban qualities, including walk-ability, viable public transport, jobs access and other urban amenities, which reduce car dependencies. Further, obesity level, stress level, and children's mental health development have been linked to automobile dependency.

2.4 Transport Energy and Emission

The transportation demand would increase the energy requirement in transportation segment, which further causes more CO₂ emissions in the system. Energy consumption and CO₂ emission in transport sector is influenced by urban development policies, land use and public transport organization. In India the vehicular population has increased from 5.362 to 81.5 million, i.e., about 15 times between 1981- 2005. The increase in vehicles on roads in India is not commensurate with increase in road width and road length. As a consequence, the roads (except the four and more lanes roads) are facing numerous amount of problems, which include congestion, traffic accidents, public health deterioration, sharp increase in CO₂ emission in the system, etc. Further, the transport sector has been consuming various sources of energy including coal, diesel, petroleum and electricity and consumed about 17 percent (36.5 Mtoe) of the country's energy (217 Mtoe) consumption in the year 2005-06. Whereas, in the year 2007,



it consumed 595 Mtoe energy, and released CO₂ emission equal to 132 Mtoe, ranking India the 5th major greenhouse gas emission country of the world.

The level of traffic mobility, energy demand and CO₂ emission on land transportation was projected in India up to 2020-2021, and observed that the passenger traffic in India would increase at the rate of 6.72 percent per year during the next two decades. Of the land based transportation, 91.7 percent would be on road and rest by rail. Energy demand in passenger transport sector is expected to increase at the rate of more than 8 percent per annum from 1060.8 PJ in 2000-2001 to 5584.4 PJ in 2020-2021. Similarly, the per capita energy consumption is expected to rise by the factor of 4 from 1041 MJ in 2000-2001 to 4201 MJ in 2020-2021. As a consequence, the CO₂ emission would increase from 19.80 to 93.25 million of carbon equivalents (Mtce) between 2000-2001 and 2020-2021.

In India, globalization and liberalization of economic policies of the government in 1990's have increased the number of road vehicles about 92.6 percent from 1980-81 to 2003-2004. As a consequence, the transport sector emitted 258.10 Tg of CO₂, of which road transport contributed 94.5 percent. Emission load from road transport are quantified based on number of vehicles and distance travelled in a year by different types of vehicles. The total CO₂ emission from road transport in the year 2003-2004 is approximately 3.2 times more than the year 2000. Among all the States and Union Territories of India, Maharashtra stood first in road transport emission, i.e., 28.85 Tg (11.8 percent) of CO₂, followed by Tamil Nadu 26.41 Tg (10.8 percent), Gujarat 23.31 Tg (9.6 percent), Uttar Pradesh 17.42 Tg (7.1 percent), Rajasthan 15.17 Tg (6.2 percent) and, Karnataka 15.09 Tg (6.19 percent). These six States account for 51.8 percent of the CO₂ emissions from road transport.

Energy consumption in public transportation requires less amount of energy compared to private car based transportation system. It has been observed that bus dominated transit system conserved 31 percent in energy use, while the metro rail dominated transit system it would conserve 61 percent. The rail-based public transportation systems achieve a much more quantity of energy conservation than the bus based system owing to its lower energy intensity. However, the electric powered transport systems would decrease emissions from passenger transport.

Provision of clean, affordable and reliable energy represents one of the greatest challenges of sustainable development. Adoption of plausible sustainable transportation system would bring sustainable development in the system, and sustainable transportation requires various measures including improving the efficiency of the vehicles, such as engine's performance; fuel type and quality; introducing low pollution fuels; adoption of environmental regulations; and improving the quality of road infrastructure and public transport.



2.5 Renewable Energy and Transport

Application of renewable energy in transport sector is the viable option, which would reduce consumption of fossil fuel and also reduce polluted emissions in the system. The renewable sources of energy including biodiesel, methanol, ethanol, hydrogen, electric vehicles, and natural gas are the best preferred option in this regard. Application of methanol reduces 60 percent emission compared to petrol. Biodiesel has strong impact on greenhouse gas mitigation since no fossil CO₂ is burned. Natural gas powered vehicles (CNG) reduce 15 - 20 percent greenhouse gas emission. Few countries like Brazil, Canada and New Zealand use bio - diesel and bio - ethanol as an alternative fuel for transportation; of which Brazil use much bio - ethanol energy in its transportation system.

3. STUDY AREA AND RESEARCH METHODOLOGY

Jaipur city has been chosen for conducting the present investigation. It lies in an altitude of 431 m (above MSL) and at 26.92°N latitude & 75.82°E longitude. This city has Jaipur Development Authority for looking after the development administration. The geographical area of the Jaipur Development Authority (JDA) region is approximately 1464 square km. It has a population of 3,073,350 as of 2011, whereas the Population of the Jaipur Metropolitan area is 3,646,590. Different religion groups are living together in the city including the Hindu population accounts for 77 percent, Muslim 17 percent, Jains 4 percent, Christians 0.5 percent, and Sikh 0.5 percent. The overall literacy rate of the district is 76.44 percent, and the sex ratio is 898 females per 1,000 males. It is a center for both traditional and modern industries. It is a very famous city, since it exports larger size of gold, diamond and stone jewelry in Asia, and is the only city finishing blue diamond or tanzanite in the world. It is characterized by high temperature, low rain fall and mild winter, since it is located in the semi-arid zone of India. It consumed 936 MW of electrical energy in year 2011-12, and it is projected as 7579 MW for the year 2029-30. The maximum traffic in Jaipur city consist of two wheelers (74 percent) and four wheelers (13 percent) with a very small number of public transport vehicles including buses, hired vehicles like taxi and Auto Rickshaw. The number of vehicular population has increased from 81258 in 1980-81 to 16.95 lakh in the year 2010-11, average growth rate of about 10.19 percent in the last decade.

Survey research methodology has been employed to quantify the energy consumption for personal transportation in the study area, Jaipur city. This city is divided into 72 wards for development administration, of which, there are 24 wards selected for conducting the investigation. It is observed that some wards are having larger number of households, whereas some wards are having lesser number of households. There are 684 household chosen for conducting the investigation by employing random sampling technique. Thereafter, household



survey schedule was developed pertaining to; energy consumption for personal transportation pretested the schedule in the chosen wards; modified the schedules according to the requirement; and subsequently, the survey was conducted among the sampled households by the investigator himself. The collected data are processed by employing SPSS software, analyzed thoroughly by considering energy consumption for personal transportation as dependent variable 'y' and the associated energy related variables as independent variables 'XS'. Thereafter, multiple regression model is developed by considering the aforesaid y and x variables and the results are analyzed thoroughly and presented. The most important variables, which have direct bearing in the system pertain to energy consumption for personal transportation are analyzed and presented. The tabulation analysis, and regression analysis are presented as below, and are:

4. ANALYSIS OF RESULTS

In tabulation analysis, the more important variables, which have direct association with energy consumption for personal transportation segment are analyzed and presented in the sequel.

4.1 Population and Household Size

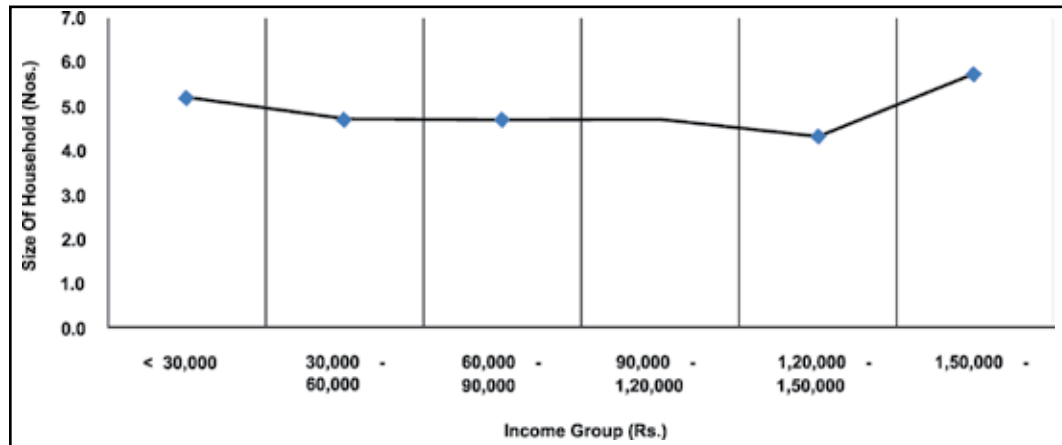
Population is the one of the most important parameters, which decides the functions of the system. The considerable growth of the population in the city is more or less responsible for all kinds of socio - economic evils, which prevail in the cities including schisms, unemployment, underemployment, disguised unemployment, poverty, malnutrition, increase in crime rate, scarcity of resources, scarcity of infrastructure services, congestion, and so on. Having this in mind, the population of the city at the household level has been considered as one of the parameters in the survey schedule, conducted the investigation among the chosen samples at the grass roots level, analyzed along with various income groups, and the results are presented in Table 1 and in Fig. 1. It can be observed that more than two-fifth (40.60 percent) of the population is confined among the lowest income group of the classification, i.e., the monthly income group of Rs. < 30,000 of the total population, and the available number of population is decreasing along with increase in income groups. It is also observed that more than two-third (70.69 percent) of the total population of the surveyed households are confined within the monthly income range

Table 1: Population and Household Size

S. No.	Income -group (Rs.)	Total Population		Size of Household
		Nos.	Per cent	Nos.
1	< 30,000	1367	40.60	5.2
2	30,000 - 60,000	1013	30.09	4.7
3	60,000 - 90,000	470	13.96	4.7
4	90,000 - 1,20,000	260	7.72	4.7
5	1,20,000 - 1,50,000	130	3.86	4.3
6	> 1,50,000	127	3.77	5.8
	Total	3367	100.00	4.9



Fig. 1: Population and Household Size



of upto Rs. 60,000, which is also almost tallying with the number of households confined in this group. Further, the size of household (persons in household) is decreasing along with increase in monthly income group of upto Rs. 1, 50,000, and then the trend get reversed, which indicate that the highest income category people produce more number of population compared to the rest of the income groups. The average population per household is working as 4.9, whereas the highest income category groups have the average household size of 5.8. The least income group of category, i.e., monthly income group of Rs. < 30,000 has 5.2 as average size of household, and the other monthly income groups categories have less than the average size of households, i.e., 4.9.

4.2 Personal Vehicles

Owning number of personal vehicles at the household level is considered one of the parameters, since it decides the function of system. The higher income group people mostly have four-wheelers at their household level and the middle income group people have two-wheelers. The low income group people use to have bicycle at their households for their day to day transportation purposes. Further, having own vehicles making the people free in mobility since the available public transportation system is in a pathetic situation in the system (study area) compared to the public transportation system available in the developed countries. The higher income group people used to possess four-wheeler and two-wheeler vehicles at the household level for using different purposes based on the requirement. Having this in the mind, owning number of personal vehicles has been considered as one of the parameters in the survey schedules, conducted survey at the grass roots level, analyzed by grouping the vehicles into six different groups including bicycle, two-wheeler petrol, two-wheeler petrol, four-wheeler diesel and four-wheeler gas, their respective values are considered along with different income groups, and the results are presented in Fig. 2 and the per capita availability of aforesaid six group of vehicles along

Fig. 2: Personal Vehicles

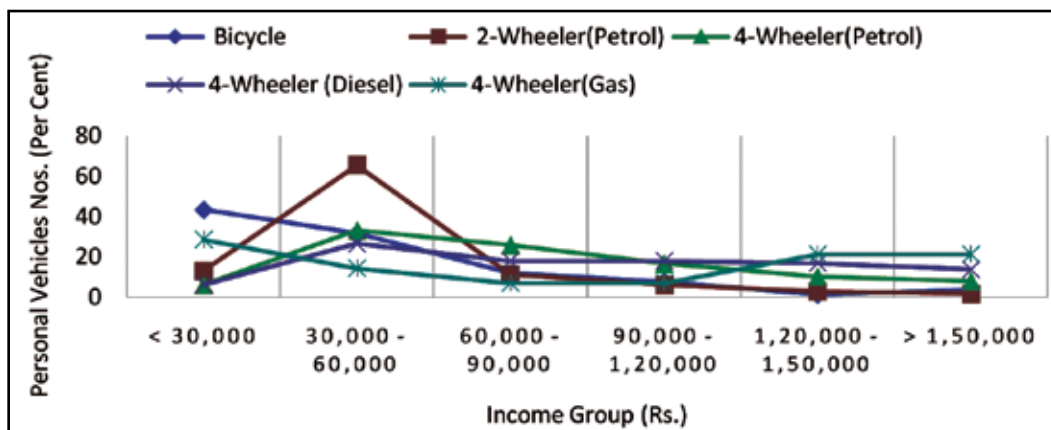
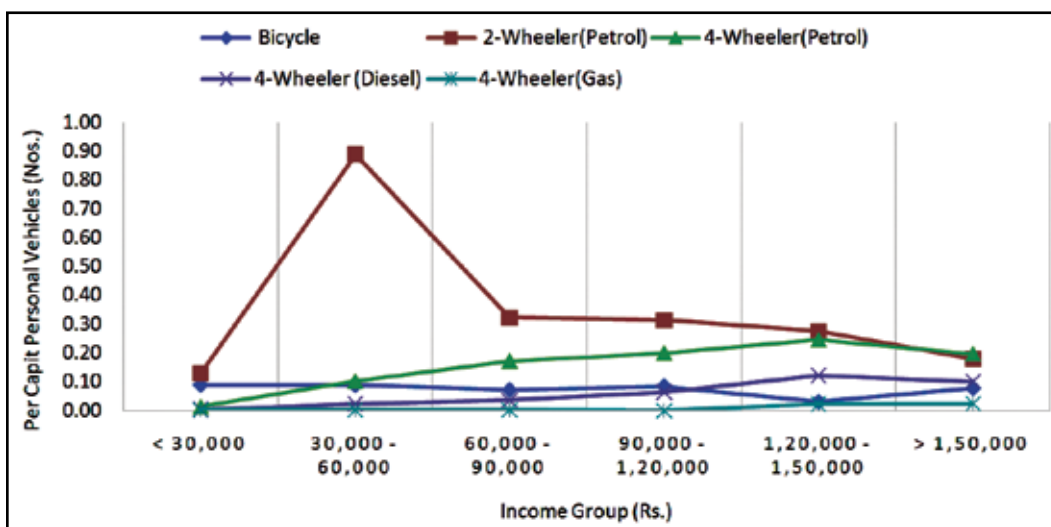


Fig. 3: Per Capita Personal Vehicles



with their respective income group are presented in Fig. 3. These figures reveal that two wheeler are very much dominated in the system and its contribution is about two-third (66.14 percent) of the total vehicles available among the surveyed households. Followed by, the share of four-wheeler (petrol) is about one-seventh (15.08 percent), share of bicycle is more than one-tenth (13.62 percent), share of four-wheeler diesel is very meager (4.53 percent) and the rest (0.63 percent) are four-wheeler gas. The availability of bicycle is decreasing along with increase in monthly income group of up to Rs. 1,50,000, and then observe the reverse trend. In the bicycle segment, it is observed that about half (43.46 percent) of the bicycle available in the system are confined within the monthly income group of < Rs. 30,000, which shows that bicycle is the common man's vehicle. Further, it is observed that bicycle and two-wheeler petrol, are the common vehicles irrespective of all income groups. The per capita analysis



show (Fig. 3) that the higher income group persons possess more number of four-wheeler vehicles compared to the lower income group persons, and the middle income group person almost possess one two-wheeler vehicles each, i.e., 0.89 two-wheeler vehicle per capita. It is deduced from these figures that the higher income group have more number of four-wheelers and two-wheeler, whereas, the lower income group people have mainly bicycle and the middle income group have more number of two-wheelers for their mobility in the system.

4.3 Distance Travelled by Using Personal Vehicles

Distance travelled by using personal vehicles is one of the parameters considered in this investigation since the higher income group people travel long distance by using their own personal vehicles, though the expenditure is much higher for using the personal vehicles compared to the public transportation system. Using

Fig. 4: Distance Travelled by using Personal Vehicles

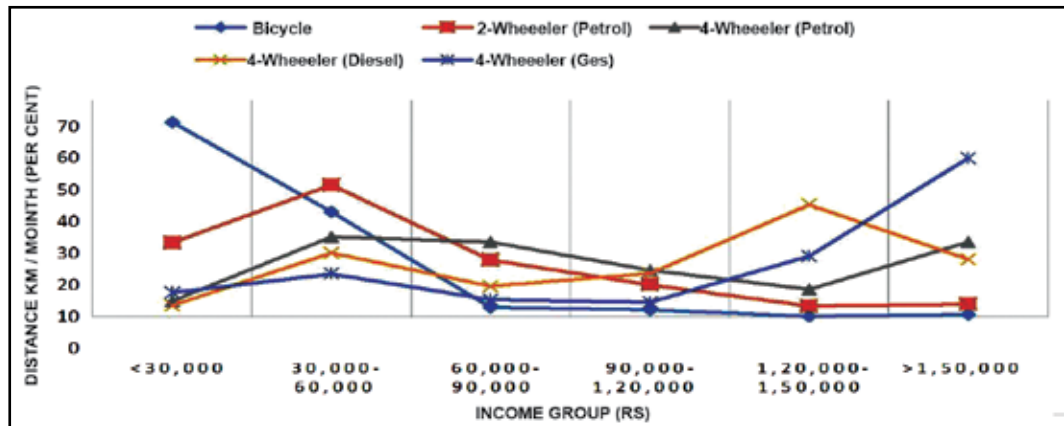
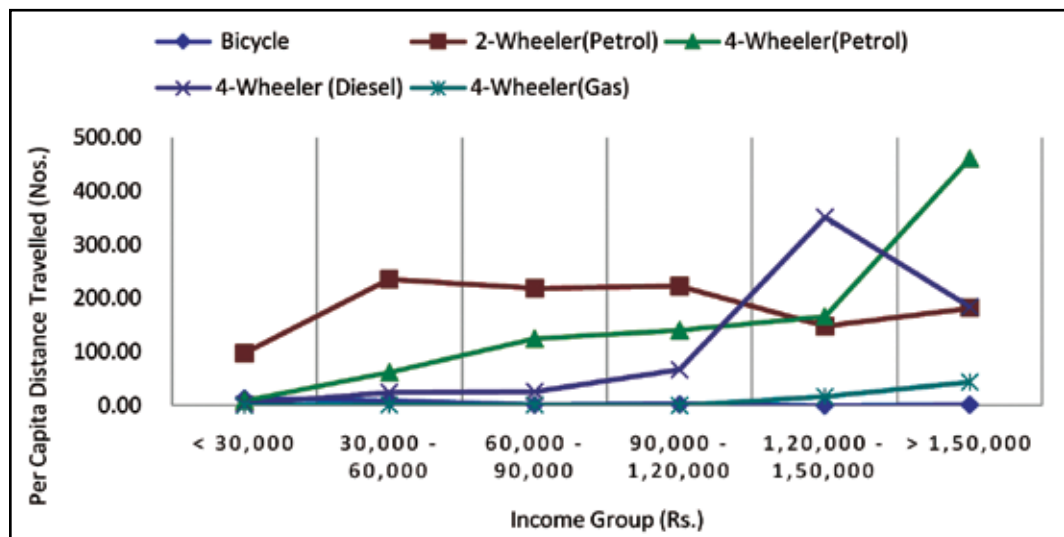


Fig. 5: Per Capita Distance Travelled by using Personal Vehicles (km/month)





personal transportation for long distance can be afforded by only the higher income group people, but not by the lower income group people. Having this in mind, the investigator has considered the distance travelled by using personal vehicles as one of the parameters in the survey schedule, conducted investigation, analyzed thoroughly for different vehicles including bicycle, two-wheeler petrol, two-wheeler battery, four-wheeler (petrol) and four-wheeler gas, the values are considered along with income groups, and the results are presented in Fig. 4 and 5 based on distance of travel done by household and the distance of travel made by per capita basis, respectively. The Fig. 4 illustrates that uses of two-wheeler occupies the highest priority in distance, i.e., about three-fifth (57.86 percent), of the total distance. Followed by one-fourth (25.07 percent) of the distance covered by the four-wheeler petrol, and about more than one-eighth (13.01 percent) of the distance covered by four-wheeler diesel and the rest are almost evenly distributed among bicycle, two-wheeler battery and four-wheeler gas. In income group analysis, it has been observed that the distance travelled by almost all vehicles are increasing along with monthly income group of up to Rs. 60,000, and then the reverse trend occurs, whereas distance travelled by bicycle is decreasing along with increase in income. In per capita distance travel analysis (Fig. 5) by using personal vehicles, it is observed that except four-wheeler (diesel), the distance travelled by using personal vehicles is increasing along with increase in income. In fact, the higher income group people use more quantity of diesel powered four-wheeler vehicles. It is deduced from these figures that the higher income people use four-wheeler motor powered vehicles to the larger extent for their day to day activities, whereas middle income group people use more two-wheelers.

4.4 Fuel Consumption for Personal Vehicles

In the study area, different kinds of the vehicles are used for transportation purposes and these vehicles use different sources of energy including petrol, diesel and gas. As already stated the lower and middle income group people use more number of two-wheelers and two-wheelers consume petrol, whereas the other income group people use four-wheeler petrol, four-wheeler diesel and four-wheeler gas for their day to day activities. Having this in mind, the investigator considered the sources of energy consumption for personal vehicles used in the system as one of the parameters in the survey schedule, conducted the investigation at the grass roots level among the sampled households, analyzed it properly along with various income groups and the results are presented in Fig. 6 and 7, respectively. The investigator converted all sources of the energy into kJ since the values of petrol, diesel and the gas are different. It has been observed that more than two-fifth (40.14 percent) of energy are consumed by the two-wheeler petrol. Followed by about two-fifth (37.06 percent) of energy are consumed by four-wheeler petrol, about one-fifth (19.22 percent) are consumed by four-wheeler diesel and the rest 3.56 percent are consumed by four-wheeler



Fig. 6: Fuel Consumption on Personal Vehicles

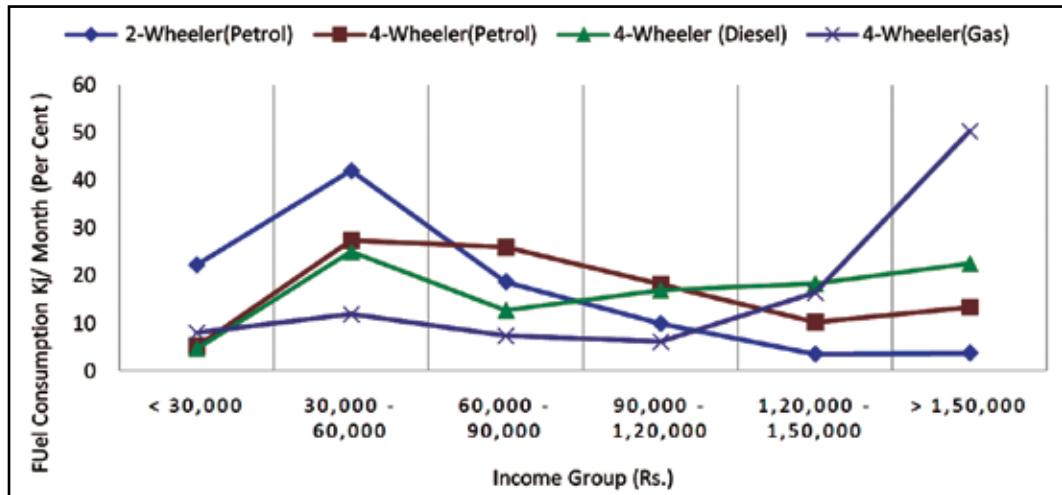
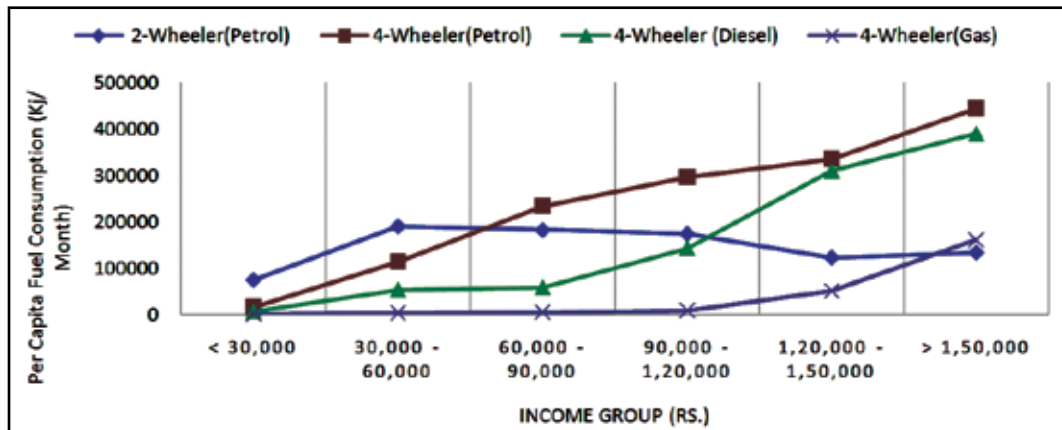


Fig. 7: Per Capita Fuel Consumption for Personal Vehicles (kJ/ month)



gas. In income group analysis, it has been observed that energy consumption done by all kinds of vehicles including two-wheeler petrol, four-wheeler petrol, four-wheeler diesel and four-wheeler gas are used along with increase in income up to Rs. 60,000 per month, and then observe the reverse trend. Whereas in per capita analysis, (Fig. 7) it has been observed that energy consumption done by four-wheeler petrol, four-wheeler diesel and four-wheeler gas are increasing along with increase in income from the lowest income group to the higher income group, i.e., income group of Rs. < 30,000 to 1,50,000 and above per month. In two-wheeler petrol, the per capita energy consumption is increasing up to the income group of Rs. 60,000, and then observe the reverse trend, which shows that income increases the people are using four-wheelers to the maximum extent in the system and their energy consumption is much phenomenal, this observation also further, supported by the data presented in the same figure that the per capita



energy consumption made by the two-wheeler petrol, four-wheeler (petrol) four-wheeler (diesel) are increase considerably from the lowest income group to the higher income group, i.e., 1.79 fold, 28 fold, 52 fold and 68 fold respectively, which depicts that higher income group people use more number of four-wheeler and their energy consumption is much higher compared to two-wheelers.

4.5 Multiple Regression Analysis

A multiple regression model was developed for understanding the impact of energy consumption for personal transportation in the system. In this model, energy consumption is considered as dependent variable (Y), and the following variables, such as household income (x_1), numbers of 2 - wheeler petrol vehicles (x_2), distance travelled by 2 - wheeler petrol vehicles (x_3), numbers of 4 - wheeler petrol vehicles (x_4), distance travelled by 4 - wheeler petrol vehicles (x_5), numbers of 4 - wheeler diesel vehicles (x_6), distance travelled by 4 - wheeler diesel vehicles (x_7), numbers of 4 - wheeler gas vehicles (x_8), distance travelled by 4 - wheeler gas vehicles (x_9), are considered as independent variables. The model equation and the results of the model are presented below. The model results that the adjusted R² value is 0.803, which shows that 80.3 percent variation in energy consumption for personal transportation are explained by these explanatory variables in the model.

$$Y = (29.524 \times x_1) + (-13937.445 \times x_1) + (2633.756 \times x_3) + (2112483.105 \times x_4 + (1824.574 \times x_5) + (8760549.628 \times x_6) + (969.918 \times x_7) + (-2549638.284 \times x_8) + (7378.652 \times x_9) - 605600.878$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.897 ^a	.805	.803	3642626.75435

- vehicles (x_2), distance travelled by 2 - wheeler petrol vehicles (x_3), numbers of 4 - wheeler petrol vehicles (x_4), distance travelled by 4 - wheeler petrol vehicles (x_5), numbers of 4 - wheeler diesel vehicles (x_6), distance travelled by 4 - wheeler diesel vehicles (x_7), numbers of 4 - wheeler gas vehicles (x_8), distance travelled by 4 - wheeler gas vehicles (x_9)
- Dependent Variable: Energy consumption for personal transportation

Anova^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	36855571563261832.000	9	4095063507029092.500	308.625	.000b
	Residual	8916586339272632.000	672	13268729671536.654		
	Total	45772157902534456.000	681			



- Predictors: (Constant), household income (x_1), numbers of 2 - wheeler petrol vehicles (x_2), distance travelled by 2 - wheeler petrol vehicles (x_3), numbers of 4 - wheeler petrol vehicles (x_4), distance travelled by 4 - wheeler petrol vehicles (x_5), numbers of 4 - wheeler diesel vehicles (x_6), distance travelled by 4 - wheeler diesel vehicles (x_7), numbers of 4 - wheeler gas vehicles (x_8), distance travelled by 4 - wheeler gas vehicles (x_9)

Model	Coefficients a			t	Sig.
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error			
(Constant)	-605600.878	242340.23	Beta	-2.499	0.013
Household income (Rs.)	29.524	4.448	0.171	6.637	0
Personal 2 - wheeler petrol (Nos.)	-13937.445	6113.689	-0.039	-2.28	0.023
Distance travelled by using personal 2-wheeler petrol (k m.)	2633.756	158.56	0.294	16.61	0
Personal 4 - wheeler petrol (Nos.)	2112483.105	294310.25	0.155	7.178	0
Distance travelled by personal 4 - wheeler petrol (k m.)	1824.574	92.593	0.36	19.705	0
Personal 4 - wheeler diesel (Nos.)	8760549.628	459319.81	0.41	19.073	0
Distance travelled by using 4 - wheeler diesel (k m.)	969.918	129.238	0.148	7.505	0
Personal 4 - wheeler gas (Nos.)	-2549638.28	1392776.8	-0.047	-1.831	0.068
Distance travelled by personal using 4-wheeler (k m.)	7378.652	1126.521	0.182	6.55	0

- Dependent Variable: energy consumption for personal transportation

It has been observed from the ANOVA Table above that, the $F(9, 681) = 308.625$ and the p value is less than 0.001, which shows significant, since the p value is < 0.05 , i.e., in this model it is < 0.001 . As the F is large, it is determined that regression model is a good fit of the system data. Further, the variables, such as household Income (x_1), distance travelled by 2 - wheeler petrol vehicles (x_3), numbers of 4 - wheeler petrol vehicles (x_4), distance travelled by 4 - wheeler petrol vehicles (x_5), numbers of 4 - wheeler diesel vehicles (x_6), distance travelled by 4 - wheeler diesel vehicles (x_7), numbers of 4 - wheeler gas vehicles (x_8), distance travelled by 4 - wheeler gas vehicles (x_9), are having the respective coefficients are positive and p value was observed as $p < 0.05$, which denotes that these variables are statistically significant in the model. For example, if all the variables household income are constant, then the energy consumption for personal transportation would increase by 29.524 kJ/year. With similar assumption, if effects of all other variables are held constant, then the energy consumption for personal transportation would increase as follows: 2633.756 kJ/year for one km of increase in distance travelled by 2 wheeler petrol vehicles; 2112483.105 kJ/year for one unit of increase in 4 wheeler petrol vehicles; 1824.574 kJ/year for one km of increase in distance travelled by 4 wheeler petrol vehicles; 8760549.628 kJ/year for one unit of increase in 4 wheeler diesel vehicles; 969.918 kJ/year for



one km of increase in distance travelled by 4 wheeler diesel vehicles; 7378.652 kJ/year for one km of increase in distance travelled by 4 wheeler gas vehicles. The number of 2 wheeler petrol vehicles exhibited negative relationship with the energy consumption for personal transportation. Therefore, energy consumption for personal transportation would decrease by 13937.445 kJ/year for one unit of increase in 2 wheeler petrol vehicles.

5. RESULTS AND DISCUSSION

Major findings arrived from the literature review, survey data analysis, and the multiple regression model are considered for discussion.

In community management, it is observed that transportation is strongly affected by small reduction in auto-mobile acquisition. Transportation management along with land use planning lead to major reduction in energy consumption and CO₂ reduction.

Transportation, subsystem functions as a catalyst for development. Transportation in India is increasing along with increase in economic growth, and development, increase in standard of living, increase in ownership of private vehicles in the urban system, etc. The vehicular population growth has increased 9.4 percent between the year 1980 and 2000, and thereby energy consumption in transportation is also increased, considerably.

Transportation energy consumption is the function of density of population, functional mix, transit accessibility, parking management and walkable travelling distance. The following parameters, such as increase in distance of travel, mode of travel, quantity of vehicles, congestion on road, and the road quality are much responsible for increase in energy consumption in road transportation.

The factors, such as socio - economic condition, household income, and the fuel price are responsible for travel pattern and travel behavior. The public transportation system is very much economical since it carries more number of people with less amount of energy consumption compared to using private cars.

Compact city promotes high density of population with mixed land use, as a consequence, the travel distance requirement of the people decreased, which resulted into less quantity of energy consumption in transportation segment. Further, the city, which is developed with mix land use, consume less quantity of transportation energy compared to the city has sector-wise development pattern, since the travel demand of the inmates of the city has increased in the sector-wise developed cities. Similar findings were also observed among the neighborhood design based developed cities, where the travel demand is very less compared to the sector-wise developed cities.



Energy consumption and CO₂ emission in transport sector is influenced by the Government policies, land use pattern and the public transportation system in the cities. Besides these, adoption of appropriate technology in the vehicles play a major role in energy consumption, and application of advance technology in transportation system resulted into reduction in energy consumption and thereby reduction in CO₂ emission.

Application of multi-objective optimization technique resulted in to the reductionist policy centric approach to complex energy-economic modeling facilitated by the dynamic programming methodology is most suitable for arriving at optimal policy in the context of the developing countries. Few more models, which include goal programming technique based model, multiple regression model, variable intercept and constant coefficient model, variable coefficient model, etc., were employed for understanding the travel and optimum resource allocation in different parts of the world and observed that there is an association between urbanization and energy consumption, economic development, population growth, and urban transportation. Further, it is observed that the following parameters, such as increase in population growth, urbanization, urban ecological development, fragmentation of urban land use pattern and increase in travel distance are responsible for increase in energy consumption in the urban system. Application of energy efficient managerial system at the micro and macro level in energy production, energy distribution and energy consumption would pay the way for energy conservation in all segments, which include physical, social, economics, infrastructure and institutional sub systems.

The average population per household is working as 4.9, whereas the highest income category groups have the average household size of 5.8. The least income group of category, i.e., monthly income group of Rs. < 30,000 has 5.2 as average size of household, and the other monthly income groups categories have less than the average size of households, i.e., 4.9.

The higher income group have more number of four-wheelers, two-wheeler, whereas, the lower income group people have mainly bicycle and the middle income group have more number of two-wheelers for their mobility in the system. It is observed that except four-wheeler diesel, the distance travelled by using personal vehicles is increasing along with increase in income. In fact, the higher income group people use more quantity of diesel powered four-wheeler vehicles. The higher income people use four-wheeler motor powered vehicles to the larger extent for their day to day activities, whereas middle income group people use more two-wheelers.

The per capita energy consumption made by the two-wheeler petrol, four-wheeler petrol, four-wheeler diesel are increase considerably from the lowest income group to the higher income group, i.e., 1.79 fold, 28 fold, 52 fold and 68 fold respectively,



which depicts that higher income group people use more number of four-wheeler and their energy consumption is much higher compared to two-wheelers.

In this investigation multiple regression model was constructed including energy consumption for personal transportation with household income, different types of personal vehicles and distance travelled by them. The energy consumption for personal transportation is totally associated with different types of vehicles used and distance travelled by them in the system. The 4 - wheeler gas vehicles are insignificant in the system, since they are not much used. The 2 - Wheeler petrol vehicles exhibited negative relationship with energy consumption for personal transportation with distance. There is a strong association between household income and energy consumption for personal transportation. The households, which are having higher income and are affordable to have cars at their household level, and their energy consumption for personal transportation is increasing along with household income.

In this investigation, the findings of the literature review and the survey results occurred in the study area are perfectly matching. In the literature review it is observed that energy consumption for personal vehicles is increasing along with the household income, and in the study area survey result is also perfectly matching the same. Moreover, in literature it is observed that socio - economic condition, household income, and fuel price are responsible for travel behavior. This result is also reflecting with survey results, and in the survey it is observed that the lower income group person are having more number of two wheelers petrol, whereas the higher income households have four wheelers petrol, which consume more quantity of fuel for a kilometer travel distance, which shows that few variables results in the study area are closely matching with the published literature. Further, the author employed system dynamics technique to understand the function of the city with energy consumption in transport segment, and the results may be published in the subsequent paper.

6. CONCLUSIONS

In this investigation literature pertaining to transportation energy consumption is collected, analyzed, and presented under the focus areas of energy and transportation system, compact city, land use and travel behavior, transport energy and emission, renewable energy and transport. A household survey was conducted among the chosen sample of 684 households in the study area pertaining to energy consumption for personal transportation at the residential level, number of personal vehicles owned, distance travelled by them and their energy consumption at the household level, etc.; well analyzed and presented. Thereafter, multiple regression model is constructed by considering energy consumption for personal transportation as dependent. The other associated variables are considered as independent variables in the model. The paper



concludes with findings from the literature review, survey results and application of multiple regression technique. Their results may be used for policy making for the development of the city.

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3D Volumetric Analysis in Urban Planning

Dr. Faiz Ahmed C and Dr. Sekar S. P



Abstract

This paper presents the 3D volumetric analysis of an urban space which could enhance the analysis, planning and decision making process. GIS tools were used to produce an information-rich 3D model and from the integration of data on land use, building use and height with a floor space index and a water distribution network. An integrated methodological framework for assimilating 3D volumetric analysis in planning processes is presented. The analysis was performed on physical infrastructure parameter (i.e., water supply network), which shows that a 3D volumetric analysis can substantially enhance the planning of an urban space and could act as proactive decision support tool.

1. INTRODUCTION

The planning of an urban area involves numerous processes, procedures and analyses. It demands an extensive understanding of problems, both in horizontal and vertical dimensions. Currently, one of the major limitations in urban analysis is the failure to embrace the vertical dimension of a city. Urban growth is increasingly occurring on the vertical scale, particularly in Asian countries where vertical growth is rapid. A two-dimensional (2D) plan of a city centre with skyscrapers limits the appraisal of the provision of (physical) infrastructural facilities for such an area. In practice, 2D plans hardly ever reveal the vertical volume of an area and they put planners under severe imaginative strain when conceptualizing a 'mental map' of a given area. Planners' analytical vision is significantly restricted by conventional 2D plans, the limitations of which become increasingly evident as cities grow bigger and more complex (Batty et al 2003, Lee and Kwan 2005). Generally, urban analysis is restricted to two dimensions and thus, fails to analyze the growth and development of a city in three-dimension (3D) (Hwang 2009, Thill et al 2011).

Urban planners are reluctant to use 3D tools because of their complexity regarding data integration and modeling, their cost, and the lack of appropriate skills available for incorporating 3D models into everyday planning processes; thereby compromising the efficiency and effectiveness of the plans prepared (Al-Douri 2006). This outmoded approach to urban planning and management must

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be replaced by incorporating technological advancements that support efficient planning (Xu et al 2009). The application of 3D models is a recent development in urban planning and design, where 'digital information' is translated into common graphical information; however, most applications are restricted to visualizations of the urban environment (Lewis et al 2012). This graphical information creates an opportunity for urban researchers to visualize and explore urban characteristics in several ways, such as in 2D (maps), 3D (built-form), or four-dimensional (temporal) forms (Pettit et al 2012). For urban planners, it is an opportunity to become familiar with and to integrate these tools for efficient analysis, planning and designing of urban spaces.

Today, 3D models and visualization are considered more reliable than other traditional representations, which support superior understanding of spatial data (Lammeren et al, 2010). One of the main advantages of a 3D model is its realistic illustration of the world. By using 3D city models, decision makers and urban planners can obtain a clear vision of how a city would look in terms of its spread and profile. In practice, applications of 3D city modeling are restricted mainly to data visualization and communication (Al-Douri 2006). This research attempts to integrate 3D models into everyday urban planning processes for superior analysis and planning of the urban environment. Geographic Information Systems (GIS) are used extensively by urban planners for planning and analysis using 2D maps. They enable users to overlay data spatially and to use it for analyzing and managing urban space effectively (Herrmann and Osinski 1999, Hudson-Smith and Evans 2001, Pettit et al, 2012). Using 3D city models generated from ArcMap and ArcScene, a range of analyses can be performed, including, attribute and spatial queries, view-shed analysis, shadow analysis and others (Holtier et al 2000). The objective of this research is to perform 3D volumetric analysis of the study area (Kannadasan Nagar, Chennai) to determine the volume of activities generated as against the physical infrastructure, i.e. Water supply demand, and its impact on planning, analysis and decision making.

This paper is built on the following question "How 3D volumetric analysis can be used as proactive decision support tool for enhancing the decision making process in urban planning context?" A methodology for conducting 3D volumetric analysis described by Ahmed and Sekar 2014, is adopted. ArcMap™ and ArcScene™ are used for creating an information-rich 3D model of the study area. 3D volumetric analysis of important planning parameter, i.e. water supply is carried out to demonstrate 'how 3D volumetric analyses enhances the decision making process?'

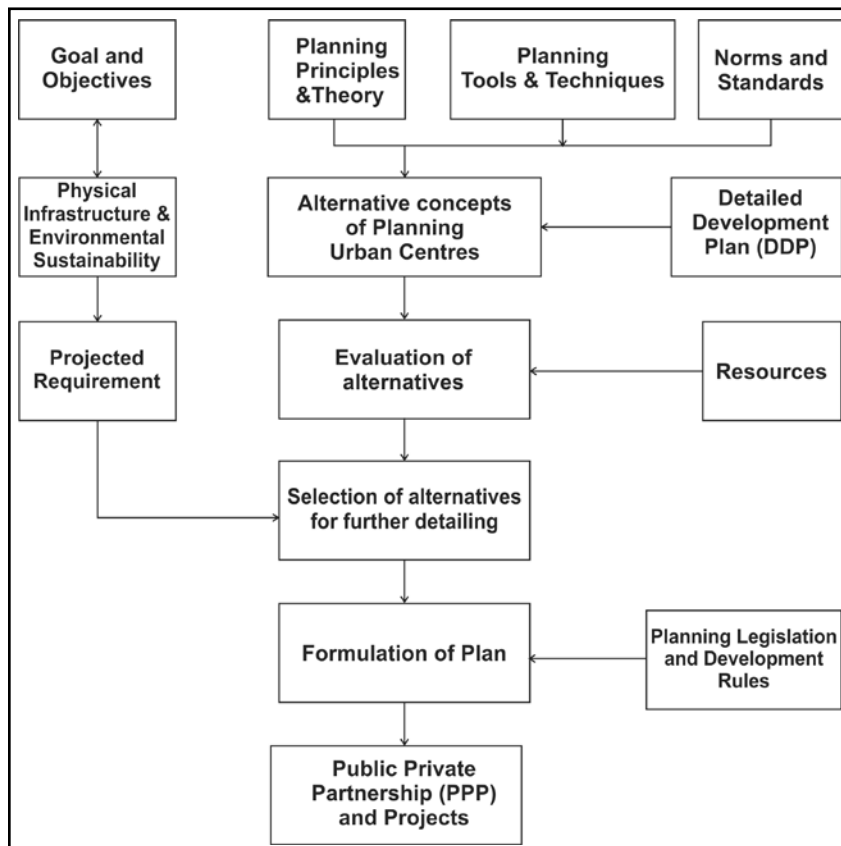


2. CONVENTIONAL PLAN-MAKING AND REGULATORY MECHANISM

2.1 Conventional Plan Formulation Process

Conventional Plan formulation process practiced in India is depicted in the Fig. 1 (UDPFI, 1996). The foremost step in Plan formulation is the identification of aim of the plan, which is generally a policy note by decision maker, based on the aspirations of people. Objectives are specific statements the ways and means of achieving the aim of the Plan formulated. The next major step in Plan formulation is the identification of projected requirements of various activities. Traditionally Town Planning Departments are the nodal agency that collects and compiles the relevant information from various Departments on their future plans. This process has not been effective and potent as the participation and coordination among the departments are very poor in nature (UDPFI, 1996). Urban planner gather inputs from various Departments and prepare a future Plan and this makes the role of planner to be crucial. In addition to the above information, plan formulation takes into consideration of planning theories and principles; planning tools and techniques; and norms and standards, followed by evaluation processes. A similar Plan formulation process is practiced in Chennai and the growing metropolis is unable to keep pace with the developments in the provision of sustainable infrastructure to its population. The emergence of new economy bases demands a new approach from the traditional Master Plan preparation tools and techniques to enable sustainable and equitable growth of Chennai. The conventional Plan making process has many shortcomings such as, weak database for plan preparation, non-comprehensive and non-holistic nature of the Plan, inadequate public participation, and lack of monitoring and implementation mechanism (Jauhari, 2012).

Fig. 1: Conventional Plan Formulation Processes in Practice, UDPFI-1996 (Source: UDPFI 1996)





2.2 Conventional Regulatory Mechanism

Zoning is a primary planning tool used to control the urban development in Indian cities, with a set of regulations which influences land use, density, form and volume (Fitzgerald, 2008, Jothilakshmi, 2011). It is one of the legal tools for governing the urban growth. Zoning brings orderliness in cities (Cullingworth and Caves 2008), effectively acts as design control tool (Cook, 1980) and also act as a legal mechanism for guiding land-use and protection of public health, welfare and safety (UDPFI, 1996). Therefore, zoning is a set of conditions (Pooni, 1998), used for implementation of the Master Plans or Development Plans and often it is considered as means of regulatory measure a city development agency holds. Zoning is governed by important parameters like land-use, bulk, height and form of the building (Cook, 1980). However, the conventional tools such as two-dimensional maps used for creating zoning regulations, fails to create a platform for understanding the existing development and the infrastructure in place (Zambuni, 2013). In cities like Chennai, zoning is the primary planning tool used. Therefore, extensive understanding is required for urban planners on the impact of zoning regulations on city development. Planning for a better future is almost impossible with the current tools and techniques, which are primarily dependent on conventional 2D plans.

2.3 Overlapping Competencies and Clash of Authorities

Chennai's governance is characterized by the role that State Government agencies retain in the management of urban affairs. Apart from Local Governments, agencies like Public Work Departments (PWD), Tamil Nadu Housing Board (TNHB), Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB), Chennai Metropolitan Development Authority (CMDA), etc., are involved in planning and management of urban services. Effective planning and management of urban services are practically challenged due to overlapping competencies and clash of authorities.

3. 3D GIS AND VOLUMETRIC ANALYSIS FOR PLANNING

3.1 3D GIS for Planning

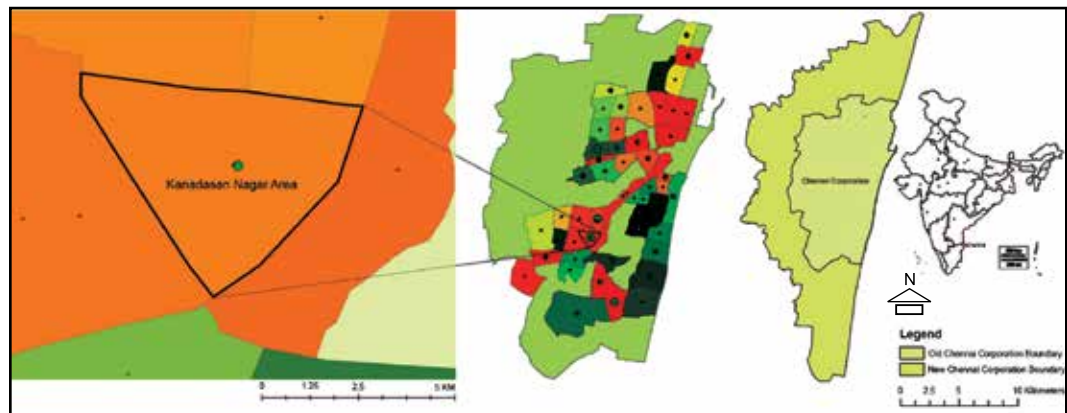
Geographic Information Systems (GIS) plays a significant role in planning processes which involve spatial data for analysis, planning and decision making (Zhou et al 2006), and it is immensely popular among the planners for its spatial analysis (Yin and Hastings 2007), apart from acting as an effective tool for data sharing across the line departments (Johar et al, 2007). GIS has developed from 2D representation to 3D representation since 1960's (Ghani, 2012). Third dimension currently acts only as add-on attribute to 2D drawings with limited analytical competencies (Bruce, 2007). 3D GIS are often seen as a technical subject, where 3D data structure, processing and visualization are carried out (Roland 2000). One of the major limitations of using 3D city models in urban

planning processes is the conventional 2D database. Effective visualization of complex 3D built environment is still a challenge for urban planners. With latest advances in GIS technologies on quantitative urban planning and analysis (Yin and Hastings, 2007), there is a huge demand for effective and efficient integration of 3D GIS for urban planning purposes for enhanced analysis, planning and decision making (Jiang and Li, 2005). The application of 3D GIS has started to influence the planning profession (Kwartler and Bernard 2001, Yin and Hastings, 2007). Current research has shown that the use of advanced 3D city models for quantitative assessment enhances the understanding of complex urban system (Ahmed and Sekar 2013), and it resolves urban planning issues and generates better planning outcomes (Ghani, 2012). The key feature of 3D GIS is scenario development based on the analyses and for generating what-if scenarios (Shiode, 2001, Counsell and Smith, 2007); visualize alternate land-use Plans and their impact on urban environments (Steinicke et al, 2006). 3D GIS models can relate past, present and possible future developments of built-environment, closely reflecting the real world (Yin, 2010). 3D GIS supports spatial analysis, planning and decision making in two ways; firstly, using the data storage and retrieval capabilities, which provides rapid and efficient data retrieval and sharing, to support planning decisions. Secondly, by means of its integrated 3D urban analytical capability, that enables different alternatives to be modeled (Shiode 2001, Johar et al 2007). There are various methods of generating 3D city models which mainly depend on GIS dataset (Emem and Batuk, 2004).

3.2 Volumetric Study in Urban Planning

A volumetric study is a quantitative study performed to establish the 'volumetric-ness' of an urban space, i.e., a study of the built-environment density, the volume and intensity of activities it generates, and its influence over an urban space (Koninger and Bartel, 1998, Hwang 2009). For instance, it would be difficult to draw any significant conclusions on two similarly sized built environment analyzed

Fig. 2: Study Area Location Map



using 2D maps, creating enormous pressure on urban planners to develop 'metal maps' with 'some' intensity of development that may not reflect the ground reality. There exists a mismatch between the conceptualized plans with that of reality. 3D volumetric analysis tool is an advanced spatial planning and decision support tool which is interactive and dynamic to enhance the urban planning processes (Ahmed and Sekar 2014).

4. METHODOLOGY

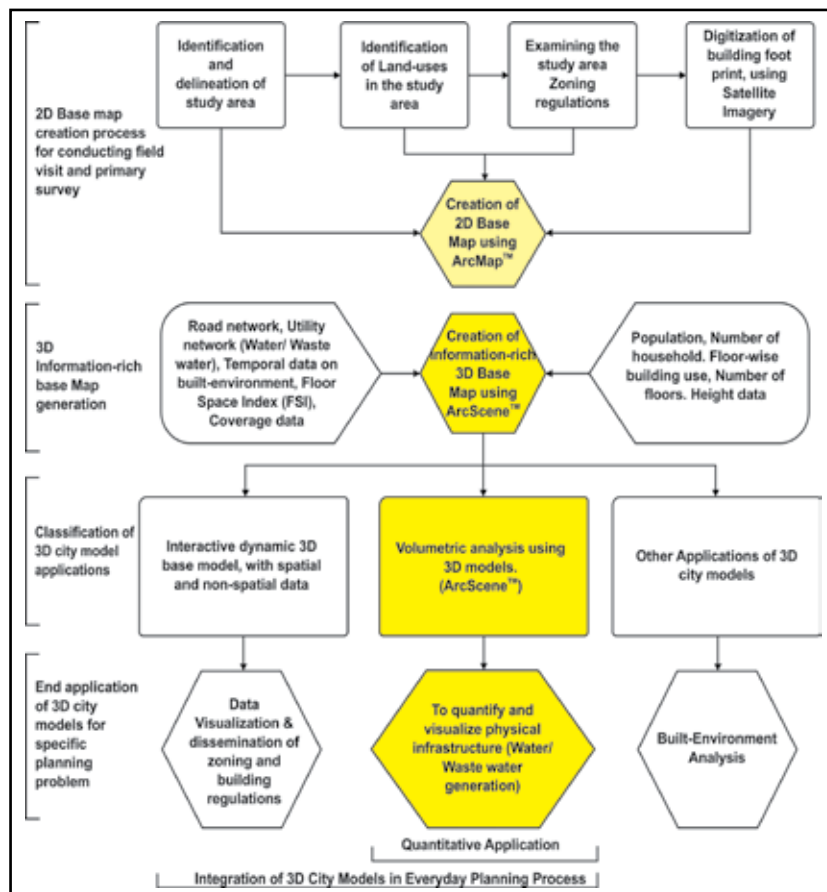
4.1 Study Area Profile

Kannadasan Nagar area is one of the planning units in Chennai Corporation (CMDA 2008). It forms the southeast part of Theagaraya Nagar (T. Nagar), Chennai (Fig. 2). T. Nagar is reputed to be the biggest shopping districts in India. The total extent of the planning units is about 0.69 sq km The Detailed Development Plan (DDP) of Kannadasan Nagar area was prepared in 1980. Currently, the population of the study area is about 77,270 (Field survey 2013), with 917 buildings of different uses.

4.2 Procedures for 3D Model Generation

For creating 3D city models of the study area, procedures depicted in Fig. 3 conceptual framework for creating 3D information - rich models and for performing volumetric analysis is deployed and an integrated methodological framework for assimilating 3D volumetric analysis and is developed as shown in Fig. 4. The study area has mixed use buildings and with varying height. Using Google imagery, the profile of each building within the study limit is digitized (Fig. 5). The digitized building footprints are overlapped with proposed land use of Chennai 2026, for its com-

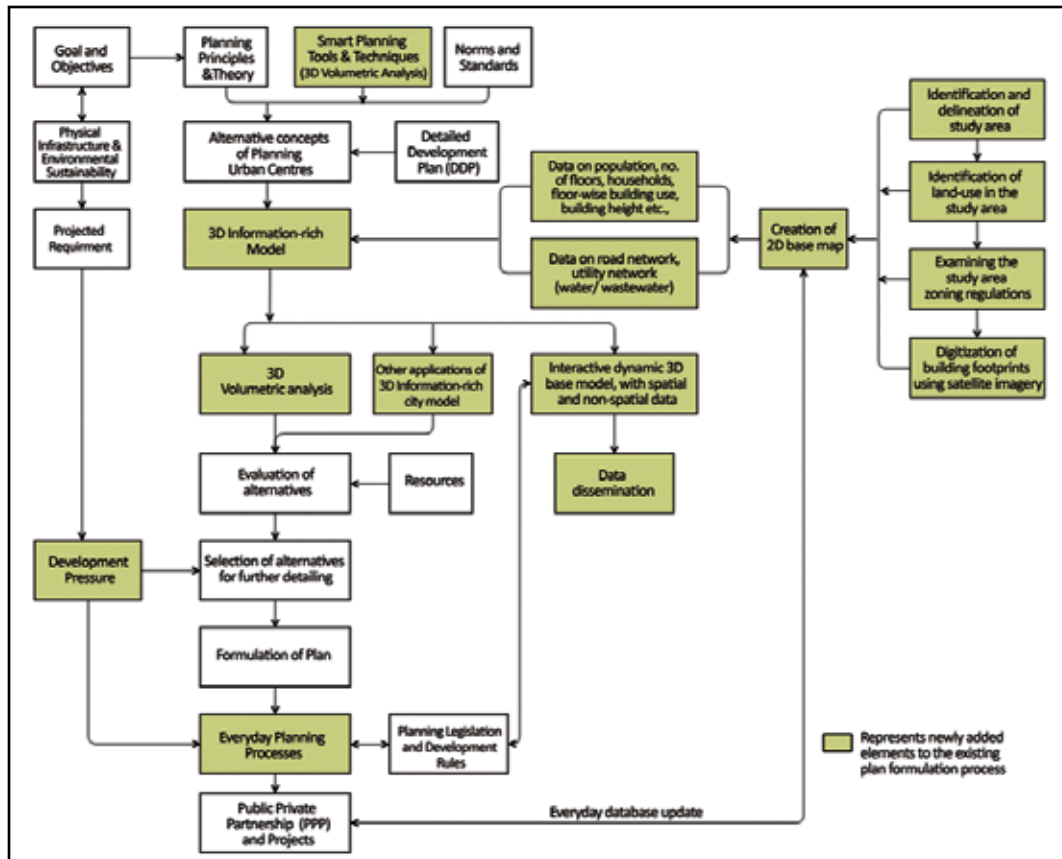
Fig. 3: Conceptual Framework for Creating 3D Information-rich Models and for Performing Volumetric Analysis.



Source (Ahmed & Sekar, 2014)



Fig. 4: An Integrated Methodological Framework for 3D Volumetric Analysis in Everyday Urban Planning Process



Source: Modified from UDPFI guidelines

patibility. Floor Space Index (FSI), set back and maximum permissible height are taken from the proposed Master Plan 2026. Through primary survey, the existing development is traced and a base map is generated using ArcGIS. The base map prepared is used to generate 3D building volumes, zoning and floor wise building use, by using ArcScene.

4.3 Information - rich 3D base model

The total extent of the study area is 0.69 sq km of which 53 percent of plots are residential, 0.17 percent commercial, 18 percent mixed-use, 8 percent institutional, 2 percent parks and playgrounds and about 19 percent of land is used for road network (CMDA 2008). The plot level data such as the plot boundary, area, frontage, land uses, allowable floor space index (FSI), maximum permissible building height, road connectivity, utilities (water supply network data), etc.; of the study area are obtained through secondary sources from Chennai Metropolitan Development Authority (CMDA), Chennai Metropolitan Water Supply to Sewerage Board (CMWSSB). Satellite imagery of the study area is used for obtaining building footprint and

Fig. 5: Footprint and Coverage of the Study Area in 2013

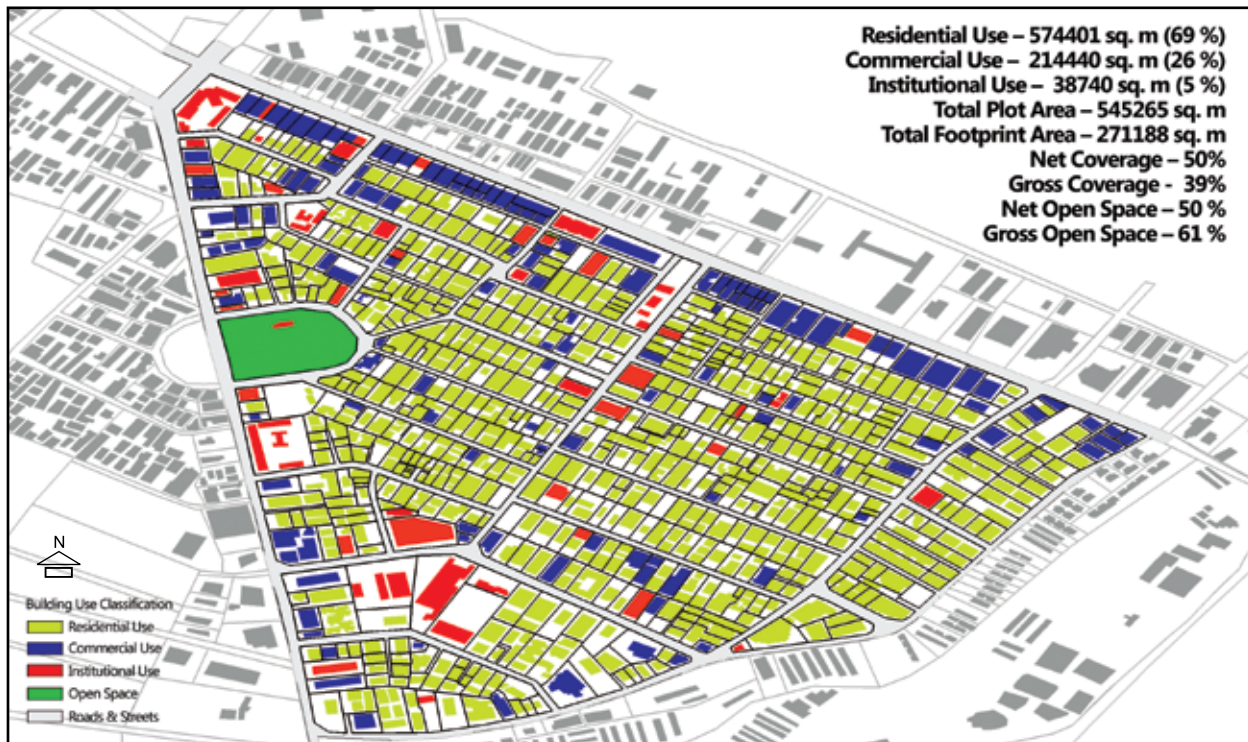


Fig. 6: Intensity of Development - Building use Classification of the Study Area in 2013

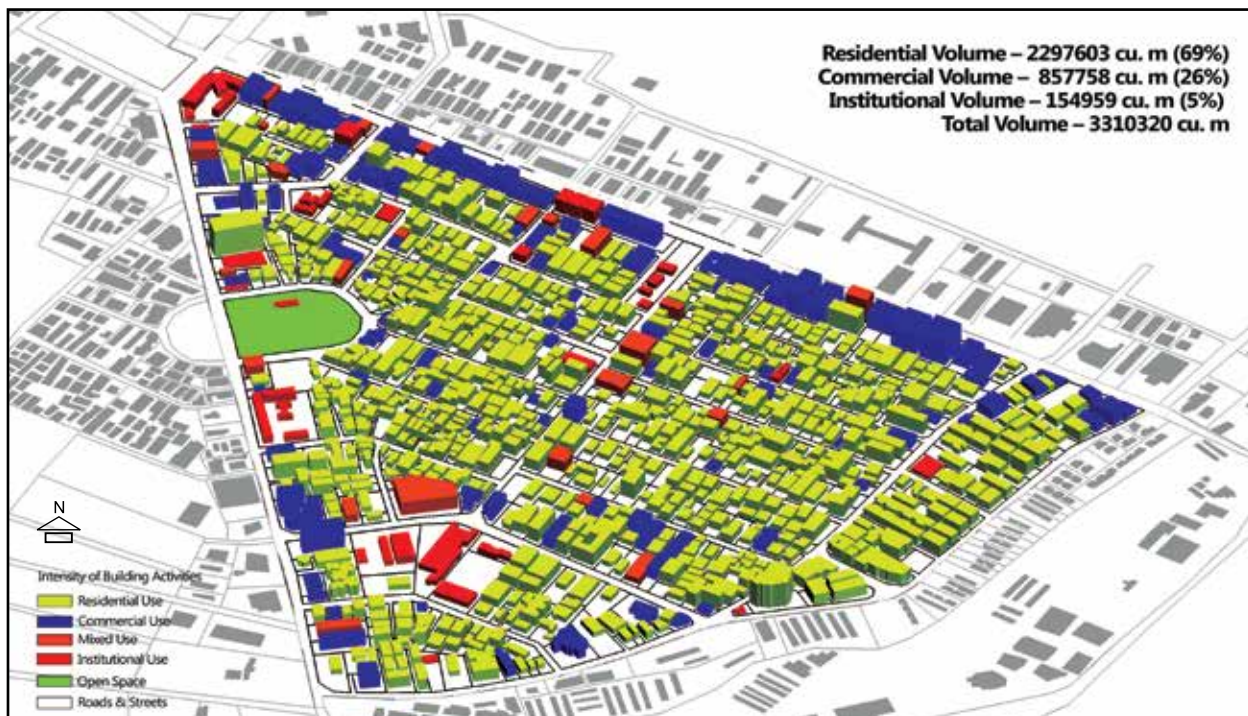




Table 1: Criteria used for Classification of Plots

Classification of plots	Road width	Plot size
Ordinary buildings (G+1 building)	Less than 9 m	Less than 200 sq. m
Special buildings (G+3/Stilt+4 building)	9-12 m	200-1199 sq. m
Multi-storied buildings (above G+3/Stilt+4 building)	12 m and above	1200 sq. m and above

Source: CMDA 2008

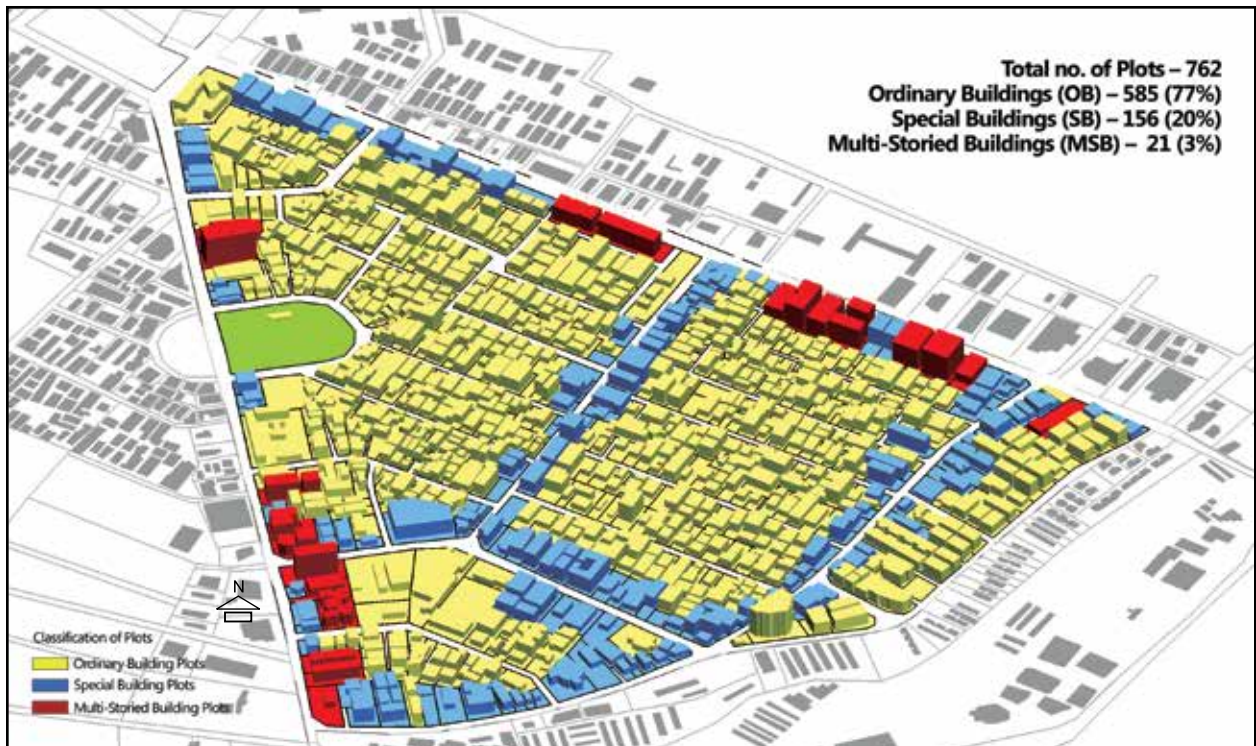
Based on the development regulations, all the 917 plots of the study area are classified into three categories. i- Plots where ordinary buildings are permitted for constructions. ii- Plots where special buildings are permitted for constructions. iii- Plots where multi-storied buildings are permitted for constructions. Table 1 shows the criteria used for classification of plots. This is based on the regulations stipulated in second Master Plan for Chennai city (CMDA 2008).

Fig. 7 shows the anticipated development as per proposed development plans of CMDA 2008. Based on the classification, 77 percent of the total plots available

complete enumeration on number of floors and floor-wise data is carried out through primary survey. With above data an information-rich 3D base model is developed using ArcMap™ and ArcScene™ (Fig. 6).

4.4 Classification of Plots Based on Development Standards

Fig. 7: Classification of Plots of the Study Area Based on Development Standards (2013 Data)



in study area are suitable for ordinary building constructions, 20 percent for special buildings and 3 percent for multi-storied buildings. Fig. 8 shows the actual development for the current year 2013. Most of the multi-storied buildings marked in red are not compatible with proposed development regulations, clearly violating the zoning regulations proposed by CMDA. As per data available, 75 percent of buildings that were constructed in 2013 fall under ordinary buildings, 4 percent special buildings and 21 percent multi-storied buildings as shown in Fig. 8.

4.5 Assessment of the Water Supply Network of the Study Area

A thematic water supply network of the study area is prepared (Fig. 9). Buildings in the study area is broadly divided into two zones and further grouped under 38 sub zones, based on the connectivity of the water supply network (Table 2). The quantity of water demand generated at each node is computed (Fig. 10). CMWSSB guidelines are used for the calculation of water demand based on the size of the floor area, through equivalence with the dwelling unit sizes. 135 litres per capita per day (lpcd) of water is supplied at a velocity of 0.8 m/s and the water supply network uses a peak factor demand of three, which is used to determine the size of the pipe (Santhosh 2008). Using this background information water demand generated for 2013 dataset is computed (Table 2) and the carrying capacity of pipe is also evaluated.

Fig. 8: Actual Intensity of Development in 2013



Fig. 9: Water Supply Networks Analysis of the Study Area 2013

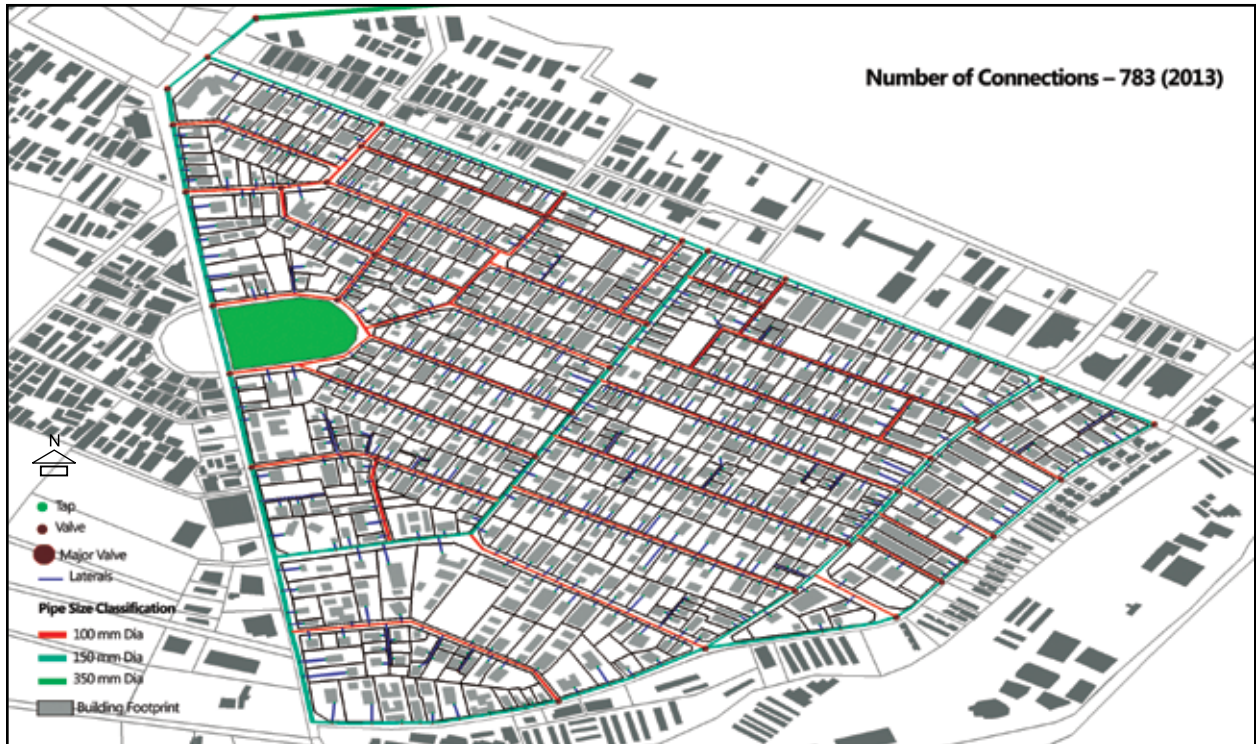


Fig. 10: Water Supply Networks Analysis of the Study Area 2013

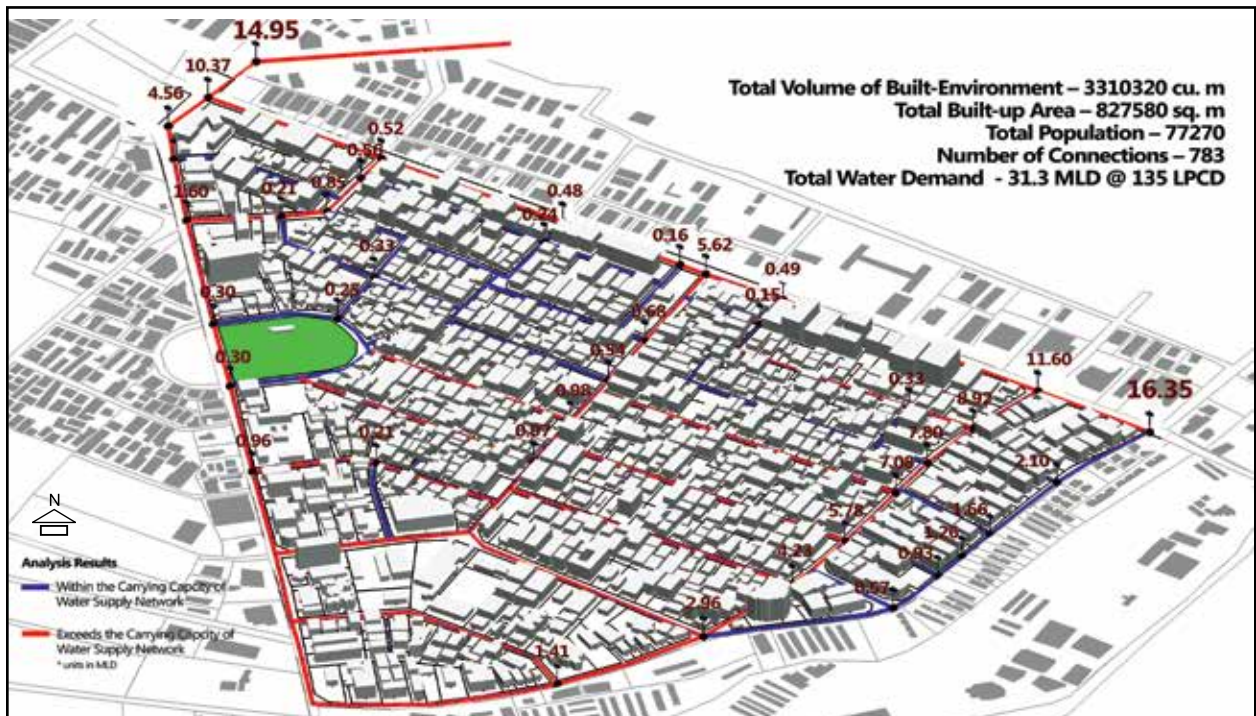


Fig. 11: Water Supply Networks Analysis Result of the Study Area and Critical Network 2013


5. RESULTS AND DISCUSSION

The results for the 2013 dataset, water demand are shown in Fig. 10 and 11. There are 917 buildings in 2013 with a population of 77270; the total water demand generated is 31.3 MLD, with an FSI of 1.52. An increase of 28 percent in number of buildings was observed between 1980 and 2013. The findings show that in a span of three decades, footprint of the study has increased by 110 percent and a phenomenal 263 percent increase in building volume, has created an increased demand of water supply by 230 percent. Of all the total 38 zones of water supply network, 11 zones critically exceeds the designed carrying capacity of the water supply network to take up the increased pressure of development (Table 2). 49 percent of the buildings are affected due to critical networks which exceed the designed carrying capacity, with a total of 40,035 people getting affected (Fig. 11). Such proactive assessments are virtually impossible to carryout using conventional planning tools and techniques in practice. Assessing the carrying capacity of the infrastructure in place becomes crucial for making decisions to either increase or to control the developments. In this research 3D volumetric analysis is restricted to the analysis of carrying capacity of water supply network. For more informed decision making all the other physical and social infrastructure parameters must be included. 3D volumetric analysis is one such tool to integrate the entire physical and social infrastructure for enhancing the decision making process. Zones of optimal intensities of development could


Table 2: Volumetric Assessment of Water Supply Network of the Study Area

Zone	Plot Area	No. of buildings 1980	No. of buildings 2013	Building Area 1980	Building Area 2013	Volume 1980	Volume 2013	Population 1980	Population 2013	1980 FSI	2013 FSI	Water demand (in MLD) 1980	Water demand (in MLD) 2013	Critical node analysis for 1980 data	Critical node analysis for 2013 data
Zone I															
I	9815	13	17	2563	12709	10253	50836	275	1095	0.26	1.29	0.111375	0.443475	1	1
II	8268	10	14	3941	11033	15765	44132	505	1275	0.47	1.33	0.204525	0.516375	1	1
III	8409	5	16	3920	15271	15679	61084	315	1395	0.52	1.82	0.127575	0.564975	1	1
IV	12971	23	21	7927	22898	31707	91592	775	2100	0.64	1.77	0.313875	0.8505	1	1
V	5081	10	10	2332	5487	9327	21948	230	520	0.46	1.08	0.09315	0.2106	1	1
VI	6742	4	14	725	7735	2901	30940	75	740	0.10	1.15	0.030375	0.2997	1	1
VII	6350	13	15	2113	6989	8453	27956	295	605	0.33	1.10	0.119475	0.245025	1	1
VIII	5350	10	12	2466	7996	9865	31984	245	805	0.46	1.49	0.099225	0.326025	1	1
IX	7822	19	21	2704	12008	10817	48032	275	1215	0.30	1.54	0.111375	0.492075	1	1
X	4733	4	5	1466	7673	5864	30692	95	600	0.35	1.62	0.038475	0.243	1	1
XI	4223	8	7	1663	2368	6651	9472	270	390	0.39	0.56	0.10935	0.15795	1	1
XII	12183	20	23	6272	17746	25089	70984	660	1690	0.51	1.46	0.2673	0.68445	1	1
XIII	12913	20	25	6085	13810	24338	55240	620	1330	0.47	1.07	0.2511	0.53865	1	1
XIV	17706	23	31	5412	24898	21648	99592	650	2420	0.31	1.41	0.26325	0.9801	1	0
XV	21152	32	48	8205	24270	32821	97080	1060	2390	0.39	1.15	0.4293	0.96795	1	0
XVI	18070	32	47	7656	23693	30623	94772	845	2360	0.42	1.31	0.342225	0.9558	1	0
XVII	4962	6	12	1639	4691	6558	18764	160	515	0.33	0.95	0.0648	0.208575	1	1
XVIII	33178	38	36	11900	53498	47599	213992	1545	6050	0.37	1.61	0.625725	2.45025	1	0
XIX	29335	30	37	12938	54344	51753	217376	1750	5150	0.45	1.85	0.70875	2.08575	1	1
XX	22329	32	27	16661	49314	66643	197256	1760	4265	0.72	2.21	0.7128	1.727325	1	1
Zone II															
I	22341	25	24	17922	65792	71687	263168	1050	3935	0.80	2.94	0.42525	1.593675	1	0
II	2621	8	9	797	4477	3189	17908	75	365	0.29	1.71	0.030375	0.147825	1	1
III	6249	6	17	1676	8882	6703	35528	175	855	0.26	1.42	0.070875	0.346275	1	1
IV	17060	23	42	6434	19637	25734	78548	760	1950	0.37	1.15	0.3078	0.78975	1	1
V	4106	4	8	3069	8226	12274	32904	275	810	0.65	2.00	0.111375	0.32805	1	1
VI	49827	55	63	19706	64920	78825	259680	2065	5405	0.37	1.30	0.836325	2.189025	1	0
VII	5707	6	9	1763	11123	7051	44492	170	975	0.31	1.95	0.06885	0.394875	1	1
VIII	6784	5	11	3452	8899	13808	35596	340	990	0.53	1.31	0.1377	0.40095	1	1
IX	4155	2	5	4219	7971	16877	31884	220	805	1.60	1.92	0.0891	0.326025	1	1
X	4020	3	5	4471	8864	17884	35456	250	885	1.24	2.21	0.10125	0.358425	1	1
XI	14037	24	33	4499	18378	17996	73512	445	1785	0.34	1.31	0.180225	0.722925	1	1
XII	21681	31	47	9109	31969	36436	127876	915	3215	0.41	1.47	0.370575	1.302075	1	0
XIII	30652	47	54	9311	38321	37244	153284	930	3820	0.30	1.25	0.37665	1.5471	1	0
XIV	29173	33	54	7580	34629	30321	138516	760	3135	0.27	1.19	0.3078	1.269675	1	0
XV	5698	3	9	2973	14094	11891	56376	305	1410	0.55	2.47	0.123525	0.57105	1	1
XVI	26708	33	29	8882	40454	35527	161816	1010	3835	0.33	1.51	0.40905	1.553175	1	0
XVII	29027	32	44	9396	33286	37584	133144	925	3470	0.31	1.15	0.374625	1.40535	1	0
XVIII	13827	17	16	4040	29227	16159	116908	435	2715	0.26	2.11	0.176175	1.099575	1	1
Total	545265	709	917	227887	827580	911548	3310320	23510	77270	0.42	1.52	9.5	31.3	0	11

Critical node analysis results: (1) within designed carrying capacity, (0) exceeds designed carrying capacity



be mapped based on the volumetric analysis of carrying capacity of physical infrastructure in place.

5. CONCLUSIONS

As 3D modelling tools and techniques become more commonplace, urban planners are beginning to think three dimensionally to address the ever-growing urban problems, particularly in dealing with the built environment. In this research, the feasibility and the need for integrating 3D volumetric analysis into everyday urban planning processes is presented. 3D information-rich model equips planners with up-to-date information on city development for enhanced analysis, planning and decision making. Transparency in planning processes is also enriched by sharing the 3D information-rich models in public realm. One of the major advantages of having a 3D city model is its ability to quantify the activities being generated over a given space, not only two dimensionally, but also in three dimensions. Volumetric data help planners quantify and assess the activities in terms of volume versus the infrastructure services in place. This research also shows the use of 3D models for evaluating the conceptualized Development Plans with that of the current trend of development. The findings show how certain zones within the study area critically exceeds the designed carrying capacity of the network, when there is an increase in built-environment intensity without a concurrent improvement of the existing infrastructure services. This research contributes in widening the applications of 3D city models for enhancing the urban planning processes especially as decision support tool.

In order to avoid the cities to become more and more unserviceable and unsustainable, urban planning and development agencies in India must embrace the advancement in planning tools and techniques. Creation of information rich city database with dynamic and static 3D city models, along with cities essential data is one of the essential steps that need to be taken-up by the development authorities. Geo - spatial data infrastructure act would be the way forward in this regard. An authoritative database of this kind is the need of the hour for cities like Chennai that are impeded by overlapping competencies and clash of authorities over their role in decision making.

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Accessibility Level Planning of Health Facilities - Case Study Patna

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Abstract

Accessibility for health facilities has various dichotomies: spatial versus aspatial, potential versus revealed. On one hand, where spatial accessibility deals with distance or travel impedance of access to health care facilities, on the other hand, aspatial accessibility uncovers the affordability aspects of health care expenditure. This paper aims to study both the aspects of healthcare accessibility at Patna, supported by various models and techniques duly supported by case studies. Distance Impedance Function method has been adopted for calculating the accessibility scores of all the 72 Wards in Patna Municipal Area for various LOS-Dispensaries, Sub - Divisional Hospitals, Speciality Hospitals and Super Speciality Hospitals. This method was also replicated by the authors for calculating the accessibility scores of all the Hospitals for 72 Wards of Patna Municipal Area.

1. INTRODUCTION

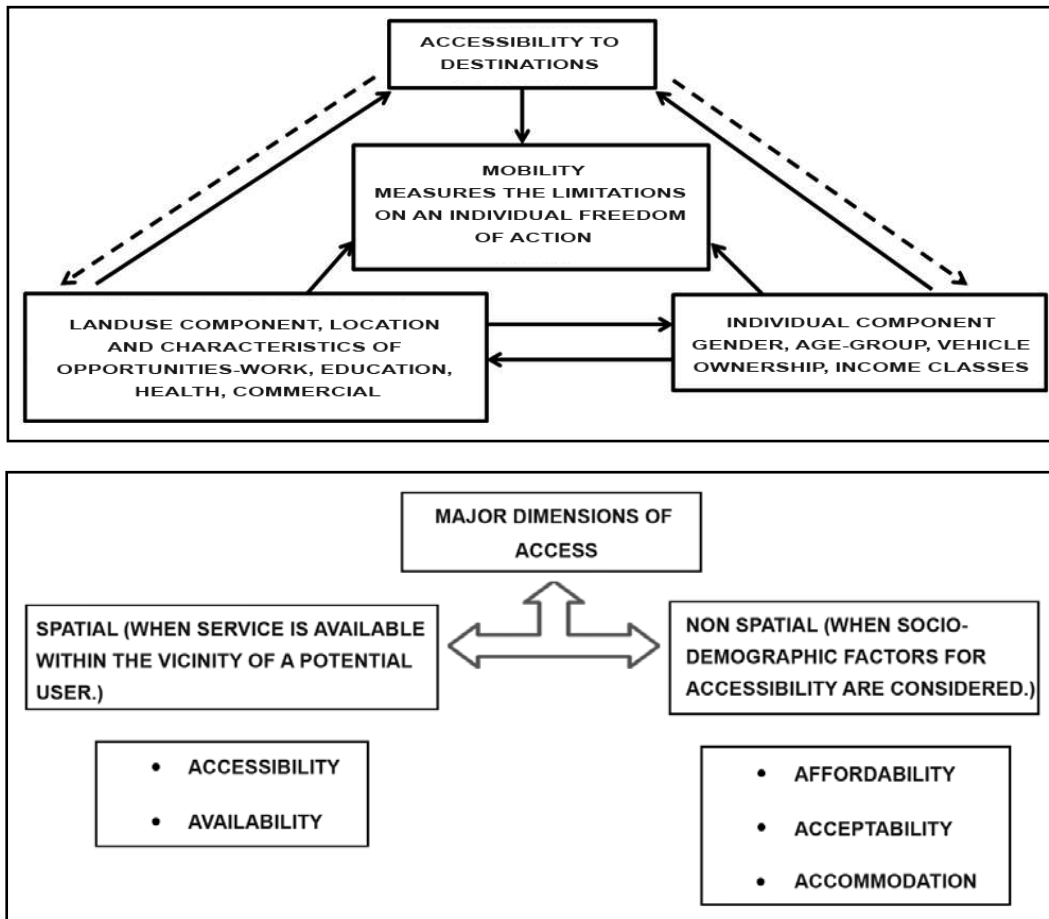
Accessibility is a general term used to describe the degree to which a product, for example, device, service, and environment is accessible by as many people as possible. Accessibility can be viewed as the 'ability to access' the functionality, and possible benefit of some system or entity.

Access to health care may be classified according to two dichotomous dimensions (potential versus revealed, and spatial versus aspatial) which split up into four categories, such as: potential spatial access, potential aspatial access, revealed spatial access, and revealed aspatial access (Khan, 1992). Revealed accessibility focuses on actual use of health care services, whereas potential accessibility signifies the probable entry into the health care system, but does not ensure the automatic utilization of the offered services (Joseph and Phillips, 1984; Khan, 1992; Phillips, 1990; Thouez et al, 1988). Spatial access emphasizes the importance of the spatial and distance variable (as a barrier or a facilitator), whereas the aspatial access stresses non geographic barriers or facilitators, such as social class, income, ethnicity, age, sex, etc (Joseph and Phillips, 1984; Khan, 1992; Meade and Earickson, 2000, page 383-392).

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Fig. 1: Relationship Between Accessibility and Mobility



2. WHO GUIDELINES ON ACCESSIBILITY TO PHC

World Health Organization has stipulated following guidelines on accessibility to Public Health Facilities:

- **Universal access:** This is a concept, when applied to environments ensures that health facilities can be accessed by all people regardless of where they live or work.
- **Focus on population with “high health needs”:** High-need population groups usually experience more access difficulties than the rest of population. Therefore, priority is to ensure, they have appropriate access to PHC.
- **One thousand people per general practitioner.**
- **A precondition is to ensure that they become directly and permanently accessible, without undue reliance on out-of-pocket payments and with social protection offered by universal coverage schemes.**



- Arrangements for the transformation of conventional care - ambulatory- and institution-based, generalist and specialist - into local networks of primary-care centres.
- Using information and communication technologies to improve access, quality and efficiency in primary care.

3. A BRIEF OUTLINE OF STUDY

Major aims and objectives of this study are as follows:

- To measure spatial accessibility at Health Service Level across various LOS for whole Patna Municipal Area.
- To measure spatial accessibility at ward level for various LOS of Health Services in Patna Municipal Area.
- To measure Level of Services within the hierarchy of health service.
- To measure Spatial Distribution of health service in the city.
- To Ascertain Need and Demand of various user groups.
- To measure Affordability Level of Healthcare Expenditure at user Level.

In order to achieve these objective, the following aspects will be examined:

- Assessment of Accessibility level keeping in consideration Socio - Demographic factors at Neighborhood level.
- Comparing Socio - Economic characteristics with the level of accessibility.
- Determining Catchment area of lowest level of health facility for the population in vicinity.
- Assessment of Distribution pattern of various levels of health services in the city.
- Ascertaining the Acceptability level of different level of health services across various user groups.
- Exploring highly disadvantaged areas and Proposal for location allocation of health services.

Limitations of this work are that this research is restricted to Patna Municipal boundary and cannot be extrapolated at regional or state level. It will also not include cost of road improvement for improvement in accessibility.

3.1 Measuring Spatial Accessibility to Health Facilities

Measures of spatial accessibility to healthcare can be classified more simply into five categories:

- Provider-to-population ratios method



- Travel Impedance to nearest provider method
- Average travel Impedance to provider method
- Gravitational models of provider influence method
- 2 Step Floating Catchment Area method

Provider-to-Population Ratios Method: It is also referred to as supply ratios, are computed within bordered areas. They are the most popular type of SA measure because they are highly intuitive, the data sources are readily available, and they do not necessarily require GIS tools and expertise

Travel Impedance to Nearest Provider Method: It is typically measured from a patient's residence or from a population centre, such as the geometric centroid of county of residence, depending on the resolution of the available data.

Average Travel Impedance to provider Method: It is a combined measure of accessibility and availability. It is measured from any patient or population point of interest. From that point the travel impedance to all providers within a system is summed and averaged.

Gravitational Models of Provider Influence Method: It is a combined indicator of accessibility and availability. It provide the most valid measures of spatial accessibility, be the setting urban or rural.

Two Step Floating Catchment Area Method: Like population-to-provider ratios, the 2SFCA method does not utilize spatial movement data but rather it groups populations and health care services within a common boundary. Since spatial accessibility needs to capture proximity and availability together, two distinct elements are used in calculating the 2SFCA method - the location of primary care services and the population, as well as the number of services and size of the population at each location.

Firstly, Step 1 of the 2SFCA method computes a population-to-provider ratio, for each service location, by aggregating all population locations that are located within a defined threshold (catchment size).

$$\text{Step 1: } R_j = S_j / \sum_i P_i \quad (1)$$

Where, S_j is the number of full-time equivalent services at location j , P_i is the number of residents at population location i and R_j is the population-to-provider ratio for service j .

Then, Step 2 of the 2SFCA method also computes a population- to-provider ratio (access score), for each population location, by aggregating all service



population-to provider ratios of services that are located within the same defined threshold (catchment size).

$$\text{Step 2: } A_i = \sum_i R_i \quad (2)$$

Where A_i is the accessibility for population location i

3.2 Measuring Non- Spatial Accessibility to Health Facilities: A Case Study Zambia

3.2.1 Data Collection and Survey Procedure

Non spatial factors include non-geographic barriers or facilitators such as age, sex, ethnicity, income, social class, education and language ability. This paper attempts to explain health care expenditure among households from different socio - economic groups as a barometer for measuring affordability. In an economic perspective, an individual's propensity to utilize health care is determined by the costs of utilization and the perceived benefits of health care. The Central Statistical Office in Zambia has so far carried out two Living Conditions Monitoring Survey (LCMS). Data was collected on the living standards of households and persons in the areas of education, health, income sources, income levels, food production and consumption, and access to various amenities. The LCMS 1998 covered 16,710 households representing a sampling fraction of about 1 household per every 113 households. The survey covered 8,487 households in rural areas and 8,223 households in urban areas.

3.2.2 Results and inferences

Based on Multi Variate Regression analysis it has been found that Zambian households' expenditure for health care are connected to total monthly expenditure, LNEXPEND and monthly expenditures on other than food, LNEXPFO. Another variable being a proxy of economic circumstances is ownership of house or not. Households not owning their own house seem to have lower expenditures of health care compared to households who actually own their own house. The findings also suggest that access to facilities is important. Moreover, the distance to the nearest health care facility also affects the expenditure level.

The size of the household does of course reflect on expenditures, but not to such a high extent that one might suspect. On the other hand the age of the head of household is a significant variable reflecting on total health care expenditures. In future, econometric methods can be used for refining the analysis of the data material, by exploring the data set.

3.3 Data Collection

3.3.1 Primary and Secondary Data

Primary data is mainly collected by conducting the Surveys and Interviews. Here, Household Survey was conducted to collect Primary data for assessing the Healthcare accessibility and affordability level at Household level.

Secondary data mainly comprises of Institutional Survey data, data from Census and Patna Municipal Corporation office and Expert Opinion Surveys. Secondary data from Census Office includes: 2001 Demographic Data and Town Directory of Patna District and from Patna Municipal Corporation Office includes: Ward wise Map and Ward wise Population data of Patna Municipal Area.

3.3.2 Household Survey Procedure

Entire Patna Municipal Area of 72 Wards was sub-divided into 10 different zones (Fig. 2) with each Zone comprises of 7 Wards barring Zone No. 1 and Zone No. 5 with 8 number of Wards each. Population Range of Wards varies from 21709 to 24441. Altogether 300 Household Surveys were conducted with 30 numbers of Surveys done in each zone. Samples were Proportionately Collected representing from various socio - economic groups: HIG, MIG and LIG. Survey Questionnaire was framed mainly to assess the following parameters:

- Type of household with religion and social group.
- Demographic Particulars with number of women in fertile age group.

Fig. 2: Various Wards under Different Zones of Patna Municipal Area

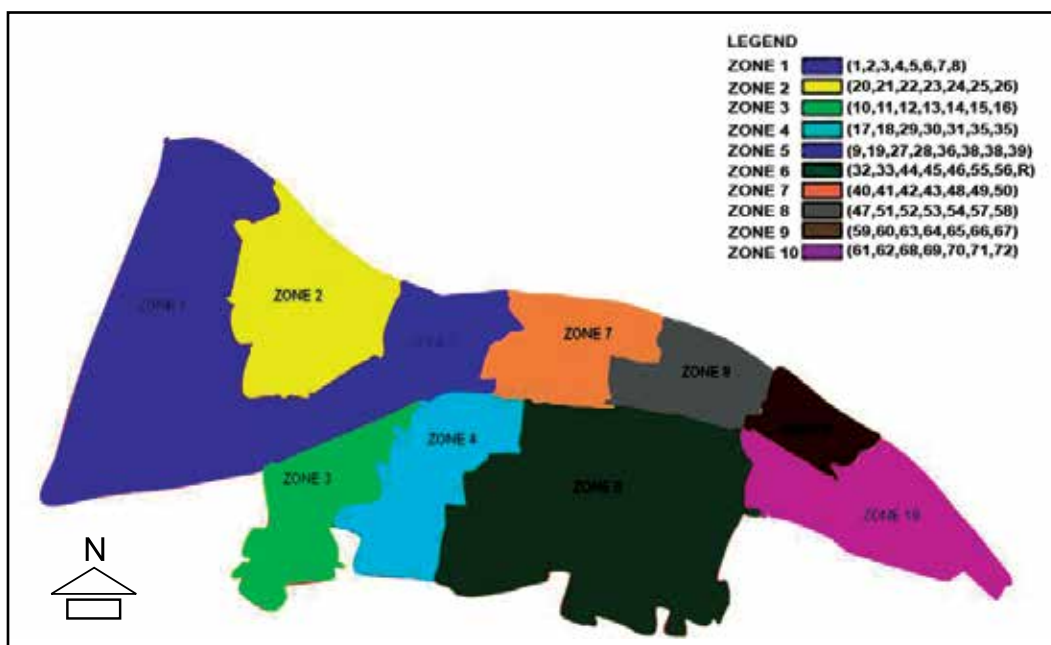




Table 1: Number of Hospitals and their Governing Body

Name of the Governing Body	Nos.
State Government	16
Central Government	6
Railways	1
Private trusts	10
Charitable trusts	2
NGO's	13

- Education Level.
- Income Pattern pertaining to Income group, Bank and Insurance Coverage with presence of any Health Cover Schemes.
- Expenditure Pattern related to food, medicines and transport.
- Housing conditions with presence and condition of drinking water.
- Health characteristics to assess presence of any diseases.

- Ownership of Vehicles.
- Access Variables for availing the various Levels of Health Facilities with Distance and Mode Chosen.

Fig. 3: Location of Dispensaries at Patna

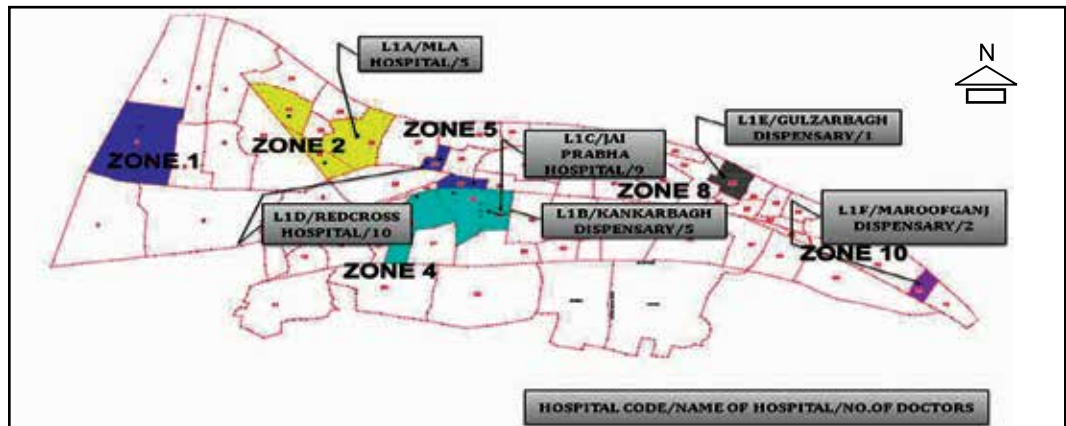


Fig. 4: Location of Sub-Divisional Hospitals at Patna

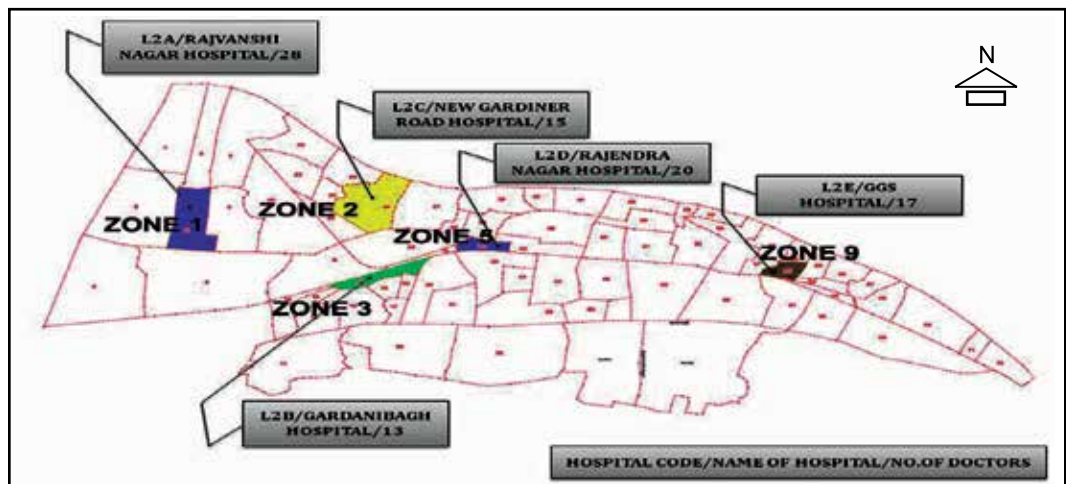


Fig. 5: Location of Speciality Hospitals at Patna

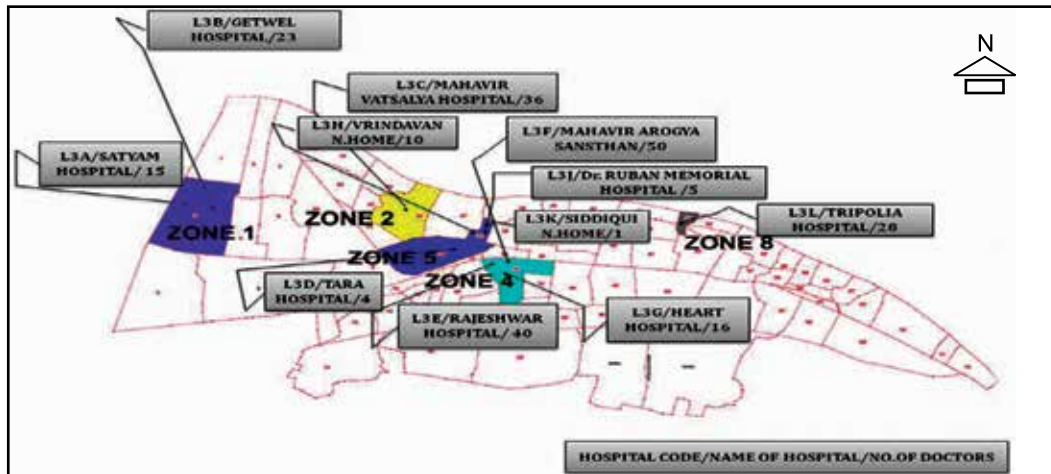
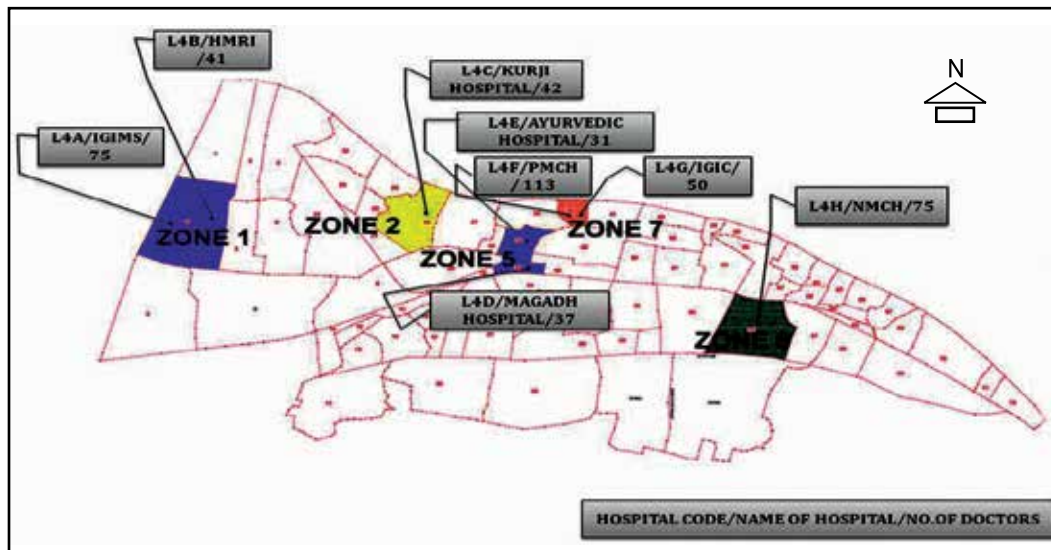


Fig. 6: Location of Super Speciality Hospitals at Patna



- Priority and Suggestions for Improvements.

3.3.3 Institutional Survey Procedure

For Conducting the Institutional Survey, following Process was adopted. Questionnaires were framed up and Survey Format was finalized accordingly. List of Health Centres were collected from Government Gazettes, (Table 1) Internet and Household Surveys. List includes all types of Government run Health Centres, Prominent Privately run, Charitable and NGO run Health Centres. Based on Level of Service there were 9 Super Specialty Hospitals, 11 Specialty Hospitals, 5 Sub Divisional Hospitals and 13 Dispensary level Health Centres (Fig. 3, 4, 5 and 6).



3.3.4 Survey format for institutional survey

Survey Questionnaire was framed to assess following parameters.

- Name of Health Centre with Governing Body and Ward Location with Address.
- Type and level of service with number of beds, doctors and paramedical personnel.
- Number and name of Departments functioning.
- Availability of Facilities including emergency facilities, third party approvals etc.
- Deficiency in Service (if any).
- Number of patients served per day including area being served.
- Consultation fees charged per patient for OPD with Availability of any Health Cover Schemes (if any); and
- General Acceptability Level from Patient point of view.

4. ANALYSIS AND RESULTS

4.1 Socio Economic Characteristics

Samples were drawn in a proportionate manner representing various occupation classes of people. Entire Sample has been sub-divided into three class i.e. Class A, Class B, and Class C. Income Level was the parameter for sorting the different class. Presence of Bank Account, Insurance and Health Cover Scheme has been taken as proxy for economic circumstances. Monthly Household Income and expenditure for food, healthcare and transport has been taken under Income and Expenditure Characteristics. Here, the factors governing Monthly Household Healthcare Expenditure has been assessed by Multi Variate Linear Regression Analysis with the help of various explanatory variables.

4.2 Multi Variate Regression Analysis: Assessing Monthly Household Healthcare Expenditure

For assessing the monthly household healthcare expenditure methodology adopted: was out of 300 Household Surveyed, only those Household having Monthly Household Health Care Expenditure were taken (229 in number). HEXPEND (Monthly Household Health Care Expenditure) was taken as Dependent Variable. Out of all parameters surveyed, only 16 Variables were taken as Significant Independent Variables which were under following set of Characteristics: demographic, economic, housing, ownership and access characteristics It was then put into Analysis in MS EXCEL for Multi Variate Linear Regression by assigning Dummy values with 90 percent Confidence Interval. Results from Multi Variate Regression Analysis are given below:



Summary Output		ANOVA TABLE					
Regression Statistics			df	ss	MS	F	Significance F
Multiple R	0.539574	Regression	6	1.29E+08	21471584	15.19649	1.44729E-14
R Square	0.29114	Residual	222	3.14E+08	1412931		
Adjusted R Square	0.271982	Total	228	4.43E+08			
Standard Error	1188.668						
Observations	229						

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 90.0%	Upper 90.0%
Intercept	460.9648	146.8792	3.138394	0.001929	171.5088	750.4206	218.3576	703.571
X8	248.7271	63.86603	3.894513	0.00013	122.8658	374.5883	143.2366	354.217
X9	465.9034	121.5207	3.833942	0.000164	226.4216	705.3853	265.182	666.624
X10	-530.42	273.9574	-1.93614	0.05412	-1070.309	9.470147	-982.928	-77.911
X14	399.9229	168.5446	2.372802	0.018507	67.77084	732.0749	121.53	678.315
X15	679.246	189.0529	3.592888	0.000403	306.6779	1051.814	366.9785	991.513
X16	-281.431	155.4857	-1.81001	0.071646	-587.8476	24.98616	-538.254	-24.607

Regression Equation so formulated is as:

$$Y=460.96+248.72X8+465.90X9-530.42X10+399.92X14+679.24X15-281.43X16$$

4.3 Measuring Spatial Accessibility of Wards

Distance Impedance Function method has been adopted for calculating the Accessibility Score of all 72 Wards of Patna Municipal Area under different Level of Service (LOS) as:

- LOS 1:Dispensaries and Community Level Health Centres;
- LOS 2:Sub Divisional Hospitals;
- LOS 3:Specialty Hospitals; and
- LOS 4: Super Specialty Hospitals

Ward Accessibility Scores AW_j , of Ward j , for each Hospital of capacity C_i is

$$AW_j = \sum C_i / (d_{ij})^2 \text{ for all } i$$

Where,

AW_j =Accessibility Score of Ward j for all Hospital i ,

C_i =Number of Doctors at Hospital i and

d_{ij} =Distance between Hospital i and Ward j .

4.4 Measuring Spatial Accessibility of Hospitals

Here also, Distance Impedance Function method has been adopted for measuring the accessibility by assuming that with increasing distance between hospitals and wards, hospital accessibility level get decreases.

Fig. 7: Ward Accessibility Scores for Dispensaries at Patna

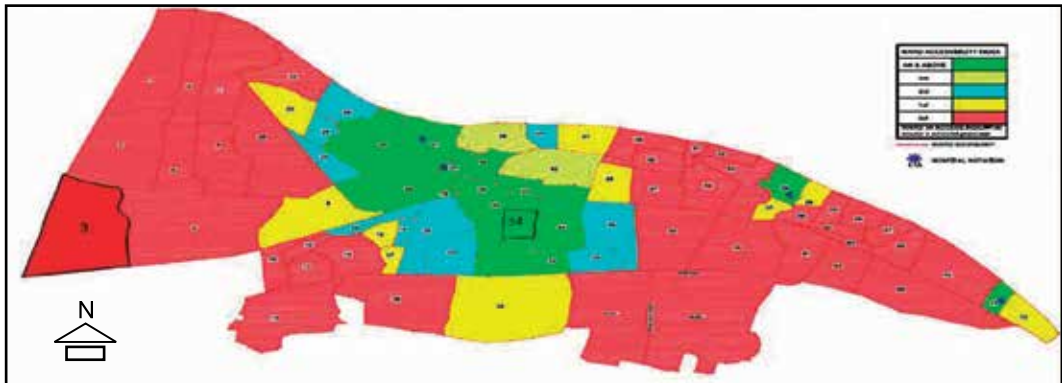


Fig. 8: Ward Accessibility Scores for Sub Divisional Hospitals at Patna

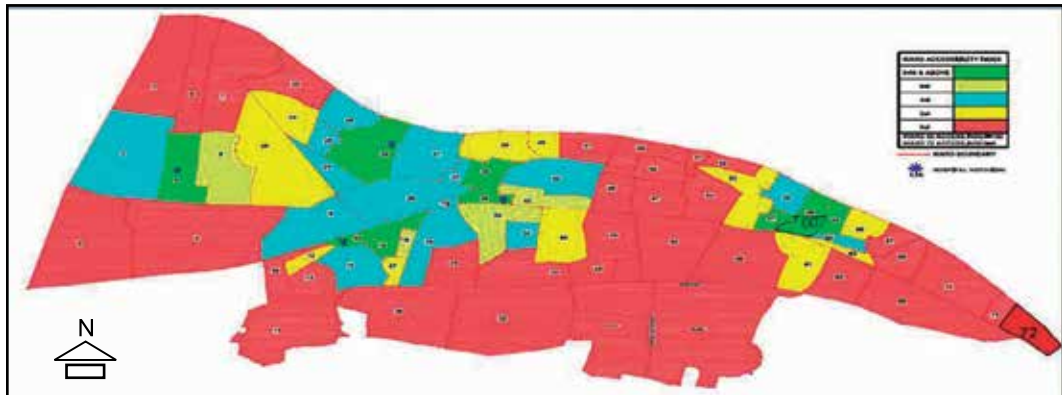
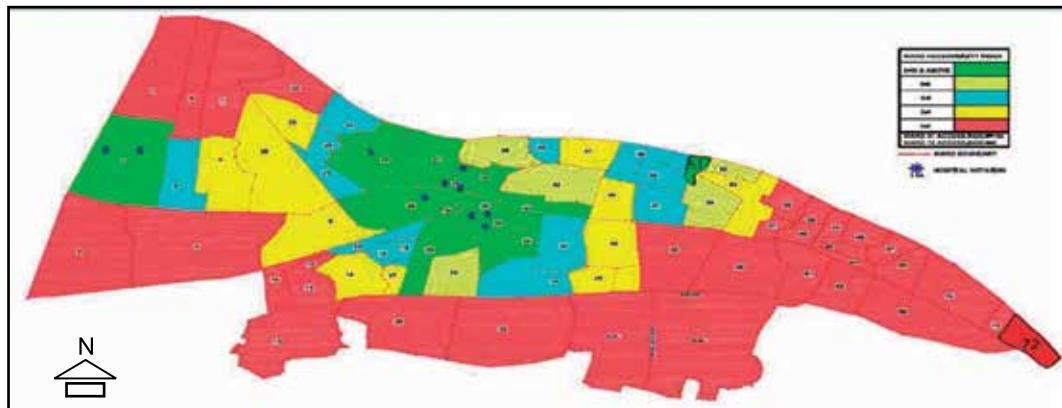
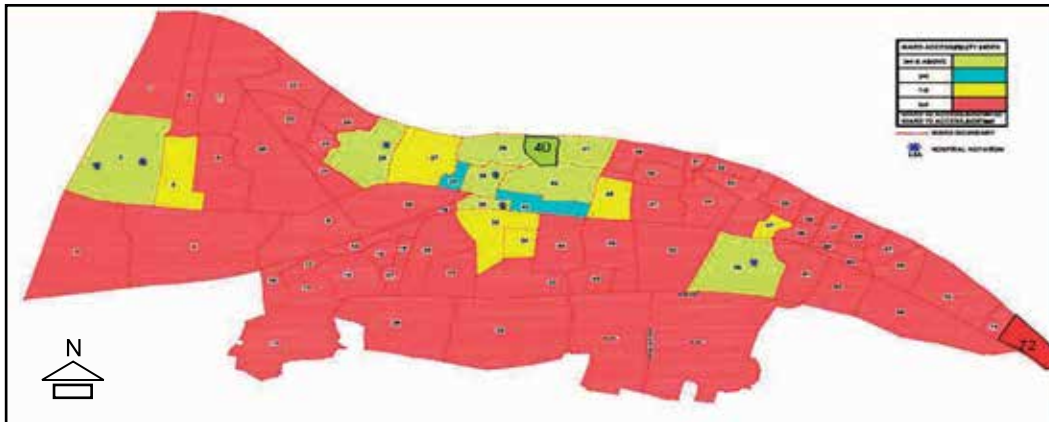


Fig. 9: Ward Accessibility Scores for Speciality Hospitals at Patna



Map 10: Ward Accessibility Scores for Super Speciality scores at Patna



Hospital Accessibility Scores AH_i , of Hospital i , for each Ward of population PW_j is

$$AH_i = \sum PW_j / (d_{ij})^2 \text{ for all } j.$$

Where,

AH_i = Accessibility Score of Hospital i for all Ward j .

PW_j = Population of Ward j .

d_{ij} = Distance between Hospital i and Ward j .

5. PROPOSALS

Methodology adopted for the proposal can be enumerated as follows:

Proposal is mainly targeted for improvement in Ward Accessibility Scores for lower level of health facilities viz. LOS-Dispensaries and LOS-Sub Divisional Hospitals due to the following reasons:

- This mainly serves the local population with catchment area confined to city level.
- These levels of health facilities provide preventive and curative care of health facilities and multitude of health programs at local level.
- Strengthening these levels of services may desist common people for availing the health facilities at private clinics, thus reducing their out of pocket payments for availing the health services.

Methodology mainly consists of following three steps:

- Capacity reorganization in existing hospitals
- Capacity augmentation in existing hospitals
- Proposing a location for a new hospital

Fig. 11: Accessibility Scores of Dispensaries at Patna

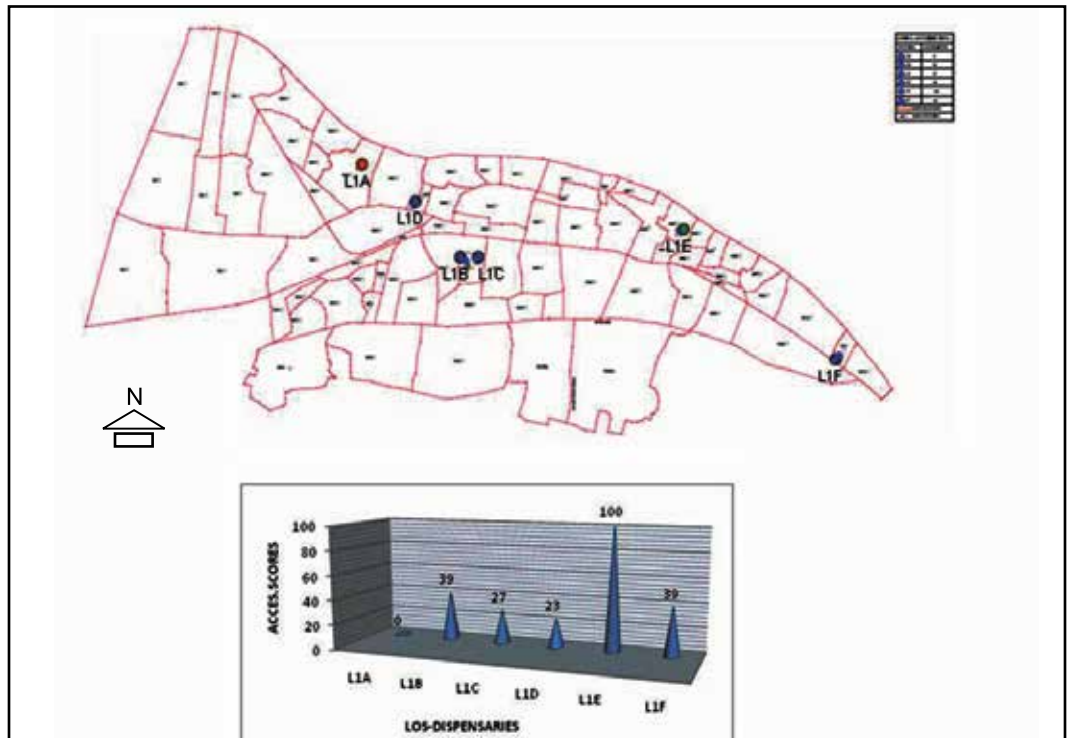
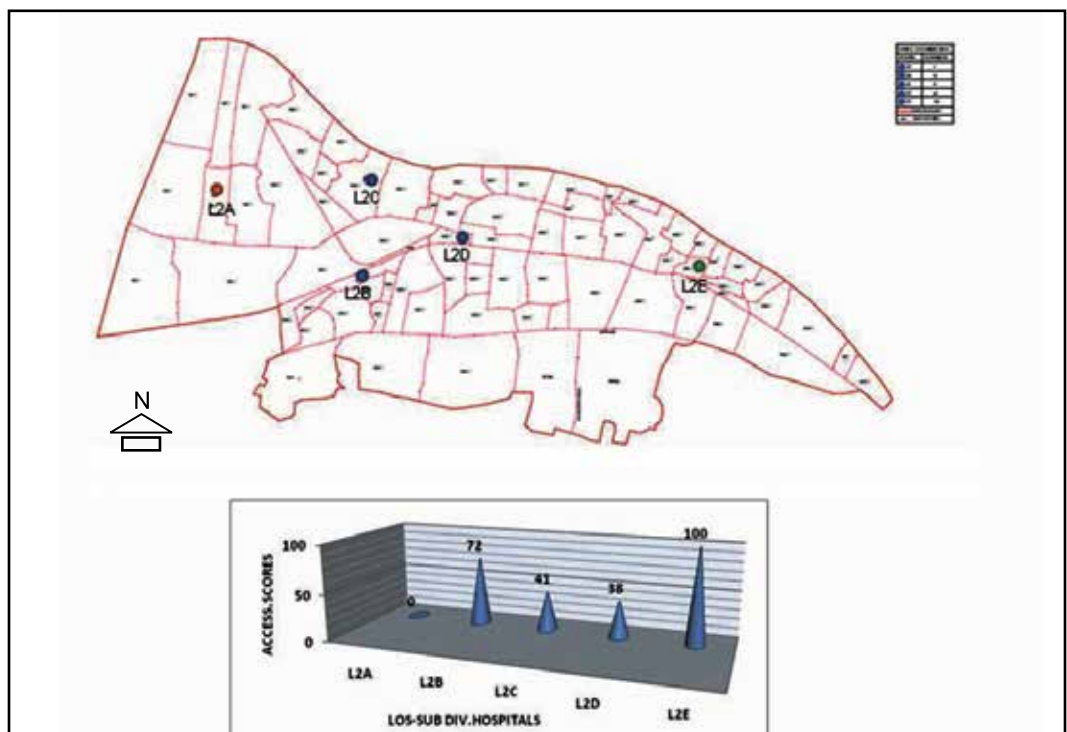


Fig. 12: Accessibility Scores of Sub Divisional Hospitals at Patna



5.1 Process: Proposal for LOS - Dispensaries

Following process has been adopted under proposal for LOS - Dispensaries:

- Capacity Reorganization Process in existing 6 dispensaries of 32 doctors capacity was carried out in five iterations. It results in
 - o Reducing the Standard Deviation of overall Accessibility Scores from 12.71 to 10.29.
- Improvement in the Accessibility Scores of up to 34 Wards.
- Capacity Augmentation Process in existing 6 Dispensaries was carried out by adding 13 new doctors in ten iterations to bring the total count of doctors up to 45. It results in
 - o Improvement in Accessibility Scores of all 72 Wards.
 - o Bringing more number of wards in higher band of Accessibility Scores.

Fig. 13: Accessibility Scores of Speciality Hospitals at Patna

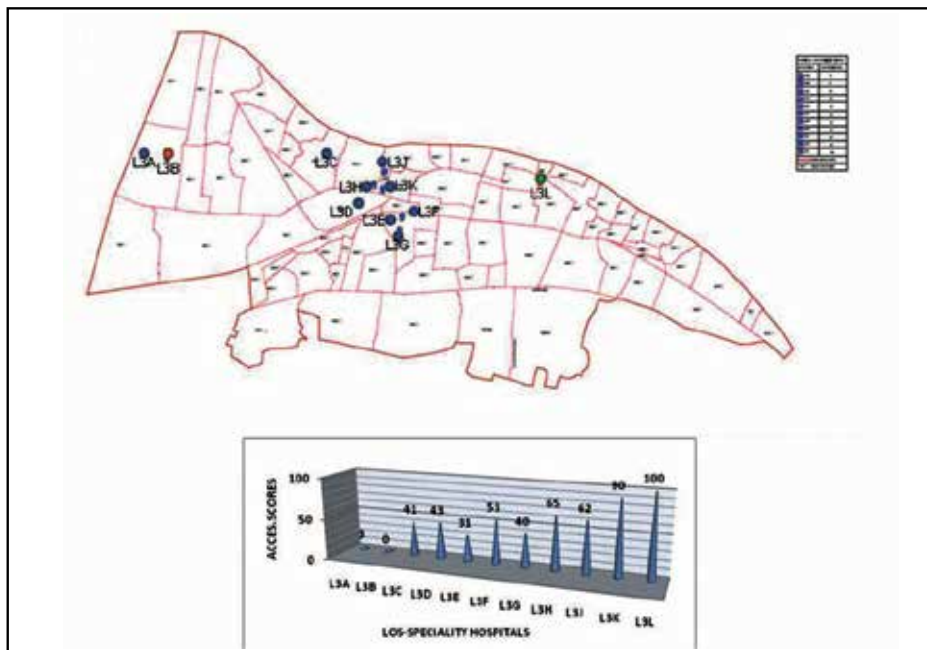
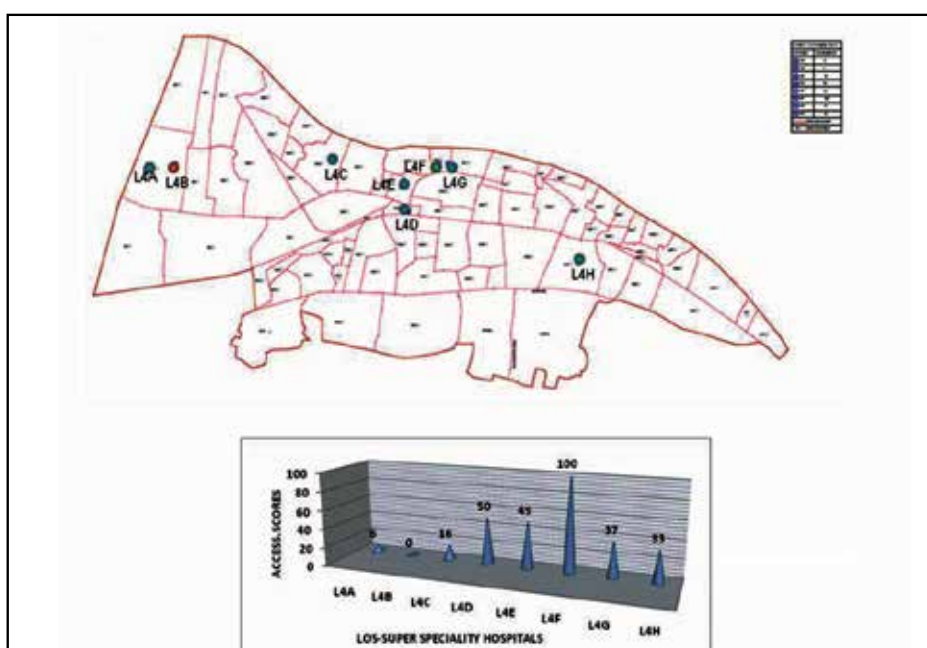


Fig. 14: Accessibility Scores of Super Speciality Scores at Patna



**Table 2: Comparative Analysis between Plan A and Plan B**

Comparative Analysis		
Particulars	Plan A	Plan B
Process	Proposing a new Dispensary of Capacity 5 Doctors at Ward No.5.	Addition of 5 Doctors in existing Dispensaries resulting in total Capacity Augmentation of 18 new Doctors.
No. of doctors	32+13+5=50	32+18=50
Mean of access. Scores	8.44	7.33
Median of access. Scores	1.9	1.76
Std. dev. Of access. Scores	20.93	17.96
Improvement in access. Scores.	72 wards(+ve)	72 wards (+ve)

- Finally, third Stage of executing two alternatives ,Plan A and Plan B was made as follows:
 - o Plan A: Proposing a new Dispensary of initial capacity 5 doctors at Ward number 5, resulting in total count of doctors under this LOS up to 50.
 - o Plan B: Adding these extra 5 doctors in existing 6 dispensaries in six iterations to bring total count of doctors under this LOS up to 50.

After comparing between Plan A and Plan B, (Table 2) it was found that both the methods lead to improvement in the accessibility scores of all 72 wards but in case of Plan B standard deviation of accessibility scores is 17.96, which is lesser in comparison to 20.93 from Plan A. Lesser standard deviation means less disparity in the provision of health facilities, so here Plan B is preferred over Plan A.

5.2 Process: Proposal for LOS-Sub Divisional Hospital

The following process has been adopted under proposal for LOS-Sub Divisional Hospital:

- Capacity Reorganization Process in existing 5 Sub-Divisional Hospitals of 93 Doctors Capacity was carried out in five Iterations. It results in
- Reducing the Standard Deviation of overall Accessibility Scores from 22.92 to 21.99.
- Improvement in the Accessibility Scores of up to 39 Wards.
- Capacity Augmentation Process in existing 5 Sub-Divisional Hospitals was carried out by adding 27 new Doctors in ten Iterations to bring the total Count of Doctors up to 120 It results in
- Improvement in Accessibility Scores of all 72 Wards.
- Bringing more number of wards in the higher band of Accessibility Scores.
- Under this LOS, Overall Accessibility Condition is good with maximum number of Wards in Higher band of Accessibility Scores, therefore no new Hospital has been proposed.



6. CONCLUSIONS

Methodology to evolve location and allocation of facilities has been tried by adopting the three pronged strategy of capacity reorganization in existing facilities; capacity augmentation in existing facilities; and proposing a new location for allocation of facilities. This model has tried for provision of equity in distribution of facilities with least disparity for common people. Finally, this proposal is a suggestive model, which can be adopted for development and improvement at any level of health facilities through more iteration in terms of capacity reorganization, capacity augmentation and lastly suggesting a new location for facility allocation.

ENDNOTES

- Spatial accessibility of primary care: concepts, methods and challenges: Mark F Guagliardo. Centre for Health Services and Community Research, Children's National Medical Center, Washington, DC, USA and Department of Prevention and Community Health, The George Washington University School of Public Health and Health Services, Washington, DC, USA
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- Assessing spatial and Non spatial factors for healthcare access: towards an integrated approach to defining health professional shortage areas Wei Luo, Fahui Wang Department of Geography, Northern Illinois University, DeKalb, IL 60115-2854, USA.
- Determinants Of Household Health Care Expenditure-The Case Of Zambia-Catharina Hjortsberg Department of Economics, Lund University, IHE, The Swedish Institute for Health Economics, LUCHE, Lund University Center for Health Economics.
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Land Management and Development Strategy for Urban Fringe of Faridabad

Jai Parkash and Nauman Najamuddin



Abstract

As the cities grow and expand, the urban fringe area becomes part of the cities and new urban fringe areas are formed. This phenomenon in India is creating sever problems in terms of infrastructure delivery both in the fringe area of the cities and the peri-urban areas where about 28% of India's population currently resides in cities which is expected to rise 40% by 2020. The sprawl results in the growth of villages into towns, towns into cities and cities in to metros. Developing countries are going through a major phase of urbanization resulting into increasing metropolitan cities. In India fringe areas require good governance like that expected for the municipal governance as stipulated in the 74th Constitution Amendment where major functions of planning for economic development and social justice and implementing these Plans are assigned to Panchayats.

1. INTRODUCTION

Informal supply of land (unplanned growth in the unorganized sector) is dominating the urban environment by filling the gap in the supply of developed land. Urban areas are very sensitive area for future growth, negligence of these areas creates many problems in process of implementation of master plans and unauthorized development of residential colonies and commercial activities. We have to search best alternatives for land management to protect this costly commodity from misuse or encroachment. It is therefore necessary to study process of land management techniques which can be used for development of urban fringe areas to prevent haphazard development activities and to achieve balanced spatio - economic development.

Land is a scarce commodity as its supply is limited and it cannot be created. It is therefore, most essential to ensure that utilization of available land is judicious and in the best interest of the community through the instrument of Development Plans. Land value depends on demand and supply and it increases as the demand exceeds the supply. With the growing urban economy it is expected that fringe areas will get developed in to urban areas at accelerated rates, in unplanned manner which calls for innovative planning, regulations, technology, design, financing options and delivery that are incremental and maintainable.

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The explosive rate of growth of population has been a cause of serious concern for the Government and all concerned city authorities. Efforts were made, in the past, through the planned development and controls to contain the population of Delhi metropolis. However, due to heavy influx of migration to Delhi from surrounding areas these efforts did not yield encouraging results. This population increase has heavily strained the infrastructural facilities and its resources. Therefore, it was necessary to invest in selected settlements outside the metropolis at appropriate distance to relieve Delhi of these pressures within a reasonable time frame. In order to prevent new pressure being generated and to relieve Delhi from its present avoidable pressure it was felt that the planned growth of Delhi should be conceived in a regional context.

The paper intends to achieve the following broad objectives:

- To study the phenomenon of urbanization and profile in the urban fringe area of Faridabad.
- To identify issues related to effective land management in the fringe area of Faridabad.
- To study the Controlled Area around municipal limits of Faridabad, particularly the area forming a part of notified urban area declared under the Haryana Development and Regulations of Urban Area Act, 1975.

The scope of this study will include analysis of the quality of built environment of urban fringe area of Faridabad with emphasis on transformations in dynamics of land use and urban form. An integrated planning process will be conceived and defined so that the development of fringe area could become an integral part of the entire urban transformations and development processes.

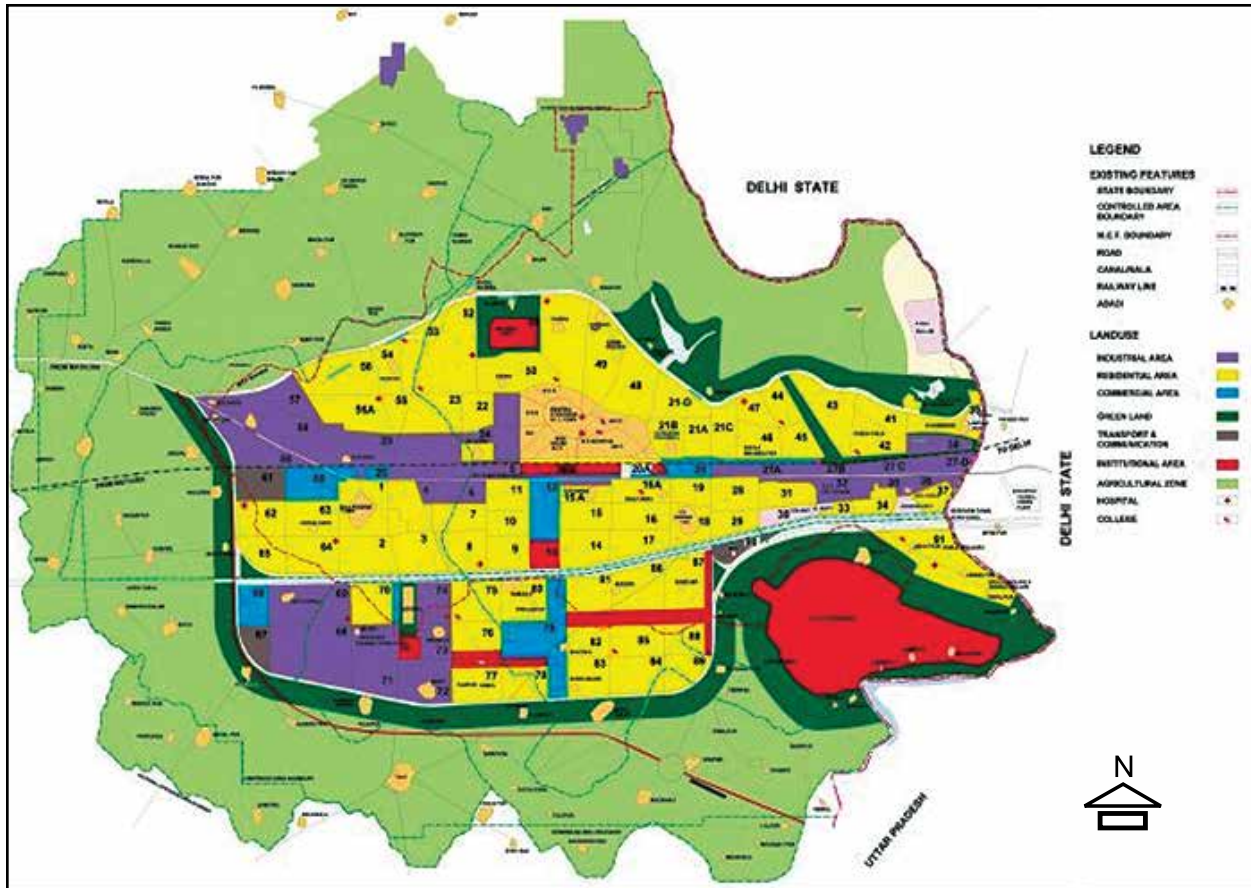
2. CITY PROFILE OF FARIDABAD

The city comprises of three towns namely Old Faridabad, Ballabgarh and NIT Faridabad. Till 1971, all the three towns had their own municipalities. In order to seek planned and integrated development, particularly on the industrial side, Faridabad Complex Administration (FCA) was constituted on 15th January 1972 under the Faridabad Complex Act, 1971, which included the towns of Old Faridabad, Ballabgarh and NIT Faridabad and 36 surrounding villages. The Municipal Corporation of Faridabad was constituted in 1994 under the Haryana Municipal Corporation Act, 1994.

Population of the Faridabad district is 18,09,733 and the population of Faridabad Municipal Corporation (Fig. 1) is 14,04,653 in 2011. Number of male is 7,50,446 and number of female is 6,54,207 as per census of 2011. Population growth rates were 33.02 during the decades. The district has an area of 741 sq km. River Yamuna flows on its entire eastern boundary. With regards to sex ratio in Faridabad, it stood at 871 per



Fig. 1 Faridabad Municipal and Planning Area



1,000 male compared to 2001 census figure of 826. The average national sex ratio in India is 926 as per latest reports of Census 2011 (Fig. 1,2, 3, and Table 1, 2).

As per 2001 Census of India, Faridabad had a population of 10,55,938 as compared to 6,25,085 during 1991 census indicating a growth of 68.93 percent in the last

Table 1: Density Variation in Municipal Corporation, Faridabad

Year	Population Nos.	Development Plan Area sq. km	Population Density Persons/sq. km
1961	56,000		
1971	1,22,000		
1981	3,30,864	156.76	2,111
1991	6,25,085	156.76	3,988
2001	10,55,938	156.76	6,736
2011	14,04,653	156.76	8,961

Source: Census 2011

Fig. 2: Population Trends in Faridabad Municipal Corporation

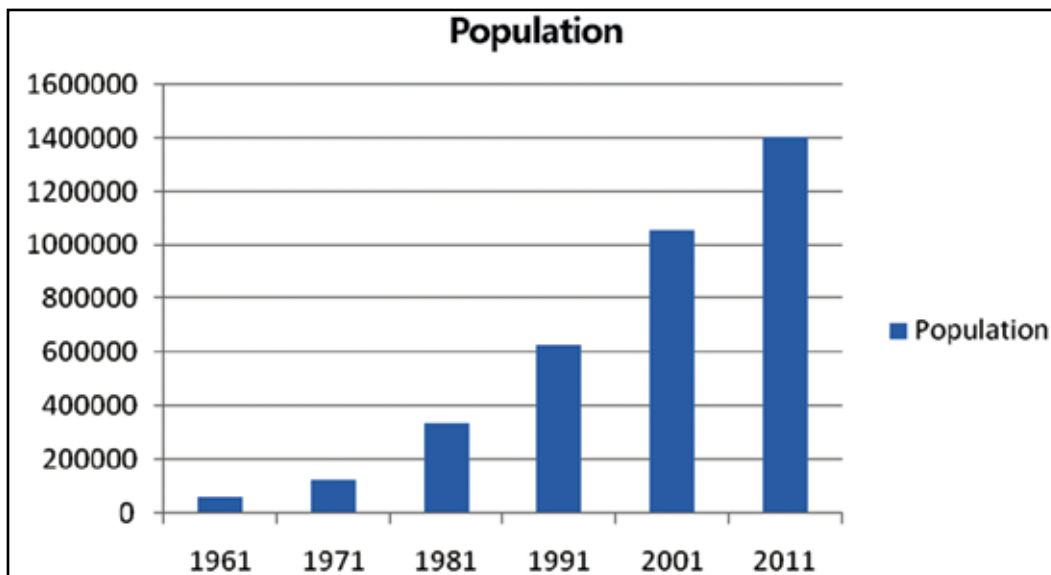
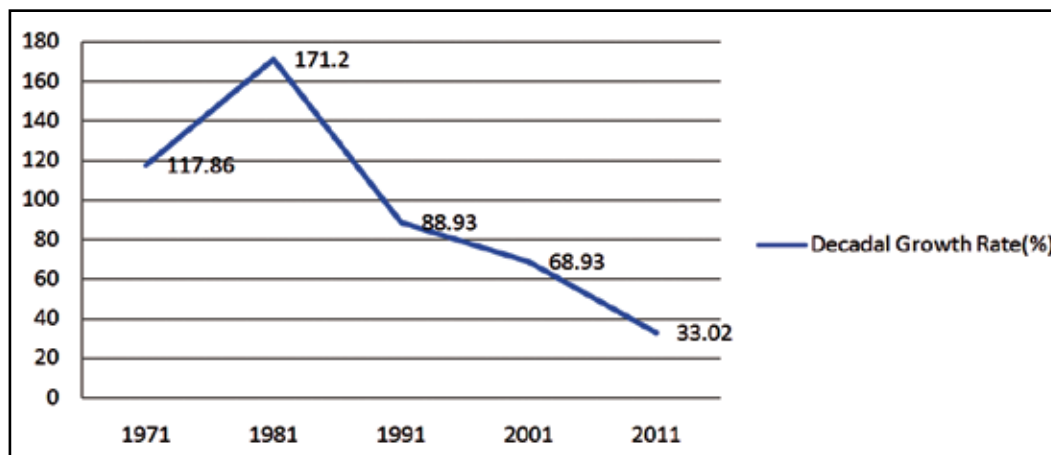


Table 2: Demographic Transition

Census Year	Population Total	Decadal Change	Decadal Growth Rate (%)
1961	56000	66000	
1971	122000	208864	117.86
1981	330864	294221	171.2
1991	625084	430853	88.93
2001	1055938	348715	68.93
2011	1404653		33.02

Source: Municipal Corporation, Faridabad, 2011

Fig. 3: Decadal Growth Rate of Municipal Corporation, Faridabad



Source: Municipal Corporation, Faridabad, 2011



decade. For the past three decades a continuous decline in population growth is observed. As per Census of India, population of Faridabad in 2011 was 1,404,653; of which male and female are 750,446 and 654,207 respectively.

3. CHARACTERISTICS OF URBAN FRINGE

For an objective and scientific delimitation of the-rural-urban fringe, its prime characteristics should be pre-considered. The characterizing features of the fringe may be enumerated as spatial, occupational, demographic, functional, or organizational, social, behavioral, etc.

3.1 Delineation of Urban Fringe of Faridabad

It is evident from the various studies carried out at global and national levels from time to time that there are some common factors which may be taken as the indicators of the urban influence on the surrounding countryside. It would be wise step to decide first those indices or determinants. At the same time it is not advisable to delimit urban fringes of Indian cities on the basis of the criterion suggested for fast growing urban centres of the west, as the land use structure of the Indian cities is highly mixed one as compared to western urban

Fig. 4: Delineation of Urban Fringe of Faridabad

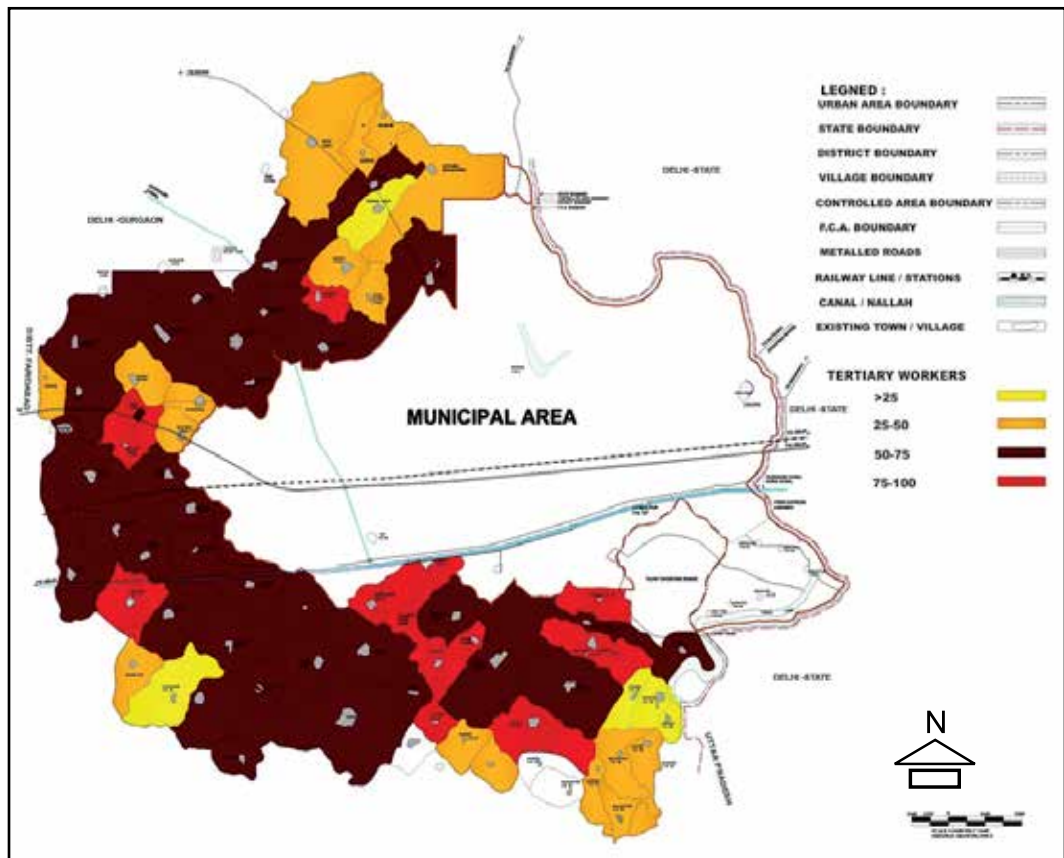




Table 3: Comparative Analysis of Municipal Corporation Area (Urban) and Fringe

S. No	Characteristics	Municipal Corporation Area (Urban)	Fringe Area
1	Area	204 Sq Km	332 Sq Km
2	Population	Census Year	
		1991	625085
		2001	1055938
		2011	1404653
3	Population growth rate	33.02%	143.81%
4	Sex ratio (2011)	871	852
5	Literacy Rate	83%	62%
6	Density of Population	6885 persons/Sq Km	596.84 person/Sq Km
7	Workforce	465269	56960
8	Land use (2011)		
	• Residential	60%	11.7%
	• Commercial	10%	0.25%
	• Industrial	6%	1%
	• Special Zones	2.8%	Nil
	• Public Utilities	1%	Nil
	• Public & Semipublic	2.7%	0.40%
	• Road/Transportation	9.9%	6.8%
	• Open/Recreational Areas	7.6%	Nil
	• Agriculture	Nil	79.85%
9	Physical Infrastructure		
	• Road/Transportation	1218 Km	105 Km
	• Street Lights	22036 units	Nil
	• Water Supply	240 MLD	24 MLD
	• Sewerage	(638 km lines) (200 MLD)	Nil
	• Storm Water Drains	800 Km	Nil
	• Solid Waste	450 MT(collection per day)	Nil
10	Social Infrastructure		
	• Education	52 primary schools, 44 middle schools and 32 higher secondary schools, 5 degree colleges, 3 vocational training institutes, 1 management institute and 1 polytechnic.	12 primary schools, 8 high schools
	• Hospital	3 city hospitals, 10 primary health centers	4 health centers
	• Fire Services	6 Fire tenders	Nil
11	Land value	HUDA Sector starting rate Rs 25000/SqYard	N/A
		Private colonies starting rate Rs 5000/SqYard	Rs 2500/SqYard

Source: MCF, CDP. Primary Survey



centres. Factors to delimit the fringe region are concerned with land use influx, mixed rural urban functions, interaction with the main city, socio - economic development, and availability of population. But we have taken only occupational factors for delineation of urban fringe of Faridabad (Fig. 4).

4. A CASE STUDY OF VILLAGE BHATOLA

Bhatola is located near eastern boundary of Municipal corporation Faridabad (MCF.) Land use of this village is predominantly residential. It is well connected to the town being situated on Faridabad - Tigaon Road and has good facility of bus service. Private transport facility is also available in this village. Many unauthorized colonies such as Bethany Nagar and Nagar Colony have come up due to good connectivity and nearness to city centre. Only little agricultural activity is left (Table 4).

The village had a population of 3,746 in 2011 with population density of 11 persons per hectare in 2011. Overall literacy rate in 2011 was 69.80 percent.

4.1 Issues

4.1.1 Issues in Land Management by Government Authorities

- In case of the village study no Government agency is involved in land development. The advantage of involvement of Government in planned development is that development is done according to standards, which helps achieve orderly development of a city. But Government agencies cannot develop the whole land at one go due to paucity of funds.
- The whole process takes a long time due to involvement of too many Government agencies and procedures.
- Demand for developed land is not being met resulting in scarcity and increasing of land prices making it unaffordable for EWS.

4.1.2 Issues related to Unauthorized Colonies

- Plots mainly bought by LIG and EWS people.
- Roads are not constructed according to hierarchy and standards.
- There is no piped water supply. People left at mercy of bore wells, hand pumps or tankers.
- Electricity is stolen or very less amount is paid in case of metering.

Table 4: Land Utilization and Occupational Structure of Village Bhatola

Land Utilization	Area in hectare	Type of Workers	Number
Cultivable Area	287.26 (84 percent)	Primary Workers	176(18.24 percent)
Uncultivable Area	23.76 (7 percent)	Tertiary Workers	720(74.61 percent)
Waste Land	30.64 (9 percent)	Total Workforce	965(25.76 percent)
Total Area	340.47 (100)		



- Stress on social infrastructure. No schools and community facilities provided.
- The provision of services at a later time becomes difficult as planning is not according to standards.
- Safety standards are ignored as one can see plots developed below high tension lines, etc.
- The major disadvantages of such colonies are deteriorating living conditions for inhabitants and are eyesores in orderly development of the city.

4.1.3 Issues related to Policies and Agencies

- There is no policy for land management in case study areas, which is not yet declared as a development area by MCF or HUDA. No demolition is done. There is no multiplicity of agencies in the fringe areas. DTP (Enforcement) is responsible to see that no construction takes place in these areas, but proper enforcement is not there due to lack of willingness and political interference.
- There are also lot of agencies involved in land management and provision of infrastructure in Faridabad resulting in overlapping of functions and sometimes ambiguity. For example MCF is responsible for land management in only areas under their jurisdiction, mother areas are under HUDA and DTCP are responsible for enforcement of Master Plan.
- Due to lack of funds the Government Agencies responsible for providing infrastructure are not in position to provide the same. The process of providing infrastructure should be made self-sustainable. Taxes may be raised to fund infrastructure projects.

4.1.4 Issues related to Lal Dora

- These are the Abadi areas in which the village population lives. Initially the houses were one storied kuccha houses and no building bye - laws are applicable in such areas according to Development Plan 1991. As these village settlements grow, some more areas are annexed and they are characterized by a mix of different land uses and have similarities in compact built form, narrow circulation space and high density developments. These mainly accommodate residential, commercial, industrial and mixed uses. These areas, established with identified uses, continue to play an economic role.
- As per Zoning Regulation - VI of explanatory note of Final Development Plan published for Faridabad - Ballabgarh Controlled Areas, published in Haryana Government Gazette notification dated 17 December 1991, "notwithstanding the reservation of various sectors for respective land uses for building purposes, the Director may not permit any change in their land use or allow construction of building thereon, from considerations or compact and economical. Development of controlled area, till such time as availability of water supply, drainage arrangements and other facilities of these sectors are ensured to his satisfaction" But this provision is not followed properly.



5. PROPOSALS

5.1 Proposal for Village Development

- Training programs in micro-entrepreneurship, processing of local produce, vocational skill upgradation, etc., allied agro - economic activities such as poultry, dairy, pottery, handlooms, handicrafts and rural tourism may be encouraged.
- Financial incentives and loan schemes for starting micro-enterprises may be worked out and delivered in a package through district planning.
- Providing urban amenities / facilities in rural areas such as housing, better sanitation, water supply, communication system, social infrastructure, etc., to improve the quality of life in the rural areas. Also provide better connectivity among various types of settlements in the rural areas.
- Increasing demand for exotic agriculture produces in the Metropolitan cities of NCR should be met through cultivating non-conventional crops such as mushrooms, broccoli, baby corn, bamboo shoot, poultry, fish as well as floriculture. The State Governments should provide necessary infrastructure in terms of technical know-how, finance and marketing support facilities, etc. to the farmers to promote the non-conventional high value commercial farming in NCR. This will increase per unit earning and also reduce the risk of its conversion to other uses.
- Promotion of strategic partnership between Government agencies, private sector, NGOs and Cooperatives in the areas of marketing, research and development and growth of rural infrastructure.
- Dissemination of relevant information on regular basis to apprise rural people about new opportunities, on-going programs, sources of micro-credit, market potentials, etc.
- The various programs of the Ministry of Rural Development should be incorporated in the Sub-regional Plans and District Plans followed by the Action Plans for their implementation by the constituent State Governments and their agencies.
- The State Governments and their agencies should identify and promote dairy growth centres in the rural areas while preparing the Sub-regional Plans and District Plans.

5.2 Proposals to Prevent Unregulated Development Activities in Fringe Area of Faridabad

- An Urban Growth Boundary (UGB) is a regional boundary set, in an attempt to control urban sprawl by allowing the area inside the boundary for higher density urban development and the area outside for lower density development. The UGB is line drawn on planning and zoning maps to show

Fig. 5: Proposals for Case Study Village - Bhatola, Faridabad



where a city expects to grow. By law, it is required to maintain a 20 year supply of land within the boundary.

- Land outside the UGB will remain rural. The amount of land to be included in the UGB depends on how much the city is expected to grow. With regard to the city's expansion it is this area that will eventually be developed. The first phase of this development is the planning and execution of urban services like sewers, streets, etc; and finally urban development takes the course.

5.3 Proposal to Encourage Private Participation in Land Development

The scheme involves land assembly to an appropriate size, planning, plotting and development of infrastructure and amenities by the private sector under the regulation / supervision of local body / nodal agency of the Government. The mechanism is suggested based on the successful models existing in Haryana (Gurgaon) and Uttar Pradesh (Lucknow) and is visualized as a tool to regulate and ensure orderly development in peri-urban areas on the one hand, and on the other, increase the supply of serviced land within the urban areas.



5.4 Proposal for Timely Implementation of Master Plan

It has been seen that due to delay in implementation of proposals of Master Plan, unauthorized colonization takes place in the fringe areas. Therefore, timely implementation of Master Plan is required so that the planned growth of the city may be ensured.

5.5 Proposal for Provisions of EWS / Affordable Housing Scheme

The persons who don't have the financial resources to buy residential properties in areas developed by the Government agencies and private builders due to high cost, go for unauthorized constructions in fringe areas since land availability in such areas are high and cost is lower. Therefore, Government should provide affordable housing to Economically Weaker Sections of the society upto the ratio between 30-40 percent. It will help in containing the unregulated expansion of cities.

5.6 Proposal for Regulatory Measures Pertaining to Land and Housing Development

The problem of sprawl and related issues should be checked through a package of tax and subsidy measures, aimed at changing relative attractiveness of the farther areas in fringe, vis-à-vis nearer areas (including the city area) for the potential buyers. Land farther from the city could be made less attractive, by making non-agricultural (NA) permission charges progressively higher with distance from periphery, thereby making the land more expensive (Fig. 5).

5.7 Proposal for Amendment in Land Acquisition Act Regarding Proposed Sector Dividing Road:

The provisions of Land Acquisition Act should be amended on the land under proposed road immediately after the notification of development plan so that unauthorized development on the said land is avoided and the sale deed of land under proposed sector dividing road be stopped immediately.

5.8 Proposal for Development of Village in Fringe Area of Faridabad

- Expansion of Lal Dora
- Village Heritage and culture
- Proper infrastructure as per urban conditions.
- Pond conservation
- Heritage Market



5.9 Proposal to curb speculation in land

- Restrictions on premature conversion on agricultural land;
- Taxes on land transfer to check speculation;
- Control of growth;
- Provision of adequate services; like sewage, power and local market.
- Jurisdictional, legal and financial limitations;
- Maintenance of environmental quality of fringe villages and maintenance of pond.

6. CONCLUSIONS

Within the urban fringe areas, *Panchayats* are smallest unit with the same responsibility structure as that of municipal corporations. Although 73rd and 74th Constitutional Amendments give more responsibilities to the *Panchayats*, due to their limited administrative set up, poor financial status and lack of technical staff, they are institutionally weak in playing their role. Given the pace of urbanization and infrastructure requirements in the peri - urban areas, and to mitigate overlaps in the functions of various systems of *Panchayat*, municipalities and other development agencies, creation of a specialized urban development agency is necessary. This agency is to be vested with powers to acquire and dispose land in high pressure zones, and should be the sole planning authority in the delineated areas. State Government may give adequate seed capital to this agency. The main task of this agency will be to prepare plans for the designated areas, and implement the same either directly, or through public private partnerships, or through private sector involvement.

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Sustainably Housing the Urban Poor: a Case of Uttar Pradesh Housing and Development Board

Prof. Subodh Shankar and Mukesh Ruhela



Abstract

Housing the Urban Poor has always been a challenge to planners and architects, ever since this subject came in to the organized domain. HUDCO, being the premier housing agency of the country took the lead, and since its inception in 1970, formulated fiscal policies focusing the urban poor. This created an impetus to various housing agencies like Housing Boards and Development Authorities to frame their housing schemes / projects with an accent on housing the urban poor. This led to the amassing of huge housing shortage in lower income group segment. As per the GOI statistics, 96% of housing shortage exists in this category. The Government of the day wishes to provide liveable houses within sustainable environs to one and all by the year 2022. Undoubtedly, it is a welcome move, especially to the urban poor - as these are the people who need utmost care and state patronage.

1. INTRODUCTION

The commitment of the Government of India to provide a liveable house to every citizen of the country by 2022, is indeed historical decision and deserves applaud from all sections of the society, especially the weaker ones, who at present are forced to feel 'happy' underneath the blue sky.

As per 2015 Union Budget presented by Finance Minister on 28 February, 2015; 20 million urban and 40 million rural houses are targeted to be constructed by 2022 - a marathon and uphill task; unimaginable as per present pace of construction. But this being the most pressing need of 21st century, no Government can run away from fulfilling this obligation.

However, before moving forward towards tackling this unprecedented and uphill task, the current housing situation needs to be studied threadbare; particularly with reference to sector-wise existing housing shortage, type of housing under construction, utilization of the existing stock and lastly the vacancy rate; pre and post allotment.

2. Housing Condition in India

A per statistics published by Ministry of Housing and Poverty Alleviation, the housing shortage in the country is to the tune of 18.78 million with more than 96 percent demand for low income category as is evident from Table 1.

Prof. Subodh Shankar, Professor, Amity School of Architecture and Planning, Lucknow and Former Chief Architect Planner, U.P. Housing and Development Board

Mukesh Ruhela, Assistant Architect Planner, U.P. Housing and Development Board



Although no authenticated data is available on this aspect, various media reports and publicity material of builders across the country suggest that most of the present day construction is targeted for the well to do people in the upper middle class and affluent people, and these are certainly not meant for the people who need it the most - the low income population.

As the housing of the day does not match the real demand pattern, thousands of housing units are lying vacant across the country, either due to their EMIs being beyond the paying capacity of the people or these being hoarded by people who wish to make huge profit out of this 'business'.

Let, as a case study glance through the working of Uttar Pradesh, Housing and Development Board - an undertaking of the Government of Uttar Pradesh, which is in its 50 years of existence as a single entity, has probably developed maximum number of housing units in the country and specifically assess its commitment towards the needy and the poor alongwith its efforts for the rejuvenation of depleting environment leading to the menace of global warming.

3. A CASE OF U.P. HOUSING AND DEVELOPMENT BOARD

The U.P. Housing and Development Board was established under the Uttar Pradesh Avas Evam Vikas Parishad Adhiniyam, 1965 with the prime objective of solving the housing problem of the state of Uttar Pradesh. As per Vision Statement the UPVP shall strive its best to ensure affordable housing in environmentally invigorating habitats with inclusive facilities especially for the economically weaker sections, low and middle income groups and competitive price options for the other sections of the society.

The 'vision' of the Board clearly lays emphasis on two major aspects; namely affordability and environment. It also lays emphasis on inclusivity.

Since its inception, the Board has been extremely sensitive and conscious to the issue of providing housing to the needy persons, specially the lower strata of the population. The fact is well demonstrated through Table - 2, which indicates that since inception the Board has developed majority of its properties (64 percent) in favour of this segment:

The Board's commitment towards low cost housing, housing for the poor and the needy is also seen from

Table 1: Housing Shortage 2012

Category	Numbers in Millions	%
EWS	10.55	56.18
LIG	07.41	39.44
MIG & above	00.82	04.38
Total	18.78	100.00

Source: Ministry of Housing and Poverty Alleviation, Government of India

Table 2: Properties Developed by the Board till March, 2014

Type	Numbers	%
EWS / SSP / SITES	126912	43.85
LIG	40404	14.78
MIG	24029	08.79
HIG	6180	02.26
SFS	16295	05.96
PLOTS *	60041	21.96
OTHERS	6554	02.40
TOTAL	273382	100.00

*Assumption - 25% of the Plots are meant for EWS and LIG category

many highly proactive actions e.g. participation in all India demonstration projects and competitions and working out innovative solutions for them. Some of which are illustrated below:

Fig. 1: Layout Plan of the HUDCO Demonstration Project

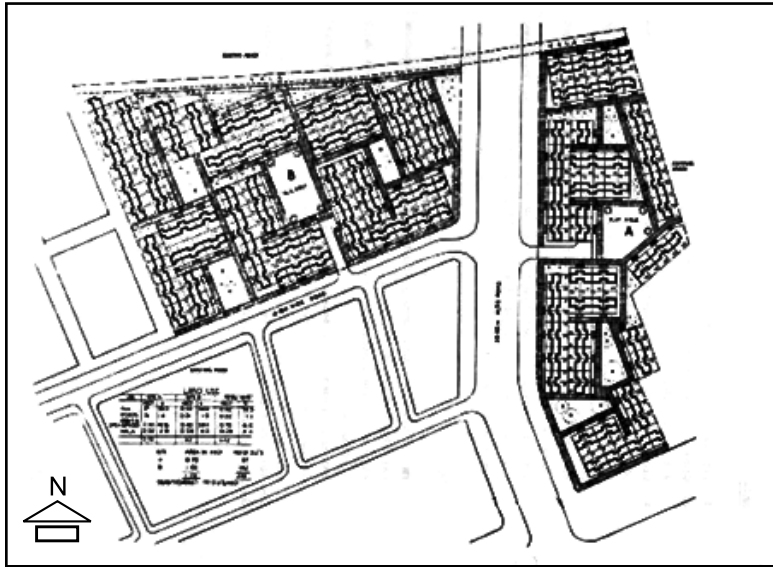
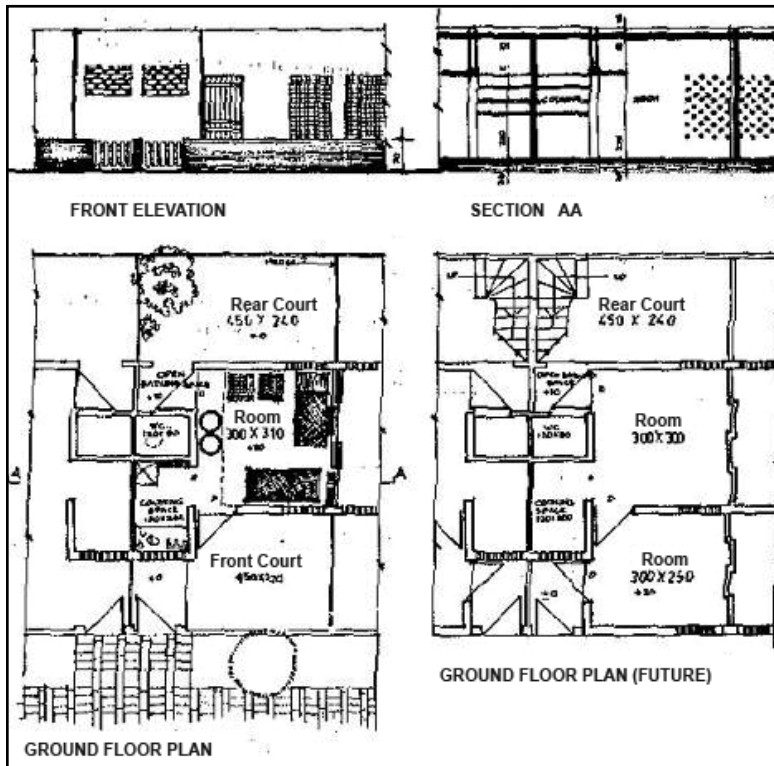


Figure 2: The Growing House



3.1 HUDCO's Demonstration Project at Ghatwasan Yojna (now Kamla Nagar), Agra

With an objective of demonstrating the potential of low rise constructions even in places where land costs are high, HUDCO took up their first ever demonstration project at Ghatwasan Yojna in Kamla Nagar, Agra in coordination with U.P. Housing and Development Board in the year 1974 - 1975.

The project consisted of 480 dwellings on a site area of 1.72 hectare. The dwellings were in the form of independent exponential houses on a plot of 4.5 m X 8 m. The initial accommodation consisted of a room of 3 m x 3 m, cooking space 1.2 m x 2 m and an independent WC with open bathing space adjacent to it. On the ground floor, a room of about 3 m x 2.5 m can be added in the front and by constructing a staircase at the rear; the entire unit can be repeated on the upper floor, providing a total built up space of 50 sq m. High density of 266 dwelling unit per hectare or 1,330 persons per hectare has been achieved, which by no means is lesser than what is achievable with high rise development.

These independent houses were constructed within the then permissible ceiling limit of Rs. 8,000 with a plinth area rate of just Rs. 286 sq m. On the other hand, if these houses were made high rise (4 storied), the Plinth Area rate would have been Rs. 354 sq m. The cost saving techniques includes - RBC in place of RCC; Brick Jali instead of regular window; mud - gobar laped flooring; joint service core of two adjacent units, etc.

Credit for this HUDCO sponsored project also goes to the U.P. Housing Board for having transformed HUDCO's dream in to a reality.

3.2 Participation in all India Housing Design Competitions

The Board has the unique distinction of having enthusiastically participated and won laurels in Hari Om Ashram Trust sponsored HUDCO's all India Low Cost Housing Competitions held in the year 1976 and 1979. In the 1976 competition, the Board's entry at Ram Sagar Mishra Nagar (now Indira Nagar), Lucknow won the Third Prize, while a project in the same scheme won the First Prize in 1979 competition. In 1979 itself, the low cost housing project at Nandanpura, Jhansi, bagged the Second Prize.

3.3 The Third Prize Winning Scheme at RSM Nagar, Lucknow

The intent of HUDCO's competition project for 1976, was to design and develop a housing cluster of 200 low cost houses alongwith a community centre cum primary school and a shopping arcade, within a challenging period of just 12 months. The typical one room house was designed to enable it to grow to two roomed unit on the ground floor which could expand to four roomed double storied unit. Each unit was constructed on a 45.8 sq m. plot with an initial plinth area of 17.1 sq m. Partially precast RB panels with RCC joists (evolved by CBRI) were used for the roofing. A density of 124 dwellings per hectare (620PPH) was achieved in this project.

3.4 The 1979 Low Cost Housing Design Competition

The 1979 low cost housing design competition was announced at a time when it was being found exceedingly difficult by various housing agencies across the country to construct houses within the stipulated ceiling costs of HUDCO. This competition was intended to demonstrate through on site implementation of actual projects and the best designs with innovative construction materials and techniques.

Fig. 3: The Layout Plan

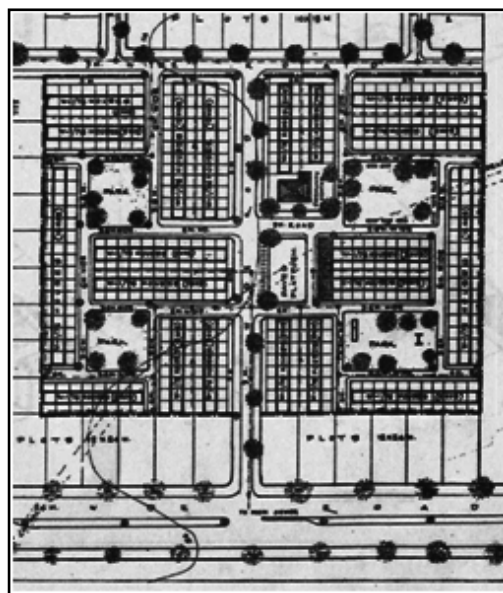


Fig. 4: The Typical Building Plan





The competition project consisted of the design and development of 400 dwellings forming part of a larger housing setup of the implementing agency divided in to 7 types with a cost range of Rs. 5,000/- to Rs. 25,000/-.

Besides 400 houses, the project was also to include a convenient shopping centre, a multipurpose community centre- which could also serve as a nursery school. The project was to achieve a density of 60 -120 dwelling units per hectare and to be completed within a period of 9 months.

3.5 The First Prize Winning Project in RSM Nagar, Lucknow

The project is located in Sector 4 of Ram Sagar Mishra Nagar, (Now Indira Nagar), in Trans- Gomti area of Lucknow. With a project area of 2.8 hectare accommodating 400 units, a density of 145 dwelling unit per hectare (725 persons per hectare) has been achieved.

The houses are designed on growing house concept in back to back terraces as single storied construction to permit individual ownership of the houses. The innovative techniques used are - half brick staggered walling system, fly ash lime sand plaster, mud gobar laping in flooring, and common door shutter for 2 openings in EWS houses.

The grouping of houses has been made to depict the interplay of houses, open spaces and access ways, promoting optimum use of individual and common spaces and also permitting sufficient vehicular traffic within the project area.

The Project fulfilled all the requirements of the competition viz. the time line and the ceiling costs. The Jury specially lauded the use of 4.5” staggered walling system and the use of fly ash lime mixture in the plastering work.

Table 3: Dwellings Details- RSM Nagar, Lucknow

Type	No. of Units	Plot Area (Sq.M.)	Plinth Area (Sq.M.)	Accommodation
EWS				
E-1	116	22.4	16.6	Multi Purpose Room +WC
E-2	60	32.0	18.0	Room, Cooking, WC+ Bath
LIG				
L-1	78	41.2	18.6	1 Room, Cooking Space, WC, Bath
L-2	61	41.2	30.3	2 Rooms, Cooking Space, WC, Bath
L-3	43	62.7	31.9	2 Rooms, Cooking Space, WC, Bath
MIG				
M-1	26	87.0	36.0	Living, 1 Bed, Kitchen, WC, Bath
M-2	16	87.0	46.0	Living, 2 Bed, Kitchen, WC, Bath

Fig. 5: The Layout Plan

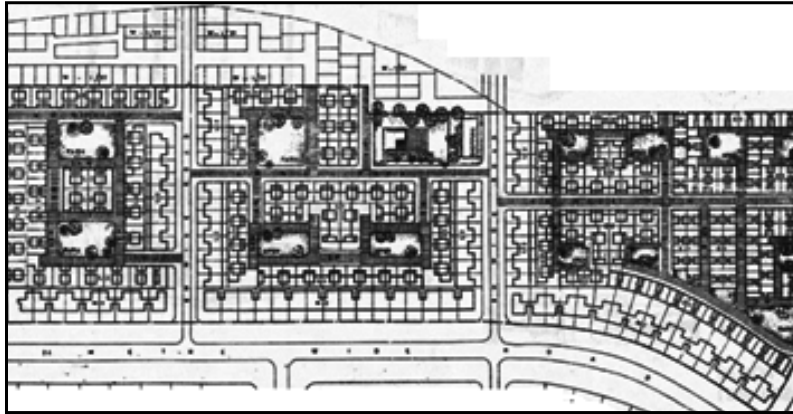
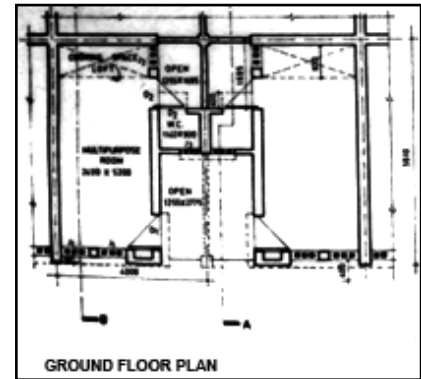


Fig. 6: The One Room Exponential House



3.6 The Second Prize Winning Project at Nandan Pura, Jhansi

The Project is located in Nandanpura scheme on Jhansi - Shivpuri State Highway. The surroundings of Jhansi region (Bundelkhand) are characterized by semi rocky terrain, hot and arid climate and sparse population. The project is sited on 3.10 hectares of land and the layout plan on it has been planned in a compact pattern. A density of 130 dwelling units per hectare (650 PPH) has been achieved without sacrificing the environmental or physiological requirements. All houses are plotted single storied with provision for further expansion.

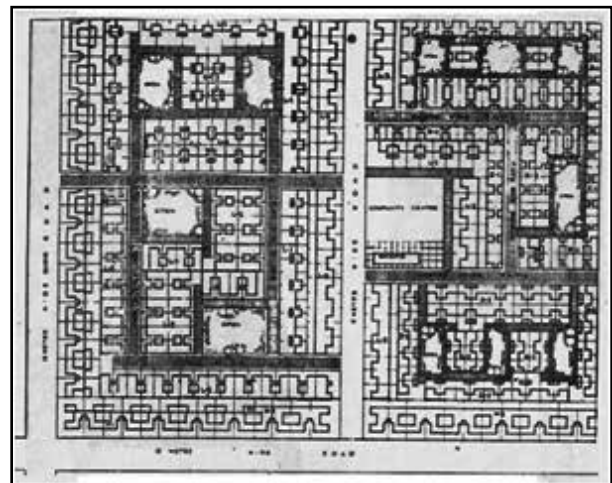
All the house types have been designed to derive maximum advantage from the selective use of locally available stone masonry in conjunction with staggered brick walling system. In all, 7 types of houses, locally available 8 cm thick sand stone slabs, with a maximum span of 2.8 m, have been used. Floors of the houses have also been laid in locally available 2.5 cm thick stone pattias. Stone has also been widely used as base materials for the roads and as a pavement element. The Project fulfilled all the requirements of the competition viz. the time line and the ceiling costs. The extensive use of locally available sand stone was highly appreciated by the Jury.

All the 3 prize winning projects of the Board have successfully demonstrated that with the use of innovative planning techniques

Fig. 7: One roomed EWS House



Fig. 8: The Layout Plan - Nandanpura, Jhansi



and technology, housing cost can be made affordable for the needy and poor population.

3.7 Ashraya Yojna, Deendayal Puram, Takrohi, Lucknow

In 1997, the Board launched a unique housing scheme with highly innovative repayment plan at Deendayal Puram, Takrohi, on the out skirts of Indira Nagar, Lucknow for the marginalized people like rickshaw pullers or the construction labour etc., earning their livelihood on daily basis. For such people 3 types of single storied exponential houses were constructed with installments as low as 5, 10 and 15 Rupees per day. All the 3 designs had a plot area of 25 sq m with one

Table 5: Details of the Dwellings at Deendayal puram, Takrohi Scheme, Lucknow

S. No	Type	No. of Units	Plot Area (Sq. M.)	Plinth Area (Sq. M.)	Accommodation
1	G-12/25 (Rs. 5 per day)	150	25	12.24	Room, Future Store/ W.C. (Replicable on upper floor)
2	G-15/25 (Rs. 10 per day)	264	25	15.00	Room, W. C. (Semi finished) (Replicable on upper floor)
3	G-15/25 (Rs. 15 per day)	300	25	15.00	Room, W. C. (Finished) (Replicable on upper floor)

Fig. 9: The Layout Plan -Ashraya Yojna, Lucknow

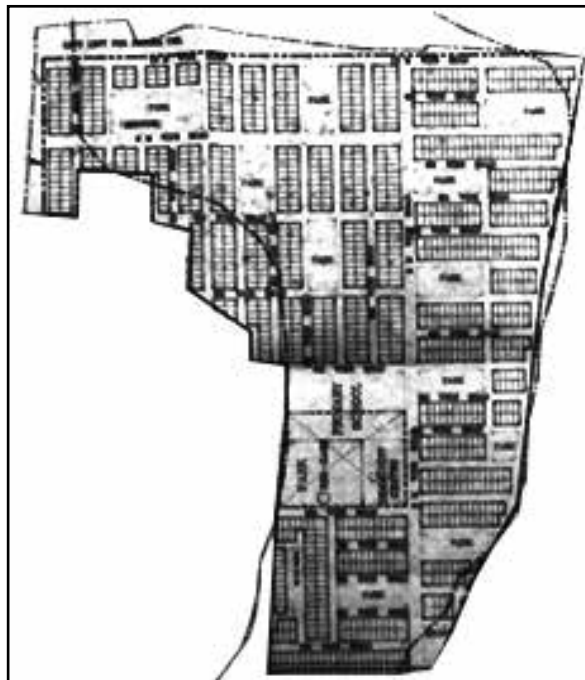


Fig. 10: Typical House Plan





multipurpose room. While the 5 Rupee installment house - mates had to depend on the facility of community toilet and water supply, other two types had in-situ toilets. On site arrangements were made for the collection of EDI (Equitable Daily Installment) and the allottees were given free bicycles for commuting to their place of work. Health, education, community and shopping facilities were provided within the site having 700 odd housing units, making the scheme a self sufficient one. The total Project Area was 4.42 hectare and number of dwelling Units were 714 and density achieved was 162 dwelling units per hectare or 810 persons per hectare.

4. ENVIRONMENTAL UPGRADATION

U.P. Housing and Development Board is fully aware and conscious of the issue of global warming. Thus, it is making all possible efforts for mitigating this menace. Some of the Board's green initiatives are as follows:

4.1 Rain Water Harvesting (RWH)

- All residential schemes of the Board having an area of 20 acres or more earmark and develop an area equivalent to 5 percent of the scheme area as a ground water recharge pond.
- In the group housing projects, rain water harvesting system is being integrated with water supply, drainage and sewerage system.
- For facilitating sufficient percolation of rain water; Parks and Open Areas are not permitted to have more than 5 percent as built- up space including pavements. The footpaths and tracks are made of permeable or semi permeable perforated blocks.
- All the existing ponds falling within UPHDB's schemes are retained and improvised by developing these as water related theme parks.

4.2 Environmental Upgradation through Provision of Ample Open Spaces and Tree Plantation

- At least 15 percent of the total scheme area is reserved for 'open spaces' which is developed in the form of park, play field or tot lots. Such spaces are planted with trees @ 125 trees per hectare.
- Besides tree plantation in the parks and open spaces, trees are also being planted along all the minor and major roads of the housing board colonies. Even, commercial areas are designed to have at least 20 percent area as green with tree plantation @ 50 trees per hectare.
- Care is taken to plant trees which require lesser water especially in summer seasons

Fig. 11: Sri Arbindo Park, Indira Nagar, Lucknow



Fig. 12: Kalindi Van at Vrindavan Yojna, Lucknow



Fig. 13: Swaranjyanti Park, Lucknow



- The Board has developed many State of Art Parks in its schemes - notable amongst these are Swarn Jayanti Park and Sri Arbindo Park- Indira Nagar, Lucknow; Shaheed Park at Amrapali Scheme, Lucknow; Kalindi Van at Vrindavan Scheme, Lucknow. The Swarn Jayanti Park and Kalindi Van have won laurels in the recently (2015) held landscape and gardening competitions.

4.3 Conservation of Natural Features and Flora and Fauna

Being environment conscious, the Board takes adequate care for retaining exiting orchards, ponds, water bodies and natural features which accentuate the eco system of the area. As an example, in Vrindavan Scheme at Lucknow, an area close to Sharda Canal where lot of seepage water was getting collected in the form of swampy land, has been developed as an extremely attractive water park, and continues to remain an abode for migratory birds.

4.4 Use of Green Materials and Techniques

The Board has been perennially conscious about use of green materials and techniques almost since its inception. It has encouraged use of locally available and low embodied energy building materials in its project. For undertaking research in low cost and eco - friendly materials and techniques the Board has established 'Building Centres, in various schemes. These centres have evolved building components mainly with the usage of Ferro cement technology- a certified green technology.

4.5 Encouragement for the Use of Solar Energy

- **Solar Lights for lighting the streets:** The Board has taken an initiative to use solar energy for street lighting. Besides, reducing the electricity bill of the local body, this



initiative will also motivate the residents of the colony for installing solar energy systems within their own premises.

- **Solar Heating:** Building plans of hospitals and nursing homes; hotels; guest houses; educational institutions; community centres and barat gharhs (Marriage Halls) and houses having an area of 500 sq m and above are sanctioned with a direction to make adequate provision for solar water heating in their premises.

5. CONCLUSIONS

Affordability and environmental concerns of Uttar Pradesh Housing Board vividly indicate that this organization is very well caring for the interests of the urban poor and side by side is also trying to upgrade the environment by way of recharging rain water, by providing state of art parks and green spaces; by encouraging use of solar energy and the use of innovative and green materials and technologies.

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To build a city is something happy to think of. To create a new town is itself a happy thing. There cannot be a greater joy than to create, it is almost godlike to create. To be associated, therefore, with the construction of a city has been a thing which I appreciate the most.

Jawaharlal Nehru