Residential Location Choice: A Study of Household Preferences for the City of Nagpur

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Abstract

The present study explores the responsiveness of various types of geographic, social and economic parameters on the choice of residential location, type and ownership pattern of households in Nagpur city. Households belonging to the monthly income bracket of INR 10,000 – 50,000 were chosen for the above study. A discrete choice model using disaggregate level data was used for exploring the process of choice making for residential location choice, dwelling type and ownership, and calibrated for sequential decision making process as well as simultaneous decision making process and their results were compared. The results highlight that housing location decision for LMIG is relatively insensitive to the ownership and housing type choice for the HMIGs.

1. INTRODUCTION

More than half of land resources in an urban area are generally dedicated for residential activity – making it the single largest land consuming land use. Residential land is distributed within the urban structure in form of residential zones each having a variety of attributes differing from one another. Urban population chooses to settle in these residential zones depending upon zonal attributes and preferences they attach to each of these attributes.

Understanding the residential choice provides key insight into housing demand characteristics. Housing demand subjected to housing supply conditions decides the housing price and prices of all other real estate assets associated with residential activities. Livability and attractiveness of an urban area is often closely interlinked with housing availability and its price. Therefore, any future urban planning initiative can not afford to overlook the dynamics of residential location choices.

A brief review of the past studies on residential location choices indicate emergence of several types of decision-making models i.e. geographic model, economic model and social models with a wide array of variables used in them. Most of the models

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are essentially disaggregate in character where household is taken as a unit for arriving at residential location choices. Relative influence of each variable at the household level has been observed to change according to various factors i.e. city size and structure, disposable income, socio-economic characteristics, family structure, social and cultural values, etc.

This study makes an attempt to identify variables which are significant for the city of Nagpur and estimates the level of influence each of them exerts on residential decision making. The study is restricted to households having disposable monthly income between 10,000 INR and 50,000 INR. This segment has been particularly chosen as households lying below this income range make residential location decisions under captive conditions due to lack of affordability, although the number of such households is very high in Nagpur. On the other hand, households lying above this income range do have lot of options to exercise and they constitute a miniscule component of the housing market in Nagpur. It is tautological to point out that this income band will vary greatly with the socio-economic characteristics of the urban area and it has been chosen for the city of Nagpur based on indigenous observations.

In the following sections, a brief review of various approaches to residential location allocation will be briefly discussed followed by model development, data collection and analysis, model validation along with the policy implications for the outcomes.

2. REVIEW OF VARIOUS APPROACHES TO RESIDENTIAL LOCATION ALLOCATION

Location allocation theories have been in existence since the last century. However, most efforts have come to light only in1950s. Based upon the relative stress each approach has placed on certain group of variables to explain the decisions taken by households for residential location, approaches could be broadly divided into three distinct categories- Geographic Models, Social Models and Economic Models.

Geographic models have stressed mainly on the parameters of accessibility i.e. distance to work place, shopping destinations, social facilities and amenities along with cost implications based on their mode affordability and choice. Social models have relied mainly on life cycle factors i.e. age and structure of households, neighborhood characteristics, quality of life, environmental pollution, community relations, ethnic and cultural ties and social recognition as the main explanatory variables. Economic models have extensively relied on economic parameters i.e. housing prices and quality, subsidies and taxes, availability of housing finance, etc. Some hybrid models have also evolved which tried to explain residential choice by using a combination of social, economic and geographic variables. A brief summary of various types of approaches along with their salient features is presented in Table 1 along with their contributors.

A brief look at the chronological development of these models indicates that geographical models received more attention between 1950s and 1970s when location decisions were believed to be guided only by accessibility parameters.

Table 1 Various Types of Models along with their Salient Features Used for Residential Location Choice

Type of model	Contributor	Salient features
Social	Rossi (1955)	Use of life cycle parameters as critical determinants i.e. age of household head and presence of children found to be most significant.
	Adams (1969)	Intra-urban residential movement is dependent on limited mental maps or images of the city parts.
	Speare et. al (1974)	Incorporated variables i.e. locational amenities, overcrowding, high quality school, crime rate, etc; to explain residential choices.
	Alba and Logan (1991 & 1993)	Introduced place stratification model for explaining racial segregation and grouping of disadvantaged sections of community.
	Rapaport (1997)	Stress on variables related to quantity of housing services demanded i.e. durability, heterogeneity and spatial fixity.
Economic	Tiebout (1956) Ellickson (1971) Friedman (1981)	Role of national and local government in housing decision making emphasized as it affects the marginal cost-benefit equation for a given jurisdiction.
	Lee (1985)	Used dynamic two-period models instead of static models with variables i.e. current housing price and income, borrowing constraints, evaluation of future prices and income, expectation of future prices, etc.Dynamic approach is not much preferred as it requires multi-period data - unavailable in most cases
	Goodspeed (1998)	Households were observed to shop for an optimal package of public services at lowest possible costs in the competitive market of differential tax service packages.
Geographical	Alonso (1964) Muth (1969) Kain and Quigley (1970) Evans (1973) Straszheim (1975)	Residential location dependent on spatial parameters, mainly job location – emphasized that marginal cost of moving towards CBD should be equal to marginal benefit.
Hybrid	Smith, Rosen & Fallis (1988)	Relied on three aspects – (a) distance from important locations i.e. CBD; (b) nature of land use in neighborhood; (c) local government in whose jurisdiction housing is located
	Werezberger (1995)	Introduced the role of spatial externalities i.e. neighborhood prestige, pollution, school quality etc.Equally stressed on access parameters, neighborhood effects and provision of public goods and tax structure; however, access parameters lacked explicit geographic content as they only considered spatial attributes of location but not its distance from CBD

However, social models soon came into prominence by explaining the anomalies which geographical models would simply prefer to call them irrational and inefficient choices. Role of qualitative aspects such as neighborhood characteristics, demographic structure of households, pollution and crime levels, ethnic and cultural ties, etc; played a major role in shaping the residential location decisions. Finally, the economic models gained much desired attention whereby residential decisions

Table 2: Discrete Choice Approaches Used for Residential Location Choice

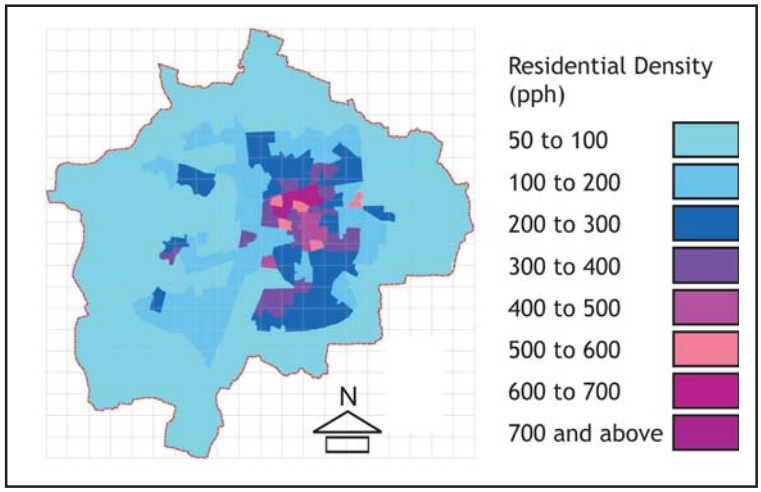
Contributor	Salient features
Quigley (1976)	First to combine individual choice model with model of the structure of the housing market; application of multi-nomial logit model for finding combined choice of residential location and housing type (this was later referred by McFadden as variant to nested logit model).
McFadden (1978)	Developed logit model suitable for empirical analysis of housing location choice; emphasized that structure of similarities between alternatives invalidates the commonly used discrete choice model and argued for application of nested logit models.
Friedman (1981)	Use of multi-nomial logit model to find the role of local public services in residential choices.
Pollakowski (1982)	Used multi-nomial logit model to estimate residential choice for various income groups and analyze their housing preferences.
Nechyba and Strauss (1998)	Applied discrete choice model to estimate the impact of local fiscal and other variables on choice of community.

were observed to be influenced not only by accessibility and social parameters but on housing availability, pricing, local government's standpoint on housing taxes, subsidies and tax relief on loans, access to housing finance, etc.

There is no doubt that each group of parameters have a role in explaining residential location choices, however, their significance level and relative level of influence vary considerably with the socio-economic, socio-cultural and demographic characteristics of the households.

Discrete choice models using disaggregate data has been the predominant approach for estimation of residential location choices since 1970s. Households choose a single location among a set of alternatives (that is why it is referred as discrete choice) by maximizing their utility function. Utility functions are estimated based on the disaggregate data collected at the household level. Choices exhibited at the disaggregate levels are then aggregated to arrive at the choice for the entire population. Multinomial Logit models in various forms (simple as well as nested) are extensively used for estimation of the utility functions and to arrive at the location choice models. A few noted approaches in discrete choice models being used for residential allocation are summarized in Table 2.

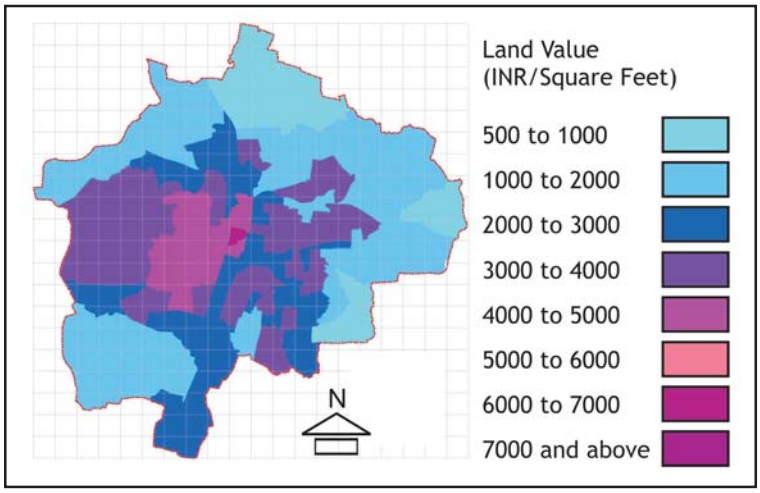
Fig.1 Population Density of Nagpur City



3. A BRIEF INTRODUCTION TO THE CITY OF NAGPUR AND ITS HOUSING SCENARIO

Nagpur Municipal Corporation is spread over an area of 217 sq km and

Fig. 2 Land Value Gradient of Nagpur City

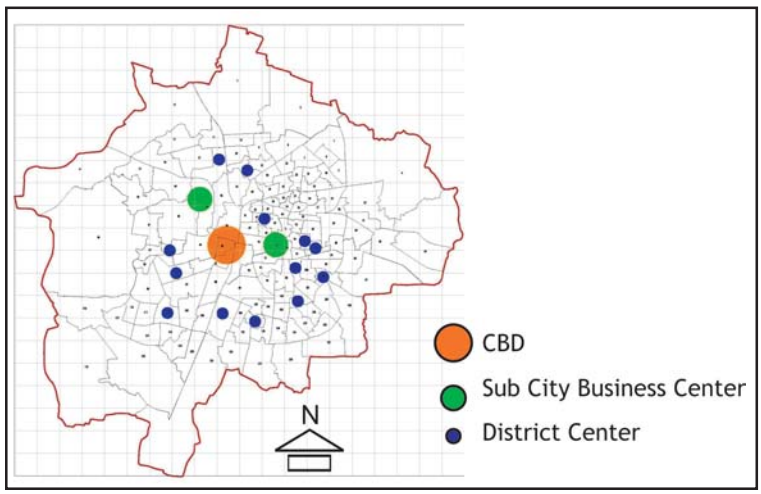


has a population of 2.05 million in 2001. In the past decade (1991-2001) it has experienced a population growth rate of 26.3 percent. It acts as the key administrative, business and institutional centre for central India. It has already established itself as an educational hub attracting students for higher education from all across the country. Information technology (IT) and IT enabled services (ITES) are also coming up at dedicated IT parks near Sadar and Parsodi.

Announcement of Multi-modal International Hub Airport in Nagpur (MIHAN) project has been one of the key developments in recent times, which is expected to greatly transform the urban structure of the city. Real estate market which was stagnant for many years has suddenly become buoyant. Fig. 1 and Fig. 2 illustrate the population density along with land values in Nagpur. Major companies i.e. General Electric, DLF, Shapoorji Pallonji, Larsen and Toubro, Patni computers, Microsoft, etc; have taken up large parcels of land within the designated SEZ of the cargo hub.

This in turn has induced a huge demand for residential floor space within the city. Real estate sources reveal that supply of residential floor space has increased rapidly in recent times. Large parcels of land have been acquired for development of large scale residential townships. New residential developments are mainly concentrated along Kamptee Road in the north east, Khamla and Hingna Road in south west as well as Besa and Wardha Road in the south. For the purposes of this study location of the residential development in Nagpur has been divided into three distinct categories as per intensity of development and land values. They are (a) near Central Business District; (b) near Sub-city Business Center; and (c) near District Center. This nomenclature has been used according to the order of commercial centers specified in the

Fig. 3: Map Showing Location of CBD, Sub-city Business Centers and District Centers in Nagpur City



Urban Development Plan Formulation and Implementation Guidelines as most of the residential zones are observed to be clustered around various commercial centers.

Nagpur is undergoing major transformations and it is trying to cope up with these changes through improving its physical infrastructure. This city is one of the million population cities and has been included under the Jawaharlal Nehru National Urban Renewal Mission for funding its infrastructure projects. It is a city for which the City Development Plan (CDP) has already been prepared.

4. MODEL FORMULATION

This study focuses on the identification of parameters which are significant in residential location choices for the city of Nagpur and estimate their relative influence on the choice probability. However, it has been observed from various studies that decision making regarding residential location choice is integrally associated with the two other types of decision making. They are choice of ownership i.e. owned or rented accommodation and consumption of land as in plotted development or condominium/apartment/flat.

Residents who do not expect to stay for a longer duration or lack affordability to buy a house or do not have easy access to housing finance prefer rented accommodation compared to ownership. Housing rents are dependent on the use value of the asset for residential usage, whereas housing prices are often based on the speculative gains one expects to make by owning that asset. A brief look at the rapidly increasing ratio of housing price to its rent till 2008 (before the crash of the real estate market) has been observed in all the major Indian cities where speculative forces went bullish. Therefore, housing rents and prices exhibit two different aspect of residential property market – rent indicative of use value and price reflecting its speculative value.

As land prices soar high near the core areas of the city, capital investments per unit area of land increases creating an economic rationale for multi-storied residential units. Most of the housing stock available near the CBD is multi-storied. Therefore, location choice is also intertwined with the choice between low rise plot and high rise condominiums.

Choices are often expected to be made simultaneously for three decisions rather than carried out in a sequential manner (Lerman, 1976 and Rapaport, 1997). In this study, we will explore both simultaneous and sequential choice making and present the differences they have in the final outcome. The decision making model developed in this study follows five distinct steps.

4.1 Identification of Variables

An extensive list of variables has been identified which are expected to influence the decision making processes for residential location, ownership pattern and type of housing i.e. plotted development or multi-storied apartments. These variables

Table 3 Broad Classification of Variables Chosen for Study of Residential Location, Ownership and Type

Broad category	Variable name	Description of variable	Type of variable (Dummy/ Continuous)
Demographic characteristics of households	Family type (FT)	FT1 - Nuclear Family FT2 - Extended Family FT3 - Joint Family	Dummy
	Household size(HHS)	HHS - No. of people in HH	Continuous
	No. of Children (NC)	NC - No. of Children in HH	Continuous
	Mother tongue (MT)	MT1 - Marathi MT2 - Hindi MT3 - Marwadi MT4 - Bengali	Dummy
	Age of household head (AHH)	AHH1 - Up to 35 AHH2 - Between 35 and 55 AHH3 - Between 55 to 65 AHH4 - Older than 65	Dummy
	Education level of household head (EHH)	EHH1 - Up to High school EHH2 - Up to undergraduate EHH3 - Professional and Postgraduate	Dummy
Socio-economic characteristics of households	No. of workers in household (NWHH)	NWHH1 – Male/one member working household NWHH2 - Both male and female i.e. two member working household NWHH3 - More than two member working household	Dummy
	Occupation of household head (OHH)	OHH1 - Industry OHH2 - Service OHH3 - Trade and commerce OHH4 - Technician and skilled labor	Dummy
	Monthly disposable household income (MDHI)	MDHI1 - Up to10,000 INR MDHI2 – 10,000 to 30,000 INR MDHI3 – 30,000 to 50,000 INR	Dummy
Economic attributes of housing stock	Type of dwelling unit (TDU)	TDU1 - Plot TDU2 - Flat	Dummy
	Dwelling ownership (DWO)	DWO1 - Rented House DWO2 - Owned	Dummy
	Monthly rent (RENT)	RENT1 - 2000 to 3000 RENT2 - 3000 to 5000	Dummy
	Net present value of housing stock (NPVH) in INR	NPVH1 - Less than 10 lakh NPVH2 - 10 lakh to 20 lakh NPVH3 - 20 lakh to 35 lakh NPVH4 - 35 lakh to 70 lakh NPVH5 - 70 lakh and above	Dummy
Quality/Structural attributes of housing stock	No. of habitable rooms (HR)	HR - Number of room ,other than kitchen and bedroom	Continuous
	No. of bedrooms (NB)	NB - Number of bedroom	Continuous
	Age of dwelling unit (ADU)	ADU1 - Up to10 years ADU2 - 10 to 30 years ADU3 - More than 30 years	Dummy

Broad category	Variable name	Description of variable	Type of variable (Dummy/ Continuous)
Social attributes of Neighborhood	Duration of stay for the present household (DS)	DS1 - Up to10 years DS2 - 10 to 30 years DS3 - More than 30 years	Dummy
	Location of Neighborhood (LN)	LN1 - Near CBD LN2 - Near Sub-city business center LN3 – Near District center	Dummy
	Access road width to neighborhood (AN)	AN1 - Less than 3.75 m wide AN2 - 3.75 m wide AN3 - 5.5 m wide AN4 - 7.0 m and above	Dummy
	Level of overcrowding /congestion (PC)	PC1 - Low PC2 - Medium PC3 - High	Dummy
	Type of Neighborhood (TN)	TN1 - Predominantly same religion TN2 - Predominantly same language TN3 - Predominantly same income group TN4 – Heterogeneous in religion/ language/income	Dummy
	Proximity to park facilities (PPF)	PPF1 - 0 km to 0.5 km PPF2 - 0.5km to 1 km PPF3 - 1km to 2km PPF4 – More than 2 km	Dummy
	Proximity to school facilities (PSF)	PSF1 - Government school PSF2 - Semi- government PSF3 - Private PSF4 - Convent	Dummy
Accessibility attributes	Place of work (PW)	PW1 - Work in neighborhood PW2 - Work in CBD PW3 - Work in Urban area PW4 - Work in Suburban	Dummy
	Mode of travel to work place (MTW)	MTW1 - Cycle MTW2 - Public transport MTW3 - Two wheeler MTW4 - Car	Dummy
	Mode of travel to shopping (MTS)	MTS1 – Cycle MTS2 – Public transport MTS3 – Two wheeler MTS4 – Car	Dummy
	Proximity to relatives (PFF)	PFF1 - In neighborhood PFF2 - Near by PFF3 - In city PFF4 - None	Dummy

have been broadly classified under five categories and presented in Table 3. Two categories of income i.e. LMIG (Lower MIG with income range from 10,000 INR to 30,000 INR) and HMIG (Higher MIG with income range from 30,000 INR to 50,000

INR) have been used for this study. Residential location also has been divided into three broad categories i.e. near CBD, near sub-city business center and near district center. Type of housing was limited to two choices i.e. plot and apartment. Detailed description of each variable type and description is presented in column three and four of Table 3.

4.2 Data Collection through Sample Survey

An extensive data set at household level has been collected during September-November 2008 through stratified random sample survey for the city of Nagpur. This data set will be used to identify variables which are significant for calibrating the model. Design of sample survey and sample characteristics are presented in the following section.

4.3 Elimination of Variables based on Level-of-Significance

The number of variables taken is 83 including continuous and dummy variables for this study and pose difficulty due to computational constraints. This stage eliminates variables which are not found significant. Simple linear regression model for both continuous and dummy variables are used for this purpose. Based on the level of significance of each variable, elimination is carried out. Only the significant variables are entered into discrete choice model for calibration. This step is only intended to ease the process of calibration which is very helpful particularly when faced with computational resource constraint. Access to sound computational sources will make this step redundant as one can directly enter all the variables for calibration of the discrete choice models.

4.4 Calibration of the Discrete Choice Model for Sequential Decision Making Process

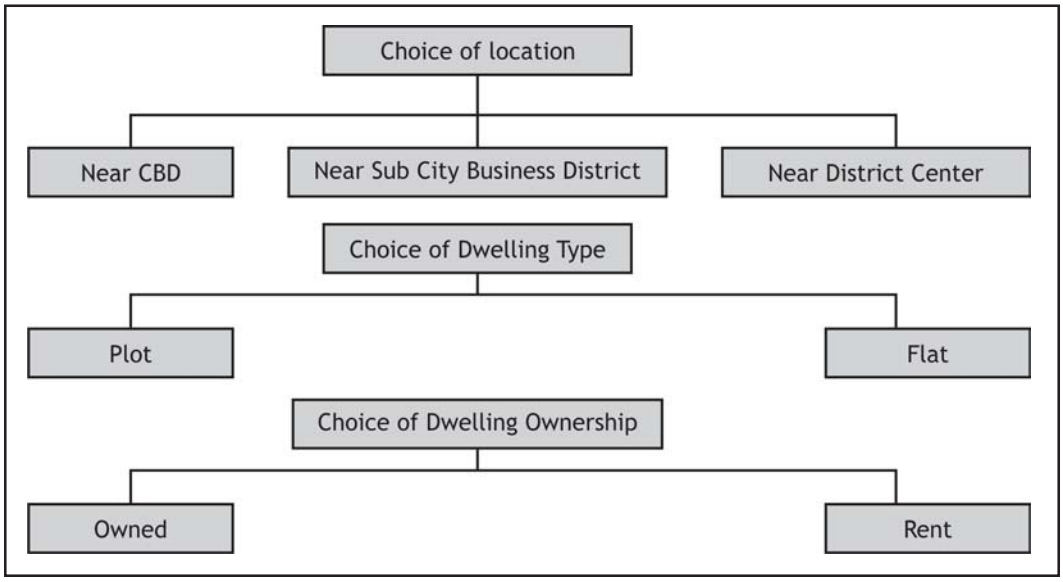
Significant variables are now entered for calibration of the multinomial logit model. As previously discussed multinomial logit models are chosen for discrete choice analysis. In this case, calibration of the logit models will be done independently for choice of residential location, ownership and type (Fig.4). For example, choice of location will be independent from whatever choice a person makes regarding ownership pattern or type of housing.

4.5 Calibration of Discrete Choice Model for Simultaneous Decision Making Process

At this stage, significant variables are entered for calibration of conditional multinomial logit models to take simultaneous decision making into account. For example, choice of location will be conditioned to the type of ownership pattern as well as type of dwelling s/he opts for.

Design of survey for data collection has been in accordance with the study objectives. Data has been collected at household level as disaggregate discrete choice models were chosen for estimation. Total number of samples collected is 287 of which 109 belonged to LMIG and rest to HMIG. Samples were collected based

Fig. 4 Choice of Location, Dwelling Type and Dwelling Ownership

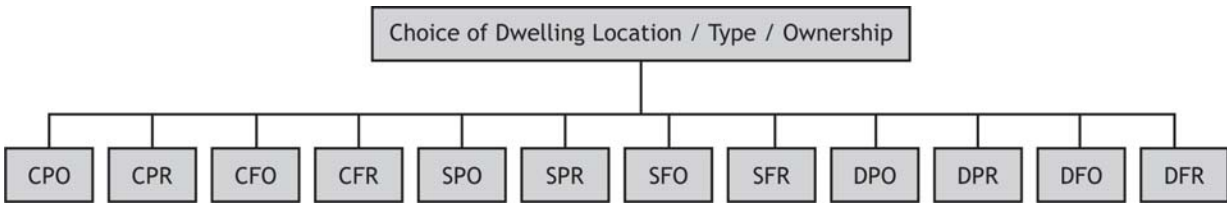


on the observed location preferences for LMIG and HMIG households near CBD, sub-city business centers and district centers. Spatial distribution of samples chosen for the study is presented in Table 4. A brief summary of the sample characteristics is presented in Table 5.

5. MODEL RESULTS AND INFERENCES

Based on the sample data collected at the household level, an OLS estimation of linear regression model is carried out with variables listed in Table 3. Both continuous and dummy variables are used in this estimation. Residential location, types of ownership and dwelling type have been taken as dependent variables. Basic purpose is to eliminate those variables which are less significant (less than 68 percent in this case). Variables with higher level of significance than the cut-off level will only be entered into the multi-nomial logit model for analysis of behavioral

Fig. 5 Type of Ownership Pattern



CPO= CBD/Plot/Own; CPR=CBD/Plot/Rent; CFO=CBD/Flat/Own; CFR=CBD/Flat/Rent;

SPO=Sub city business district/ Plot /Own; SPR=Sub city business district/Plot/Rent; SFO=Sub city business district /Flat /Own; SFR=Sub city business district /Flat /Rent;

DPO=District center/Plot /Own; DPR=District center /Plot /Rent; DFO=District center /Flat /Own; DFR=District center /Flat /Rent

Table 4 Various Order of Residential Locations in Nagpur and Sample Distribution

Order	Residential location	Area jurisdiction (Municipal Ward No.)	No. of samples
1	Near Central Business Center	Sitabadi (80)	43 (15 %)
2	Near Sub-city Business Center	Sadar (43), Mahal (70)	109 (38 %)
3	Near District Center	Chhaoni (18), Indora (20), Juna Bagadganj (61), Hansapuri (66), Juni Mangalwari (73) Shankar Nagar (82), Dharampeth (83), Haranbag (98), Sakkardara (102), Ajni (107), Pratap Nagar (110), Kailash Nagar (127)	135 (47 %)
		Total	287 (100 %)

Table 5 Salient Characteristics of the Sample Collected for the Study

Variables	Total sample	LMIG	HMIG	Variables	Total sample	LMIG	HMIG
Family Type (FT)				**Age of Dwelling Unit (ADU)**			
Nuclear Family (FT1)	62%	51%	49%	Up to10 years (ADU1)	37%	42%	58%
Extended Family (FT2)	22%	37%	63%	10 to 30 years (ADU2)	54%	47%	53%
Joint Family (FT3)	16%	32%	68%	More than 30 years (ADU3)	9%	45%	55%
Average Household Size (HHS)	5.11	4.5	5.5	**Duration of Stay of HH (DS)**			
				Up to10 years (DS1)	50%	43%	57%
				10 to 30 years (DS2)	40%	46%	54%
				More than 30 years (DS3)	10%	50%	50%
Average Number of Children (NC)	1.26	1.12	1.36	**Location of Neighborhood (LN)**			
				Near CBD (LN1)	15%	41%	59%
				Near sub-city business center (LN2)	38%	46%	54%
				District center (LN3)	47%	45%	55%
Mother Tongue (MT)				**Access Road width to Neighborhood (AN)**			
Marathi (MT1)	49%	43%	57%				
Hindi (MT2)	21%	56%	44%	Less than 3.75 m wide (AN1)	21%	62%	38%
Marwadi (MT3)	15%	21%	79%	3.75 m wide (AN2)	30%	40%	60%
Bengali (MT4)	15%	57%	43%	Less than 5.5 m wide (AN3)	26%	44%	56%
				7.0 m and above (AN4)	23%	37%	63%
Age of Household Head (AHH)				**Level of overcrowding / congestion (PC)**			
Up to 35 (AHH1)	5%	21%	79%	Low (PC1)	5%	70%	30%
Between 35 and 55 (AHH2)	49%	55%	45%	Medium (PC2)	74%	43%	57%
Between 55 to 65 (AHH3)	31%	48%	52%	High (PC3)	21%	48%	52%
Older than 65 (AHH4)	15%	25%	75%				
Education Level of Household (EHH)				**Type of Neighborhood (TN)**			
				Predominantly same (religion) (TN1)	12%	54%	46%
Up to High school (EHH1)	20%	51%	49%	Predominantly same language (TN2)	14%	43%	57%
Up to undergraduate (EHH2)	51%	54%	46%	Predominantly same income	7%	53%	47%
Professional and	29%	33%	67%	group (TN3)			
Postgraduate (EHH3)				Heterogeneous (TN4)	67%	43%	57%

Variables	Total sample	LMIG	HMIG	Variables	Total sample	LMIG	HMIG
Number of Workers in Household (NWHH)				**Proximity to park facilities (PPF)**			
Male working (NWHH1)	51%	51%	49%	0 km to 0.5 km (PPF1)	50%	42%	58%
Two member working (NWHH2)	30%	42%	58%	0.5km to 1 km (PPF2)	24%	47%	53%
				1km to 2km (PPF3)	19%	42%	58%
More than two member working (NWHH3)	19%	45%	55%	2 km to 4 km (PPF4)	7%	61%	39%
Occupation of Household Head (OHH)				**Proximity to school facilities (PSF)**			
Industry (OHH1)	6%	60%	40%	Government school (PSF1)	15%	50%	50%
Service (OHH2)	62%	50%	50%	Semi- government (PSF2)	35%	57%	43%
Trade and commerce (OHH3)	28%	35%	65%	Private (PSF3)	40%	34%	66%
Technician and skilled labor (OHH4)	4%	10%	90%	Convent (PSF4)	10%	38%	62%
Type of Dwelling Unit (TDW)				**Place of work (PW)**			
Plot (TDW1)	50%	45%	55%	Work in neighborhood (PW1)	19%	39%	61%
Flat (TDW2)	50%	45%	55%	Work in CBD (PW2)	34%	52%	48%
				Work in Urban area(PW3)	26%	40%	60%
				Work in Suburban (PW4)	21%	44%	56%
Dwelling Ownership (DWO)				**Mode of Travel to Work Place (MTW)**			
Rented House (DWO1)	16%	42%	58%	Cycle (MTW1)	4%	33%	67%
Owned (DWO2)	84%	45%	55%	Public transport (MTW2)	5%	58%	42%
				By Two wheeler (MTW3)	63%	58%	42%
				By car (MTW4)	28%	14%	86%
Net Present Value of Housing Stock (NPVH) in INR				**Mode of Travel to Shopping (MTS)**			
				Cycle (MTS1)	2%	80%	20%
1 lakh to 10 lakh (NPVH1)	11%	59%	41%	Public transport (MTS2)	1%	100%	42%
10 to 20 lakh (NPVH2)	29%	63%	37%	By two wheeler (MTS3)	53%	58%	0 %
20 to 35 lakh (NPVH3)	33%	43%	57%	By car (MTS4)	44%	27%	73%
35 to 70 lakh (NPVH4)	19%	32%	68%				
70 lakh and above (NPVH5)	8%	0	100%				
Average No. of Habitable Room (HR)	2.21	2.12	2.28	**Proximity to Relative (PFF)**			
				In neighborhood (PFF1)	16%	44%	56%
				Nearby (PFF2)	22%	47%	53%
				In City (PFF3)	57%	46%	44%
				None (PFF4)	5%	25%	75%
Average Number of Bedrooms (NB)	2.43	2.17	2.64				

preferences. Table 6 presents the list of variables according to the broad groups found significant for this study for both LMIG and HMIG households.

Multi-nomial logit model has been used to explore the strength of variables found significant (as indicated in Table 6) in deciding the location, type and ownership. Stepwise elimination process has been used using SPSS v 13.0 software and the results are presented in Table 7 and 8, separately for LMIG and HMIG households. Table 9 and 10 presents the conditional case, where it is assumed that all three decisions regarding location, type and ownership are taken simultaneously. A brief look at the results indicate that age of household head as well as number of habitable

Table 6: List of Significant Variables for LMIG and HMIG for Choice of Residential Location, Type and Ownership

Broad group of variables	Variables	Location of Neighborhood		Dwelling Type		Dwelling Ownership	
		Co-efficient value (LMIG)	*Co-efficient value (HMIG)*	*Co-efficient value (LMIG)*	*Co-efficient value (HMIG)*	*Co-efficient value (LMIG)*	*Co-efficient value (HMIG)*
Demographic Characteristics of Household	Family Type (FT)			0.063 (0.440*)	0.086 (0.049)		
	HH Size (HHS)	0.030 (0.289)		-0.062 (0.006)			-0.031 (0.083)
	Number of Children (NC)						0.106 (0.011)
	Mother Tongue (MT)	-0.083 (0.250)		0.111 (0.002)		0.037 (0.002)	
	Age of HH Head (AHH)	-0.165 (0.128)	0.064 (0.135)		0.051 (0.177)	-0.021 (0.315)	0.051 (0.270)
	Education Level of Household Head (EHH)			0.123 (0.034)		-0.025 (0.198)	
Socio-economic characteristics of household	Occupation of Household Head (OHH)		0.063 (0.246)	-0.111 (0.139)	0.075 (0.134)		-0.115 (0.054)
Economic attributes of housing stock	Type of Dwelling Unit (TDU)						-0.089 (0.198)
	Monthly Rent (RENT)	0.220 (0.242)	0.291 (0.024)	0.117 (0.050)	0.397 (0.00)	-0.481 (0.00)	
	Dwelling Ownership (DWO)				-0.119 (0.073)		
	Net present Value of Housing Stock (NPVH)			-0.164 (0.000)		0.076 (0.00)	
Quality/ Structural attributes of housing stock	No. of Habitable Rooms (HR)	-0.167 (0.009)					
	No. of Bedrooms (NB)	0.190 (0.042)	-0.054 (0.140)				-0.081 (0.056)
	Age of Dwelling Unit (ADU)		-0.087 (0.105)	0.111 (0.184)			-0.095 (0.110)
	Duration of Stay for the Present Household (DS)			-0.183 (0.016)	0.723 (0.00)		
Social attributes of neighborhood	Access Road Width to Neighborhood (AN)	-0.105 (0.111)	0.061 (0.090)			-0.020 (0.099)	
	Level of overcrowding/ congestion (PC)	-0.254 (0.095)					-0.082 (0.013)
	Type of Neighborhood (TN)	0.202 (0.003)	0.119 (0.007)				0.111 (0.024)
	Proximity to Park Facilities (PPF)		-0.151 (0.002)	-0.051 (0.163)			-0.118 (0.022)
	Proximity to School Facilities (PSF)	0.075 (0.292)	-0.059 (0.146)	0.050 (0.290)	0.073 (0.043)		-0.085 (0.052)

Broad group of Variables	Variables	Location of Neighborhood		Dwelling Type		Dwelling Ownership	
		Co-efficient value (LMIG)	*Co-efficient value (HMIG)*	*Co-efficient value (LMIG)*	*Co-efficient value (HMIG)*	*Co-efficient value (LMIG)*	*Co-efficient value (HMIG)*
Accessibility Attributes	Place of Work (PW)	0.174 (0.017)		-0.083 (0.044)	-0.071 (0.030)	0.022 (0.108)	0.069 (0.103)
	Mode of Travel to Work Place (MTW)			-0.186 (0.017)	0.050 (0.122)		
	Mode of Travel to Shopping (MTS)	2.196 (0.107)	-0.142 (0.008)				
	Proximity to Relatives (PFF)	-0.237 (0.007)	0.106 (0.163)	-0.079 (0.120)		-0.029 (0.091)	0.129 (0.104)

* Level of significance

Table 7 List of Significant Variables for Unconditional (sequential) Residential Location Type and Ownership Choice Analysis for LMIG Households

Variables	Location of Neighborhood			Dwelling Type		Dwelling Ownership	
	Near CBD	Near Sub City Business Center	Near District Center	Plot	Flat	Own	Rent
Intercept	1.255 (0.155)	-0.255 (0.627)	0.492 (0.198)	10.253 (0.000)	-10.253 (0.000)	2.995 (0.000)	-2.995 (0.000)
Age of Household Head (AHH3)		-1.580 (0.001)					
Education Level of Household Head (EHH1)				-2.408 (0.003)	2.408 (0.003)		
Household Size (HHS)				0.620 (0.008)	-0.620 (0.008)		
Type of Dwelling Unit (TDU2)		-1.068 (0.024)					
Net Present Value of Housing Stock (NPVH2)						-1.752 (0.024)	1.752 (0.024)
Net Present Value of Housing Stock (NPVH3)				-2.763 (0.000)	2.763 (0.000)		
Net Present Value of Housing Stock (NPVH4)				-4.293 (0.000)	4.293 (0.000)		
No. of Habitable Rooms (HR)		0.626 (0.002)					
Number of Bedrooms (NB)	-1.640 (0.001)						
Proximity to Park facilities (PPF2)				-2.288 (0.004)	2.288 (0.004)		
Proximity to School Facilities (PSF1)			-2.079 (0.012)	2.079 (0.012)			
Access Road Width to Neighborhood (AN2)			0.446 (0.049)				
Mode of Travel to Work Place (MTW2)				-2.083 (0.020)	2.083 (0.020)		
Estimated Probability [E]	0.113	0.617	0.270	0.990	0.010	0.880	0.120
Observed Probability [O]	0.137	0.394	0.467	0.495	0.505	0.844	0.156
Estimation Error [±(E-O)]	0.024	0.223	0.197	0.495	0.495	0.036	0.036

Table 8 List of Significant Variables for Unconditional (Sequential) Residential Location Type and Ownership Choice Analysis for HMIG Households

Variables	Location of Neighborhood			Dwelling Type		Dwelling Ownership	
	Near CBD	Near Sub City Business Center	Near district Center	Plot	Flat	Own	Rent
Intercept	-1.226 (0.204)	2.717 (0.004)	-3.113 (0.000)	-2.332 (0.114)	2.332 (0.114)	3.036 (0.006)	-3.036 (0.006)
Mother Tongue (MT3)				1.463 (0.013)	-1.463 (0.013)		
Age of Household Head (AHH4)		-1.958 (0.000)	1.303 (0.011)				
Occupation of household head (OHH4)				-2.314 (0.045)	2.314 (0.045)		
Monthly Rent (RENT1)	-1.871 (0.035)						
No. of Habitable Rooms (HR)				0.661 (0.000)	-0.661 (0.000)		
Number of Bedrooms (NB)						-1.012 (0.006)	1.012 (0.006)
Duration of Stay of HH (DS1)				0.984 (0.019)	-0.984 (0.019)		
Proximity to Park Facilities (PPF1)		1.498 (0.001)					
Proximity to Park Facilities (PPF2)			1.612 (0.001)				
Proximity to Park Facilities (PPF3)			1.426 (0.006)			-1.494 (0.006)	1.494 (0.006)
Proximity to School Facilities (PSF4)				1.520 (0.048)	-1.520 (0.048)		
Type of Neighborhood (TN1)		-1.442 (0.037)					
Type of Neighborhood (TN2)		-1.429 (0.011)				-1.352 (0.024)	1.352 (0.0240
Mode of Travel to Work Place (MTW3)			-0.844 (0.033)				
Proximity to Relatives (PFF1)	-1.446 (0.008)						
Estimated Probability [E]	0.170	0.763	0.067	0.480	0.520	0.520	0.480
Observed Probability [O]	0.164	0.373	0.462	0.500	0.500	0.171	0.829
Estimation Error [±(E-O)]	0.006	0.39	0.395	0.02	0.02	0.349	0.349

Table 9 List of Significant Variables for Simultaneous (Conditional) Residential Location, Type and Ownership Choice for LMIG Households

Variables	Lower Middle Income Group (LMIG)											
	CBD				Sub City Business District				District Center			
	Plot		Flat		Plot		Flat		Plot		Flat	
	Own CPO	Rent CPR	Own CFO	Rent CFR	Own SPO	Rent SPR	Own SFO	Rent SFR	Own DPO	Rent DPR	Own DFO	Rent DFR
Intercept	10.1 (0.010)	-4.682 (0.000)	0.76s2 (0.371)	-4.682 (0.000)	-4.054 (0.000)	-4.682 (0.000)	1.164 (0.334)	-4.094 (0.000)	-1.875 (0.148)	0.00 (1.0)	-0.689 (0.420)	-3.034 (0.000)
Age of Household Head (AHH2)								2.148 (0.050)			-1.653 (0.022)	
Mother Tongue (MT1)					-1.28 (0.057)							
Mother Tongue (MT2)							-1.538 (0.017)					
Mother Tongue (MT3)							-3.018 (0.002)					
Mother Tongue (MT4)			-3.858 (0.002)								-2.542 (0.001)	
Net Present Value of Housing Stock (NPVH4)	-5.166 (0.007)											
Number of Bedrooms (NB)	-3.635 (0.011)				1.427 (0.001)				1.329 (0.001)			
Type of Neighborhood (TN1)	-3.808 (0.004)											
Type of Neighborhood (TN4)									-1.245 (0.059)			
Accessibility to Neighborhood (AN2)									-2.361 (0.001)		1.686 (0.064)	
Accessibility to Neighborhood (AN3)			-3.503 (0.006)									
Place of Work (PW1)									1.674 (0.052)			
Mode of Travel to Shopping (MTS2)										-4.663 (0.007)		
Proximity to Relatives (PFF1)									-2.35	(0.001)		
Proximity to Relatives (PFF3)					-2.305 (0.009)		1.556 (0.016)					
Estimated Probability [E]	0.157	0.018	0.003	0.018	0.004	0.018	0.306	0.274	0.015	0.017	0.078	0.092
Observed Probability [O]	0.064	0.009	0.055	0.009	0.155	0.009	0.165	0.064	0.238	0.022	0.165	0.045
Estimation Error [±(E-O)]	0.093	0.009	0.052	0.009	0.151	0.009	0.141	0.21	0.223	0.005	0.08	0.047

rooms and bedrooms are the most significant factors influencing location decisions of LMIG households. On the contrary, location decisions for HMIG households are more explained by proximity to park facilities, type of neighborhood and age group of the household head. Net present value of the housing stock is the key element towards deciding the type as well as ownership of housing stock for LMIG households. The decisions in HMIG households for type as well as ownership are influenced by number of habitable rooms or bedrooms, duration of stay, proximity of park and school facilities, type of neighborhood, etc. It must be observed that the estimation

Table 10 List of Significant Variables for Simultaneous (Conditional) Residential Location, Type and Ownership Choice for HMIG Households

Variables	Higher Middle Income Group (HMIG) Choice (30,000 to 50,000)											
	CBD				Sub City Business District				District Center			
	Plot		Flat		Plot		Flat		Plot		Flat	
	Own	Rent	Own	Rent	Own	Rent	Own	Rent	Own	Rent	Own	Rent
	CPO	CPR	CFO	CFR	SPO	SPR	SFO	SFR	DPO	DPR	DFO	DFR
Intercept	2.415 (0.142)	-4.883 (0.000)	-1.520 (0.001)	-3.769 (0.000)	5.377 (0.013)	-4.833 (0.000)	-2.922 (0.007)	-0.717 (0.429)	5.23 (0.001)	-3.052 (0.000)	-0.693 (0.049)	-4.182 (0.000)
Mother Tongue (MT1)									-3 (0.001)			
Mother Tongue (MT3)							-1.957 (0.001)					
Mother Tongue (MT4)									-4.173 (0.000)			
Age of Household Head (AHH1)					-3.116 (0.010)							
Age of Household Head (AHH2)								1.691 (0.071)				
Age of Household Head (AHH4)					-2.237 (0.006)							
Net Present Value of Housing Stock (NPVH1)	-3.108 (0.014)											
Net Present Value of Housing Stock (NPVH4)	-3.882 (0.004)											
Net Present Value of Housing Stock (NPVH5)					-2.555 (0.003)				-2.141 (0.002)			
Proximity to School Facilities (PSF2)								-1.95 (0.017)				
Proximity to Park Facilities (PPF1)							1.309 (0.028)					
Proximity to Park Facilities (PPF2)					-2.502 (0.003)				1.317 (0.033)			
Proximity to Park Facilities (PPF3)								-3.077 (0.001)				
Access Road Width to Neighborhood (AN2)					2.369 (0.027)				-1.547 (0.007)			
Type of Neighborhood (TN4)					1.898 (0.013)							
Place of Work (PW2)			-1.892 (0.008)									
Place of Work (PW2)							2.329 (0.034)					
Place of Work (PW4)					-2.727 (0.001)							
Access Road Width to Neighborhood (AN4)											-1.586 (0.001)	
Estimated Probability [E]	0.021	0.012	0.055	0.038	0.051	0.013	0.484	0.029	0.022	0.079	0.171	0.025
Observed Probability [O]	0.059	0.014	0.074	0.022	0.141	0.007	0.148	0.074	0.238	0.044	0.164	0.015
Estimation Error [±(E-O)]	0.038	0.002	0.019	0.016	0.09	0.006	0.337	0.045	0.216	0.085	0.007	0.01

Table 11 Comparison of Results Between Sequential and Simultaneous Choice for Residential Location, Type and Ownership

	LMIG		HMIG	
	Sequential Choice	Simultaneous Choice	Sequential Choice	Simultaneous Choice
Location				
Near CBD	0.113	0.196	0.170	0.126
Near Sub-city Business Center	0.617	0.602	0.763	0.577
Near District Center	0.270	0.202	0.067	0.297
Dwelling Ownership				
Own	0.880	0.563	0.520	0.804
Rent	0.120	0.437	0.480	0.196
Dwelling Type				
Plot	0.990	0.229	0.510	0.198
Flat/Apartment	0.010	0.771	0.490	0.802

error for unconditional i.e. sequential decision making is much higher that conditional i.e. simultaneous decision making – making the latter a much preferred model for estimation of housing location, type, ownership choice probabilities.

Estimated probabilities from sequential decision making model and simultaneous decision making model are presented in Table 11 for comparison of the results. It is evident that for LMIG households the decisions taken for location are very similar in both the approaches. However, there is a wide disparity when it comes to choice of dwelling type and ownership. For HMIG households the decisions regarding location also vary considerably along with outcome for dwelling type and ownership. It can be concluded that location decisions for LMIG households can be still carried out independently without taking preference for dwelling type and ownership into account as compared to HMIG households. Unconditional decision making for dwelling type and ownership i.e. without taking location, type, ownership into account will result in spurious outcomes.

6. CONCLUSIONS

This study has found the sensitivity of various parameters on residential location, type and ownership preferences of the housing demand in Nagpur city. These findings can have immense bearing on policy and regulatory frameworks for future residential development anticipated in the Master Plan of the city. The proposed Master Plan has indicated future residential zones along with non-residential activities taking into consideration parameters for collective and comprehensive improvement of the city. However, it has often been found that with the present housing preferences exhibited, the proposed residential zones do not appear to attract future residential demand unless some policy level interventions are made. Some of the groups are very sensitive to geographical parameters whereas others are more responsive to economic and social parameters. Changing the geographic, social and economic parameter values through various policies, actions and strategies can alter the attractive potential of these zones for target groups and help residential demand

allocation along the lines of anticipated plan. However, limited sample size used for this study restricts it only for exploration of parameter responsiveness with limited predictive capacity. Large sample sizes drawn from an urban area following the same methodology will help not only to explore the significant variables but also allow predicting the demand responsiveness with certain changes in control variables.

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