

Comparative analysis of satisfaction with well-being attributes of living environment in the slums of Bhopal, India

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Abstract

Target-three, goal-eleven of Sustainable Development Goals (SDGs) 2030 "Sustainable Cities and Communities" aims to "enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries" by 2030 to 'end global poverty in all its forms' (<https://www.undp.org/>). Corresponding goal-seven of the precursor of SDGs i.e. Millennium Development Goals (MDG), was also aimed at sustainable development though the terms "Inclusive, Participatory and Integrated" are added in the post-MDG agenda i.e. SDGs, acknowledging the need and strength of inclusive planning process at all levels of intervention for sustainable development. Theoretical studies on inclusive planning and development exemplify many success stories, however the statistical analytical studies that establish relation of various dimensions of environment with inclusive environment are few.

Taking the case study of Bhopal, India, the present paper attempts to investigate interrelationship between satisfaction levels of slum dwellers' with various well-being parameters namely bio-physical, socio-economic, inclusive and overall environment i.e. Living Environment. It also attempt to identify their significance levels. Satisfaction rankings against various well-being attributes considers 306 slum households and analyses are subjected to descriptive statistics, categorical principal component analysis, confirmatory factor analysis. The paper further tries to prioritize the well-being factors for slum redevelopment interventions for each dimension. Identifying significant attributes contributing to overall well-being will help to design adaptable and sustainable slum upgrading solutions with improved environmental quality as well.

Keywords: Slum Redevelopment, Well-being satisfaction, Bio-physical Environment, Socio-economic Environment, Inclusive Environment, Living Environment

1. Context

Health and well-being of an individual and population in an urban area is govern by a large number of bio-physical, socio-economical, and inclusive aspects (Bouddha, Dhote & Sharma 2014). The well-being of the slum inhabitants, the most vulnerable population of the urban area, is always at stake. Vulnerability of already vulnerable population gets worse due to various kinds of exclusion at various level. Slum inhabitants are neither invited for their participation in slum redevelopment level planning process nor the city

level developmental benefits are equitably shared with them. Pre or post-implementation impact assessment process of slum redevelopment projects/programmes also have intended or unintended bias. In general practice, the impact assessment of slum up-gradation/redevelopment programmes is usually based on the scale of target achieved or funds utilized (Bouddha, Dhote & Sharma 2014) and not on the improvement in satisfaction levels due to improved accessibility in various dimensions of well-being and thus excludes the target population from being presenting their perception about improvement. Whereas well-being that sometimes measured as Happiness Index, is also directly associated with willingness, choices and participation that inculcate a feeling of ownership in beneficiary (Bouddha, Dhote & Sharma 2014).

61st session of the "Commission on the Status of Women" in New York (March 2017) underline the use of participatory approaches, such as slum upgrading as tools to achieve sustainable development goals, in particular the goal 11 "making cities inclusive". Forms and manifestations of **spatial, social and economic exclusion** in urban areas are multiple.

Since slums, the inevitable part of urban environment, have not accounted for inclusive city planning a number of schemes for slum dwellers could not yield desired results due to misjudging their need, choices, capabilities and well-being satisfaction.

As opined by Amartya Sen on "Capability Approach" and further enlarged the vision by successive scholars of the field "well-being can be measured by assessing people's freedom and choices, rather than their level of income or consumption (Frediani, 2007). Measuring impacts of interventions pertaining to slum up gradation in terms of satisfaction levels of the end users is key to identification of sustainable solutions.

The present paper is an attempt to identify association between different well-being attributes and their level of significance from the perspective of slum dwellers' through satisfaction ranking analysis.

The present paper is an attempt to identify the between wellbeing characteristics and their importance from the slum residents' point of view through satisfaction ranking analysis.

The paper further tries to prioritize the well-being factors for slum redevelopment interventions for each Bio-physical environment (BPE), Socio-economic environment (SEE), Inclusive environment (INE) and overall environment i.e. Living Environment (LIE).

2. Well-Being Characteristics

Conventionally, well-being has been anticipated as material progress measured by gross domestic product (GDP) or income, where it is assumed that income promotes increase in consumption and thus improve well-being (Clark et al. 2008, Deaton 2008). Hence it is equated with good living conditions or the quality of life (Sen 1999, World Bank 2001). This traditional perspective of well-being has been widened to encompass all dimensions of human life including material and non-material and associated with satisfaction of desires or preferences i.e. subjective well-being (King 2007, Kiefer 2008), life activities which people engage in (Sen 1993, Clark et al. 2008). Easterlin (2001, 2003) advocates that material resources improve one's choices, comfort level, and state of happiness while

people's subjective well-being or life satisfaction increases with improvement in their circumstances.

Various terms have been proposed to describe quality of living environment of a human society, e.g. Gross National Happiness (GNH) by Bhutan's then King Jigme Singye Wangchuck, 1972 (Wikipedia, n.d.); QOL by Canter (1996) to indicate the overall characteristics of the socioeconomic environment in a given area; QOL by WHO (WHO, 1997) as individuals' perception of their position in life; Human Development Index (HDI) by UNDP; Happiness Index by Ming Yu and Shengzhi Weng (2006); Multiple Dimensions of Urban Well Being by Mark R. Montgomery (2009). Chandrasekhar & Mukhopadhyay (2008) advocate multiple dimensions (income and non-income) of urban wellbeing to identify intracity differences between slums and non-slum urban areas in India.

The features that characterize a slum settlement have major impact on slum environment. The characteristics of the slum define the status of well-being of a particular slum and its inhabitants. Well-being is a term that is generally used to describe health of a particular dimension of environment whether it may biological, psychological, physical or socio-economical. More significantly in the context of slum environment and its habitants' well-being can be applied to combination of all these dimensions that describe the human environment. Hence in the context of present paper the characteristics of well-being whether the materialistic or non-materialistic are considered as the factors that affect the environment in slums. A comprehensive list (Table 1) of factors that affect the well-being of slum dwellers is thus include all the attributes proposed by various agencies and researchers in the field.

Table 1: Comprehensive list of Factors of Well-Being

Proposed Sub Factors (Categories of Domain/Aspects /Factors)	Hierarchy of Needs Pyramid (Maslow 1943)	Generic Structured Checklist for QOL (Canter, et. al. 1985)	WHO Quality of Life Indicators (1997)	The Multiple Dimension of Urban Well-being (Mark R. M. 2009)	Sustainable Urbanization, HABITAT Agenda (UN Habitat 2009)	Human Development Index 2014
Housing	*	*	*	*	*	*
Water Supply	*		*	*	*	*
Sanitation	*	*	*	*	*	*
Garbage Disposal			*	*		*
Electricity	*			*	*	*
Fuel Used		*	*			
Streets		*		*		*
Education	*	*				*
Occupation	*	*				
Equality	*	*		*		
Social Class	*					
Social Network	*			*		
Cultural Ethos		*	*			
Neighbourhood	*					
Violence	*	*	*	*		
Crime	*	*	*	*		

Congestion				*		
Security of Tenure	*			*		*
Vulnerability to diseases	*		*	*		*
Vulnerability to risks and hazards	*			*		
Household Income	*	*	*		*	
APL/BPL Status	*					
Per Capita Consumption Expenditure					*	
Accessibility to Savings/ Holdings of land	*			*	*	
Consumer or producer durables	*			*	*	
Health Facilities		*	*			
Educational Institutions						
Community Welfare Facilities						
NGOs and other voluntary organizations						
Time spent on non-worthy works/leisure activities		*	*	*		
Accessibility to Recreational/ Public Spaces		*	*			
Awareness						
Communication/ Information		*	*			*
Community mobility/ Political voice		*		*		
Job opportunities		*				
Equality		*		*		
Transport		*	*			*
Roads network		*			*	

3. Perceptions of Slum Dwellers

As perceived by secondary stakeholders associated with slum improvement programmes poverty is consistent to their position. Governmental officials categorize it as deserving and undeserving, economist define it as income problem, engineers as an environmental issue, health officials link it with health and illness while social workers define the poverty in terms of social characteristics (Amis 2001). However poor's own perception of poverty is important to adjudge their well-being satisfaction level.

Understanding of the beneficiaries' perception about their environment and well-being along with identification of major factors that affect well-being of slum dwellers prove to be helpful in designing and implementing slum redevelopment programmes.

4. Research Design

Research Setting: This research considers four major slum improvement programmes implemented in India after 2005 by taking an example of Bhopal City for household survey with a sample size of 154 households from intervened slums and 152 households from nearby non intervened slums and presents a comparative analysis of satisfaction with of overall living environment to satisfaction with each dimension of well-being i.e. Bio-physical, socio-economic and Inclusive environment.

Sample Selection: To assess the impacts, four slum up gradation programmes namely UWSEIMP, MPUSP, SESI, and BSUP were selected on the basis of post 2005 implementation so that the impact sustainability of the projects completed by 2010/2012

could be measurable in varied aspects of well-being. Two slums from each of the programmes were selected with the criteria that no slum may have more than one intervention so that independent impact of the intervention can be assessed.

Thus eight slum were selected that were having physical intervention after 2005, each one of them tried to be selected from diverse spatial location and diverse physical setting covering whole city from north to south and east to west.

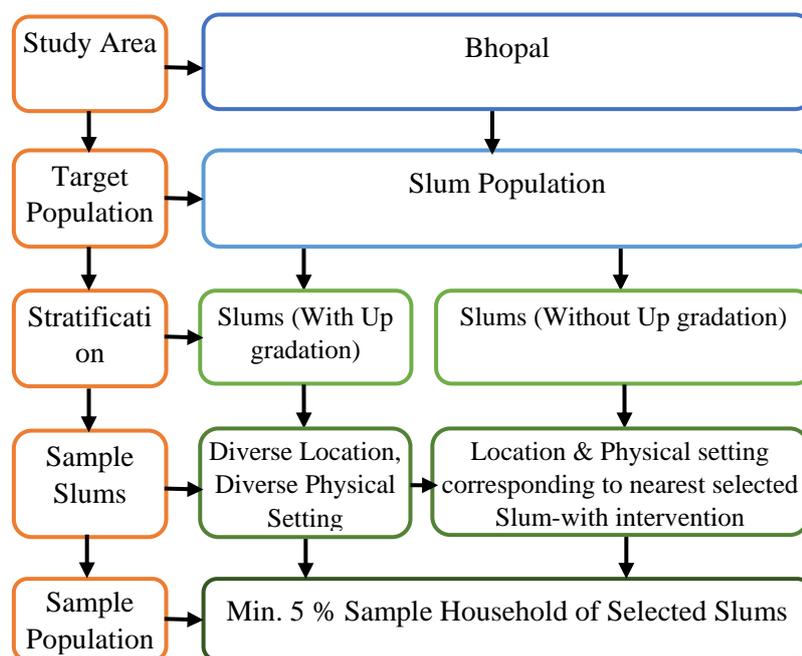


Figure 1: Sample Selection Methodology

Those slums were selected as slums-without- intervention (slum in which any planned slum improvement programme was not implemented after 2005) that were nearest to slums selected as slum-with-intervention also possibly be having similar physical setting as that of previous referenced slums.

Out of 350 households responses were got from 317 slum households.

5. Data Collection Methodology

Physical Survey: The city under consideration was surveyed physically to get the perception of the integration of city and slum settlements. Primary data is collected in form of Sample survey of slum households, Questionnaires, Observations and informal Interviews.

Sample Survey of Slum households

Attributes were grouped three dimensions i.e. Bio-Physical environment (BPE), Socio-Economic environment (SEE) and Inclusive environment (INE). Five point likert scale was used to identify satisfaction level of the respondents and a list of possible aspects of the satisfaction ranking for each question were provided against its scale. The questionnaire was translated into local language i.e. Hindi to communicate with the slum dwellers.

Socio-Economic Survey: The size of the sample is constrained by the resources and time available. Therefore, attempts are made to randomize the sample selection process to reduce systematic biases.

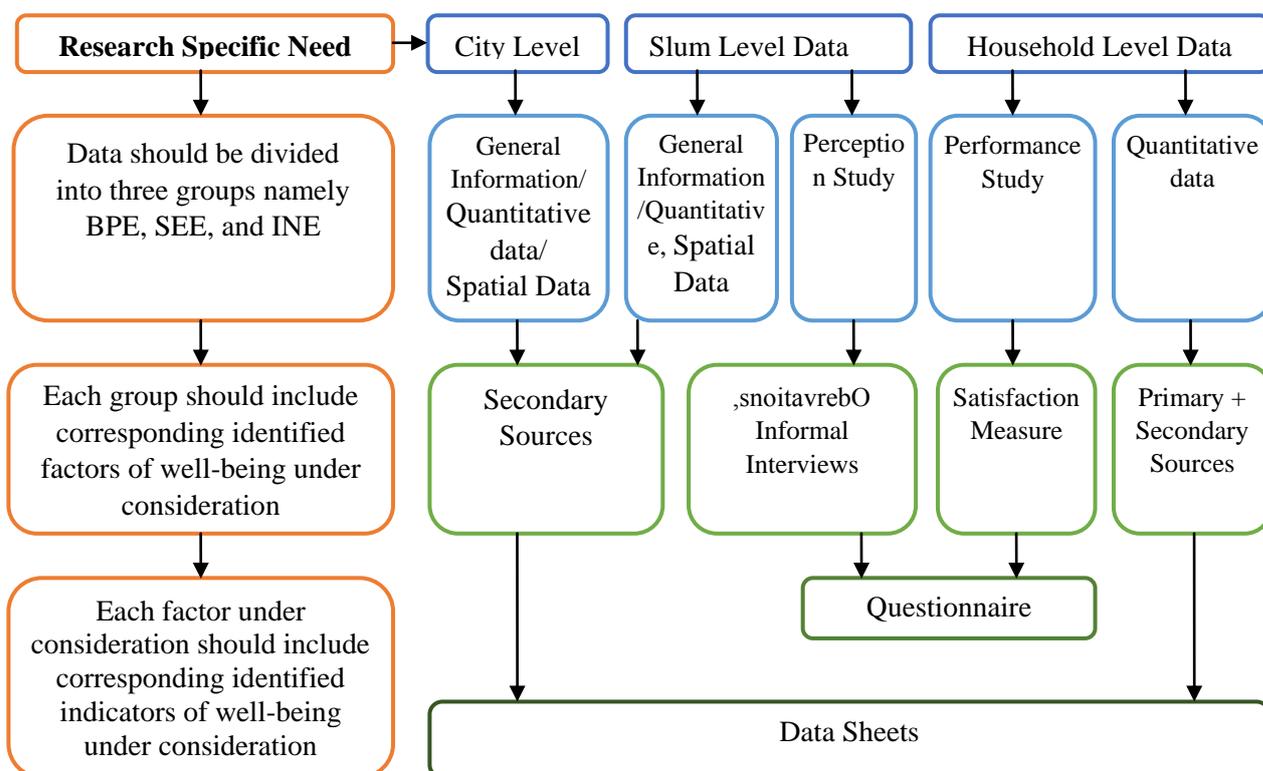


Figure 2: Data Collection Methodology

Descriptive Statistics	Frequency (N=306)	Percentage (100)
<i>Social Class</i>		
Unreserved	35	11.4
SC	91	29.7
ST	29	9.5
OBC	146	47.7
Others	5	1.6
<i>Religion</i>		
Hindu	224	73.2
Muslim	78	25.5
Christian	1	.3
Sikh	1	.3

Bouddha	2	.7
<i>APL/ BPL Category</i>		
APL Card	31	10.1
BPL Card	217	70.9
None	58	19
<i>Gender of Respondent</i>		
Male	118	38.6
Female	188	61.4
<i>Gender of Head of Household</i>		
Male	278	90.8
Female	28	9.2

Stratified random sampling is opted to improve the precision of the survey estimates, guaranteed representation of important domains and special subpopulations, administrative convenience, flexibility and to control the cost of data collection.

The formation of the strata was such that units in the same stratum are as homogeneous as possible and units in

different strata are as heterogeneous as possible with respect to the objectives of the survey.

6. Research Method

The outcome of the present paper was aimed to identify interrelation among various factors of BPE, SEE and INE. Collected data is of two types i) Satisfaction rating on ordinal scale of 1-5 point likert scale and ii) aspects in support of ordinal rating in the form of categorized data on nominal and interval scale. Analysis at household level is carried out on ordinal data of satisfaction rating. Since the stratified sampling technique is used to select samples, normality of data is checked through Shapiro-Wilk test marginally rejects the null hypothesis of normal distribution for some of the variables of all dimensions i.e. Biophysical, Socio-economic and Inclusive. Since the data deviates from normal distribution Kruskal-Wallis Test (H Test) for Chi-Square is used to analyze the significance of variance. The test is a non-parametric test used to identify significance of variance when there are k independent variables.

Categorical Principal Component Analysis (CATPCA) is used to analyze the correlation among factors. Due to the optimal scaling option CATPCA is mostly used for analysis of ordinal variables that standardizes the values of different scales automatically. CATPCA also maximizes the variance when data is non-parametric and there is no harm to use non parametric tests even if data is parametric. Objects and/or variables can be designated to be supplementary and can be omitted from the actual analysis but fitted into the solution afterwards. The information contained in the biplots and triplots can be used to draw special graphs that identify particular groups in the data that stand out on selected variables. As supported and established by the previous researches (Mikes and Hulin 1968; Locke 1969, 1976; Staples and Higgins 1998; Trauer and Mackinnon 2001; Wu and Yao 2006 and many more) weighting satisfaction scores is unnecessary and undesirable for measuring satisfaction with quality of life and other dimensions of life as they are not found to be superior over unweighted scores (Wu and Yao 2006), hence in the present research the weights are not assigned to the variables.

6.1 Factors of Well-Being considered for Satisfaction Survey

The dimensions of human society and its environment particularly in the context of urban poor or slum dweller thus includes a number of factors other than bio-physical factors that

have direct or indirect impact on the well-being of slum dwellers. Factors responsible in contributing well-being of slum environment can be grouped under three major dimensions namely BPE, SEE, and INE as adapted from Bouddha & Dhote 2013. Households' satisfaction levels have been analyzed on the attributes included in *Table 2* as they are more subjective.

Table 2: Well-Being attributes considered for Satisfaction Survey

Bio-Physical Environment	Socio-Economical Environment	Inclusive Environment
<ul style="list-style-type: none"> • Housing • Water Supply • Sanitation • Sewerage • Garbage Disposal • Electricity • Fuel Used • Streets 	<ul style="list-style-type: none"> • Education • Occupation • Intra-Slum Equality • Social Class • Social Network • Cultural Ethos • Neighbourhood • Violence • Crime • Congestion • Security of Tenure 	<ul style="list-style-type: none"> • Awareness • Communication/ Information • Community Mobility/Political Voice • Job opportunities • Intra-City Equality • Transport • Roads network

6.2 Descriptive Statistics

Descriptive Statistics	Frequency (N=306)	Percentage (100)				
Satisfaction with Bio-Physical Environment:						
Aspects	Highly Dissatisfied (%)	Dissatisfied (%)	Neutral (%)	Satisfied (%)	Highly Satisfied (%)	No Response (%)
Housing						
<i>Satisfaction with Construction Type</i>	28 (9.2)	57 (18.6)	111 (36.3)	71 (23.2)	39(12.7)	
<i>Satisfaction with Housing Area</i>	51 (16.7)	58 (19)	141 (46.1)	43 (14.0)	13 (4.2)	
<i>Satisfaction with Livelihood earning work space</i>	18 (5.9)	128 (41.8)	74 (24.2)	45 (14.7)	41(13.4)	
<i>Satisfaction with Vehicle Parking</i>	41(13.4)	69(22.6)	126(41.2)	54(17.6)	16(5.2)	
<i>Satisfaction of safety from natural calamities</i>	105 (34.3)	118 (38.6)	41 (13.4)	33 (10.8)	9 (2.9)	
<i>Satisfaction of convenience</i>	125 (40.8)	116 (37.9)	47 (15.4)	16 (5.2)	2 (0.7)	
<i>Satisfaction with sufficiency of surrounding open space</i>	76 (24.9)	53 (17.4)	103 (33.8)	62 (20.3)	11 (3.6)	
<i>Satisfaction with open space quality</i>	63(20.6)	98 (32)	48 (15.7)	37 (12.1)	60 (19.6)	
<i>Satisfaction with surrounding greenery</i>	174 (56.9)	52 (17)	51 (16.6)	18 (5.9)	11 (3.6)	
Water Supply	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied	No Response
<i>Satisfaction with water supply Source</i>	2 (0.7)	3 (1)	83 (27.1)	98 (32)	120 (39.2)	

<i>Satisfaction with water source distance</i>	39 (12.8)	23 (7.5)	65 (21.2)	89 (29.1)	90 (29.4)	
<i>Satisfaction with water quality</i>	31 (10.1)	22 (7.2)	38 (12.4)	102 (33.3)	107 (35)	6(2)
<i>Water Supply Frequency satisfaction</i>	10 (3.3)	18 (5.9)	109 (35.6)	117 (38.2)	52 (17)	
<i>Satisfaction with water supply duration</i>	25 (8.2)	20 (6.5)	116 (37.9)	97 (31.7)	48 (15.7)	
<i>Satisfaction with water quantity received/storage</i>	19 (6.2)	29 (9.5)	56 (18.3)	149 (48.7)	53 (17.3)	
<i>Satisfaction with sufficiency of water</i>	20 (6.5)	22 (7.2)	56 (18.3)	150 (49)	58 (19)	
<i>Satisfaction related to water collection</i>		5 (1.6)	129(42.2)	107(35)	65 (21.2)	
<i>Satisfaction related to water supply timings</i>	18 (5.9)	10 (3.3)	150 (49)	71 (23.2)	57 (18.6)	
<i>Satisfaction with time spend on collection of water daily</i>	96 (31.4)	17 (5.5)	116 (37.9)	36 (11.8)	30 (9.8)	11(3.6)
<i>Satisfaction of water collection from public connection</i>	147 (48)	24 (7.8)	8 (2.6)	88 (28.8)	39 (12.8)	
<i>Satisfaction with Toilet facilities</i>	72 (23.5)	26 (8.5)	13 (4.3)	89 (29.1)	98 (32)	8(2.6)
<i>Satisfaction with sewage disposal facility</i>	41 (13.4)	14 (4.6)	124 (40.5)	50 (16.3)	77 (25.2)	
<i>Satisfaction with drainage facility</i>	146 (47.7)	26 (8.5)	14 (4.6)	89 (29.1)	31 (10.1)	
<i>Satisfaction with garbage disposal facility</i>	105 (34.3)	15 (4.9)	75 (24.5)	64 (20.9)	47 (15.4)	
<i>Satisfaction with Garbage Collection Frequency</i>	117(38.2)	18 (5.9)	87 (28.4)	56 (18.3)	28 (9.2)	
<i>Satisfaction with Electricity connection</i>	4 (1.3)	2 (0.6)	63 (20.6)	119 (38.9)	118 (38.6)	
<i>Satisfaction against load shedding</i>	22 (7.2)	17 (5.6)	37 (12.1)	61 (19.9)	169 (55.2)	
<i>Satisfaction with type of fuel in use</i>	20 (6.5)	44 (14.4)	19 (6.2)	112 (36.6)	111 (36.3)	
<i>Satisfaction against inconvenience of fuel in use</i>	103 (33.7)	158 (51.6)	28 (9.2)	13 (4.2)	4 (1.3)	
<i>Satisfaction with street type</i>	35 (11.5)	68 (22.2)	78 (25.5)	57 (18.6)	68 (22.2)	
<i>Satisfaction with street condition</i>	85 (27.8)	70 (22.9)	34 (11.1)	74 (24.2)	43 (14)	

Descriptive Statistics	Frequency (N=306)	Percentage (100)				
Satisfaction with Socio-Economic Environment:						
Aspects	Highly Dissatisfied (%)	Dissatisfied (%)	Neutral (%)	Satisfied (%)	Highly Satisfied (%)	No Response (%)
<i>Satisfaction with educational qualification</i>	103 (33.7)	60 (19.6)	90 (29.4)	36 (11.8)	17(5.5)	

<i>acquired</i>						
<i>Job Satisfaction</i>	36(11.8)	23 (7.5)	44(14.4)	166 (54.2)	37 (12.1)	
<i>Satisfaction with slum level Equity</i>	3 (1)	18 (5.9)	43 (14)	112 (36.6)	124(40.5)	6(2)
<i>Satisfaction with sectors of Equity</i>	6(2)	11(3.6)	3(1)	6(2)	277(90.4)	3(1)
<i>Satisfaction with community support</i>	8 (2.6)	10 (3.3)	150 (49.0)	79 (25.8)	59 (19.3)	
<i>Satisfaction with community interaction</i>	4(1.3)	16 (5.2)	129(42.2)	101(33.0)	56(18.3)	
<i>Satisfaction with Religious/ Cultural activities</i>	2(0.7)	11(3.6)	146(47.7)	2(23.5)	69(22.5)	6(2)
<i>Satisfaction with safety and security</i>	2(0.6)	7(2.3)	50(16.3)	140(45.8)	107(35.0)	
<i>Satisfaction with neighbourers support</i>	9(2.9)	21(6.9)	122(39.9)	64(20.9)	90(29.4)	
<i>Satisfaction with Neighbourhood interaction</i>	2(0.6)	6(2.0)	21(6.9)	120(39.2)	157(51.3)	
<i>Satisfaction against domestic quarrels/ violence</i>	18(5.9)	36(11.8)	87(28.4)	107(35.0)	58(18.9)	
<i>Satisfaction against Neighbourhood quarrels/ violence</i>	7(2.3)	41(13.4)	121(39.5)	81(26.5)	56(18.3)	
<i>Satisfaction against Crime</i>	13(4.2)	189(61.8)	67(21.9)	27(8.8)	10(3.3)	
<i>Satisfaction against congestion</i>	20(6.5)	48(15.7)	29(9.5)	82(26.8)	127(41.5)	
<i>Satisfaction with availability of space</i>	43(14.1)	54(17.6)	29(9.5)	74(24.2)	106(34.6)	
<i>Satisfaction with sufficiency of space</i>	89(29.1)	54(17.6)	5(1.6)	73(23.9)	85(27.8)	
<i>Satisfaction with activity performance</i>	87(28.4)	54(17.6)	7(2.3)	71(23.3)	87(28.4)	
<i>Satisfaction due to adaptation</i>	2(0.6)	4(1.3)	40(13.1)	96(31.4)	164(53.6)	
<i>Satisfaction with Land Tenure Status</i>	101(33.0)	9 (3)	48 (15.7)	61(19.9)	86(28.1)	1(0.3)

Descriptive Statistics	Frequency (N=306)	Percentage (100)				
Satisfaction with Inclusive Environment:						
Aspects	Highly Dissatisfied (%)	Dissatisfied (%)	Neutral (%)	Satisfied (%)	Highly Satisfied (%)	No Response (%)
<i>Satisfaction with NGOs contribution</i>	99(32.4)	101(33.0)	88(28.7)	9(2.9)	3 (1.0)	6(2)
<i>Satisfaction with participation in Environmental Programmes</i>	120(39.2)	106(34.6)	74(22.2)	2(0.7)	1(0.3)	9(3)
<i>Satisfaction with Library facility</i>	169(55.2)	112(36.6)	15(4.9)	3(1.0)	1(0.3)	6(2)
<i>Satisfaction with awareness about RTI</i>	149(48.7)	122(39.9)	26(8.5)	5(1.6)	4(1.3)	
<i>Satisfaction with membership in local social associations</i>	73(23.8)	105(34.3)	63(20.6)	21(6.9)	41(13.4)	3(1)

Satisfaction with membership in local political associations	94(30.7)	105(34.3)	101(33.0)	2(0.7)	1(0.3)	3(1)
Satisfaction with Political and institutional accountability	64(20.9)	108(35.3)	106(34.6)	10(3.3)	12(3.9)	6(2)
Satisfaction with Level of inclusion in Participatory Planning	122(39.9)	83(27.1)	90(29.4)	3(1.0)	8(2.6)	
Satisfaction of getting Skilled training	120(39.2)	96(31.4)	46(15.0)	18(5.9)	26(8.5)	
Satisfaction of getting Continuing education	108(35.3)	132(43.1)	60(19.6)	2(0.7)	4(1.3)	
Satisfaction with Sponsorship Facility	113(36.9)	137(44.8)	21(6.9)	15(4.9)	20(6.5)	
Satisfaction with Loan facility	127(41.5)	116(37.9)	34(11.1)	9(3)	20(6.5)	
Satisfaction with children admission under RTE	68(22.2)	83(27.1)	80(26.2)	16(5.2)	59(19.3)	
Satisfaction with Scholarship/Assistance	110(36)	87(28.4)	45(14.7)	10(3.3)	54(17.6)	
Satisfaction with city level Equity	44(14.4)	60(19.6)	42(13.7)	102(33.3)	52(17.0)	6(2)
Satisfaction with sector of city level Equity	71(23.2)	37(12.1)	7(2.3)	7(2.3)	181(59.1)	3(1)
Satisfaction with the transport facility in the city	52(17.0)	29(9.5)	66(21.6)	118(38.5)	41(13.4)	

7. Findings

Analyzing the Correlation among Factors: Categorical Principal Component Analysis (CATPCA)

As the hypothesis pre-considers three dimensions of Living Environment i.e. BE, SE and IE with specific factors within. Satisfaction scores of eight variables from BE Environment, ten variables from SE Environment and six variables from IE Environment, for those satisfaction rankings were obtained, are included in CATPCA. The transformed correlation matrix of factor analysis with eight dimensions for BPE, ten dimensions for SEE and six dimensions for INE show that none of the variable is highly correlated. Most of the variables are negligible or least correlated with others. While some variables are moderately correlated with some other variables with correlation coefficient between .3-.5.

The highest correlation among Bio-Physical factors is between garbage and sewerage of 0.50, followed by between housing and street of .497, housing and sewerage of .495 and street and sewerage of .364. Similarly highest correlation among Socio-Economic factors is between social network, cultural ethos and neighbourhood of between .401-.465. Inclusive factors show that transport is moderately correlated with communication and intra-city equality. Highest correlation in Inclusive factors is between intra-city equality and transport of 0.342. Three factors from BPE, four factors from SEE and two factors from INE are extracted above eigenvalue one (

Table 3), however cronbach's alpha is found to be above .70 for only factor one. It suggests that internal consistency is low for factors except factor one.

Table 3: Factors Extracted above Eigenvalue One in CATPCA Analysis

	Overall (Living Environment)	Bio-Physical Environment	Socio-Economic Environment	Inclusive Environment
Dimension 1	<ul style="list-style-type: none"> Housing Sewerage Street Education Intra-City Equality Transport Awareness Communication 	<ul style="list-style-type: none"> Housing Sewerage Sanitation Garbage Street 	<ul style="list-style-type: none"> Social Network & Neighborhood Security of tenure Congestion Violence 	<ul style="list-style-type: none"> Communication Job opportunity Intra-City Equality Transport
Dimension 2	<ul style="list-style-type: none"> Sanitation Fuel Social Network & Neighbourhood Security of Tenure 	<ul style="list-style-type: none"> Water Supply Electricity 	<ul style="list-style-type: none"> Education Occupation 	<ul style="list-style-type: none"> Awareness Community Mobility/ Political Voice
Dimension 3	<ul style="list-style-type: none"> Garbage 	<ul style="list-style-type: none"> Fuel 	<ul style="list-style-type: none"> Crime 	-----
Dimension 4	<ul style="list-style-type: none"> Electricity Community Mobility/Political Voice 	-----	<ul style="list-style-type: none"> Intra-Slum Equality 	-----
Dimension 5	<ul style="list-style-type: none"> Crime Job Opportunity 	-----	-----	-----
Dimension 6	<ul style="list-style-type: none"> Violence 	-----	-----	-----
Dimension 7	None of the variable loaded highly	-----	-----	-----
Dimension 8	<ul style="list-style-type: none"> Intra-Slum Equality Congestion 	-----	-----	-----

A two dimensional CATPCA analysis has been done to check again the internal consistency. Biplots generated by the two dimensional CATPCA analysis show objects and vector loadings and reveal relationship between object points and variables and make interpretation easier through graphical plots. Object points suggest that dataset do not show presence of outliers except some under Socio-economic parameter however they are carried forward as they do not reflect as outliers under other two parameters. Biplot of Bio-Physical factors (Figure 5) shows two groups, one having water supply, electricity and fuel (may be named as vital services) and the other having housing, sanitation, sewerage, garbage and street (may be named as Physical services).

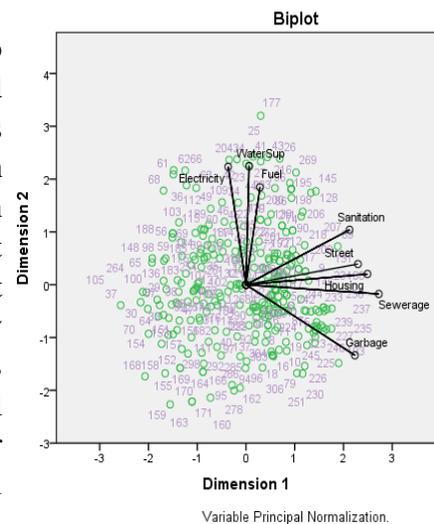


Figure 3: Binlot of Bio-Physical

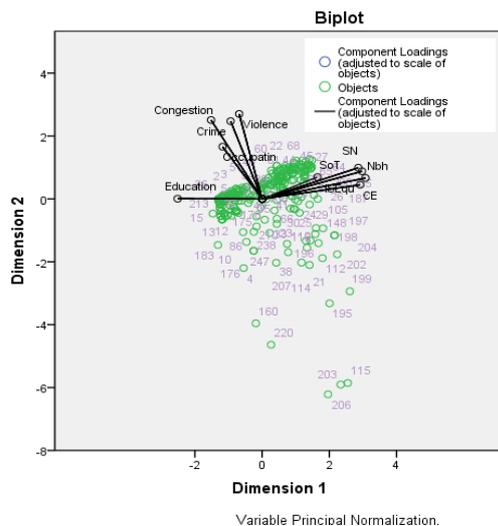


Figure 4: Biplot of Socio-Economic

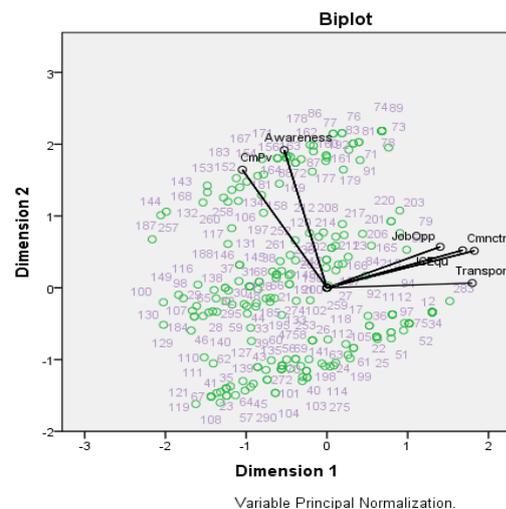


Figure 5: Biplot of Inclusive Factors

Biplot of Socio-Economic factors (Figure 3) shows two groups one having violence, crime, congestion and occupation (may be named as social stress) and the other having intra-slum equality, social network, neighbourhood, cultural ethos and security of tenure (may be named as social cohesion) while education does not appear to align along any of the factor. Biplot of Inclusive factors (Figure 4) shows group one having community mobility & political voice and awareness (may be named as social mobility) and group two having job opportunity, communication, intra-city equality and transport (may be named as integration).

The aim to carry out the factor analysis was to confirm that factors that are fairly independent to one another and can be carried forward for further analysis. However following a logical approach Social Network, Neighbourhood, and Cultural Ethos variables from socio-economic satisfaction who are showing the similar characteristics and direction have been combined as a single variable as Social Network & Neighbourhood. The variables from Bio-Physical Satisfaction that are correlated above .3 are carried forward as independent variables so as to identify their impact independently. Also, all the variables under consideration found loaded above 0.40 on either of the dimension within eigenvalue above 1 suggest sufficient contribution in variance and no one is needed to be dropped out.

Analyzing Significance of Variance among Factors

In the two dimensional CATPCA analysis Cronbach's Alpha found to be .876 for Bio-Physical, .867 for Socio-Economic and .884 for Inclusive dimension. The value above .70 shows higher level of internal consistency. Factors of BPE namely Sewerage, Garbage, Housing, Sanitation, Street, Electricity, Water Supply and Fuel are found to be responsible for 8.82, 8.03, 7.40, 6.62, 6.42, 6.06, 5.97 and 4.13 percent variance respectively. Factors namely Social Network & Neighbourhood, Intra-Slum Equality, Congestion, Violence, Education, Crime, Occupation, and Security of tenure are found to be accounted for 9.78, 8.71, 7.42, 6.82, 6.42, 5.98, 3.47, and 3.10 % variance in SEE respectively. Factors namely awareness, community mobility/ political voice, communication, transport, Intra-city equality and job opportunity are found to be

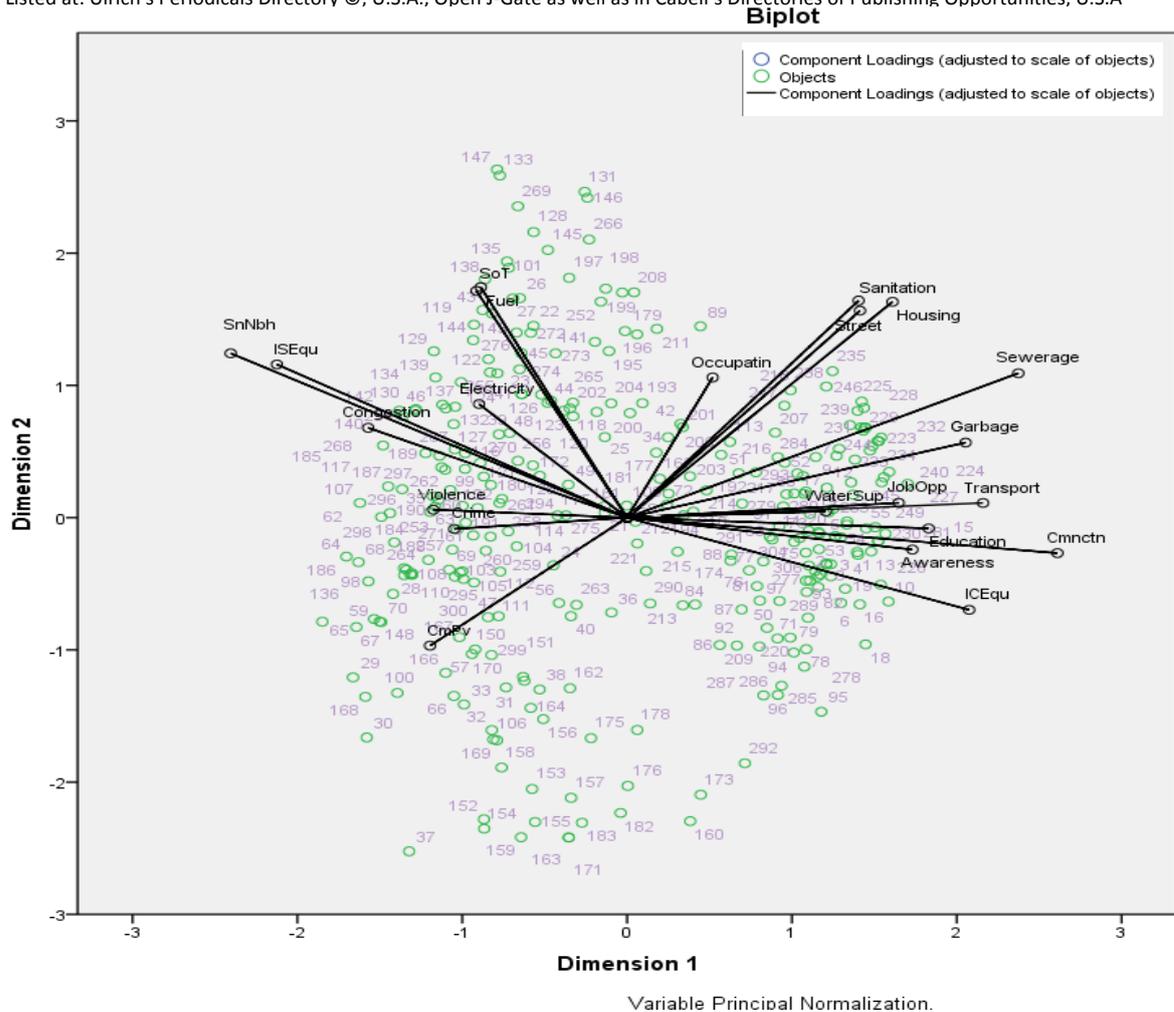


Figure 6: BiPlot of Bio-Physical, Socio-Economic and Inclusive Factors

accounted for 12.56, 12.05, 11.40, 10.27, 9.81 and 7.27 percent variance in INE respectively. In total the models of BPE, SEE and INE accounted for 53.45 %, 51.70 % and 63.36 % of variance respectively in the optimally scaled items.

From the Biplot (Figure 6) of two dimensional CATPCA analysis over Bio-Physical, Socio-Economic and Inclusive factors together it can be inferred that along with Education, Occupation and Job opportunity from Socio-economic factors, all the Inclusive factors except Community mobility & Political voice are contributing towards Bio-Physical dimension while Electricity and Fuel from Bio-Physical factors are contributing together for Socio-economic dimension. However Community Mobility & Political Voice appears as an isolated variable. Cronbach's Alpha found to be .922 and the model accounted for 37.924 % variation in the optimally scaled items.

Quantification Plots of Slums

However quantification of satisfaction levels of each slum reveal the impact of components under interventions to a certain extent. Five out of eight slums that are considered as slum-with-intervention show positive quantification for satisfaction with BPE and slum-without-intervention show vise-versa (Figure 7). It suggests that slum redevelopment projects have positive impact on well-being of slum dwellers. Shyam Nagar and Shabri Nagar, the slums where BSUP programme was implemented are within

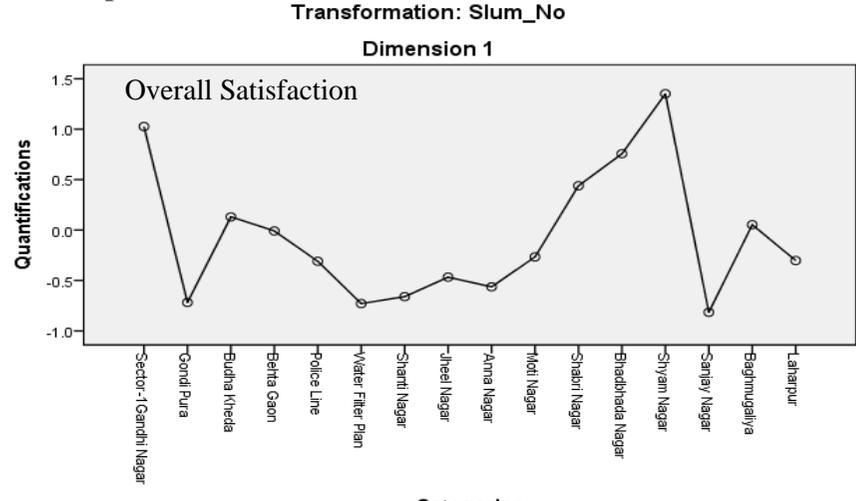
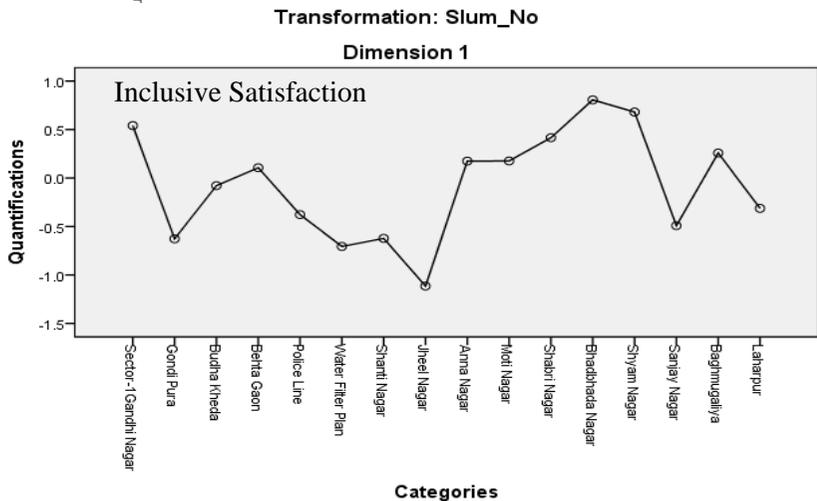
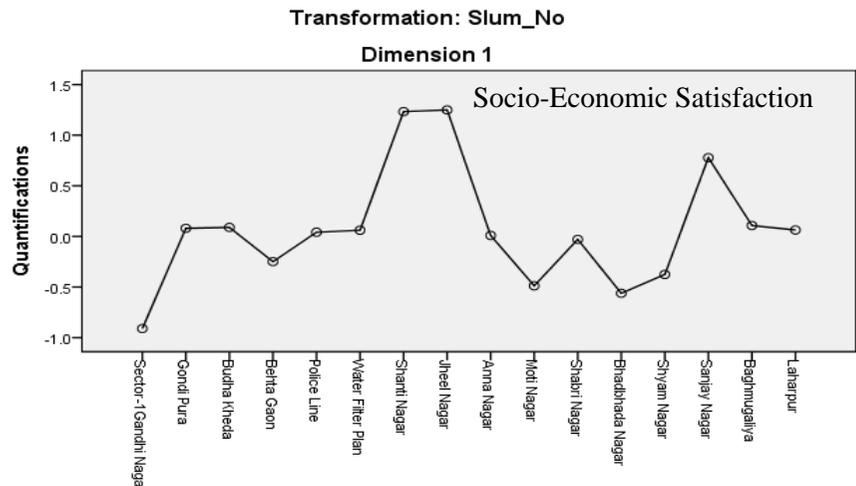
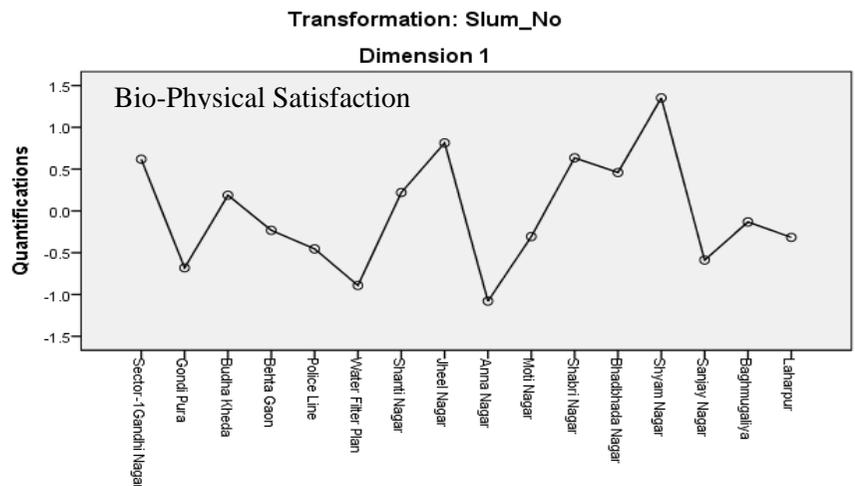
top three positions (*Table 4*). Noticeable is that Anna Nagar slum where Project Uday programme had been implemented holds lowest position. The slum was selected as CT slum (construction of community toilets only) under the programme. It is the slum which is poorly bounded on three sides by *nallah*, railway line and another slum and prone to flooding. Anna Nagar slum is also the slum where municipal water supply connections had not been provided till the date of survey and most of the houses do not have individual household toilets. Shanti Nagar slum where SESI programme was implemented though holds second position in satisfaction with SEE comes on bottom three position in satisfaction with INE and satisfaction with Overall environment. This again suggest that higher level of satisfaction with SEE lowering the satisfaction levels with Overall environment. In-spite of maximum softer interventions compared to other programmes low level of satisfaction with INE of Shanti Nagar slum possibly be the result of unsustainable slum interventions. The household survey of Shanti nagar slum supports this statement as many of the households mentioned about the discontinuation of such activities in slum.

Table 4: Quantification of Slums on Dimension one of each Parameter

Dimension	Sn.	Top Three Slums	Bottom Three Slums
Bio-Physical	1	Shyam Nagar	Anna Nagar
	2	Jheel Nagar	Water Filter Plant
	3	Shabri Nagar, Sector-1 Gandhi Nagar	Gondipura
Socio-Economic	1	Jheel Nagar	Sector-1 Gandhi Nagar
	2	Shanti Nagar	Bhadbhada Nagar
	3	Sanjay Nagar	Moti Nagar
Inclusive	1	Bhadbhada Nagar	Jheel Nagar
	2	Shyam Nagar	Water Filter Plant
	3	Sector-1 Gandhi Nagar	Gondipura, Shanti Nagar
Overall	1	Shyam Nagar	Sanjay Nagar
	2	Sector-1 Gandhi Nagar	Water Filter Plant, Gondipura
	3	Bhadbhada Nagar	Shanti Nagar

Quantification Plots for each parameter also suggest that slums are following somewhat similar trend in satisfaction with BPE and satisfaction with INE however trend in satisfaction with SEE is almost reverse to other two parameters.

A comparative analysis of quantification plots (*Figure 7*) of each parameter also reveals that where satisfaction with BPE and satisfaction with INE are high, satisfaction with Overall environment is also high but the case is largely reverse for SEE.



Optimal Scaling Level: Multiple Nominal.
Variable Principal Normalization.

Optimal Scaling Level: Multiple Nominal.
Variable Principal Normalization.

Figure 7: Quantification Plot of slums on each parameter

8. Conclusions

The study is a major learning to establish that slums cannot be dealt globally or regionally or even locally adopting a universal strategy. However a set of strategies can be developed to suit varied Biophysical, Socioeconomic and Inclusive environment that govern the slums. The lessons from the study may prove valuable to policy makers, planners and also the municipal authorities.

In the context of developing countries like India and particularly to the regions sharing the Biophysical, Socioeconomic and Inclusive characteristics similar to the study area, where vital essentials e.g. water supply, electricity and fuel are not a major issue, slum dwellers prioritize physical municipal services over vital services. Provision of housing is a key aspect of biophysical as well as overall wellbeing improvement. The first aspect indicates satisfaction of slum dwellers with vital municipal services and the second aspects is indicator of aspirations of slum dwellers for betterment of their physical environment. Housing, sewerage, sanitation, garbage and street appeared as key predictors of satisfaction with bio-physical environment. It also suggest municipal authorities to focus more on physical environment improvement. The study also reveals the ties among bio-physical, socio-economic and inclusive environment that improving only bio-physical environment cannot sustain long unless other two dimensions are also get improved.

Socio-economic Environment

Social Network & Neighborhood, Security of tenure, Congestion and Violence appeared as key predictors of satisfaction with socio-economic environment. One of the major learning from the study is that most of the slum dwellers show higher satisfaction with bio-physical and inclusive environment where satisfaction with socio-economic environment is low and vice-versa. This strengthens the fact that higher aspirations are associated with high socio-economic background and suggest the planners that slum dwellers also can be grouped in varied socio-economic strata and provided with suitable slum redevelopment solutions.

Inclusive Environment

Communication, job opportunity, intra-city equality and transport appeared as key predictors of satisfaction with inclusive environment. A major aspect of Inclusive Environment is participatory planning. High dissatisfaction of most of the slum dwellers with inclusion in participatory planning puts stress on planners to strengthen the measures to improve participation.

Housing, sewerage, street, education, intra-city equality, transport, awareness and communication appeared as key predictors of satisfaction with overall living environment. Altogether slum redevelopment projects showed positive impact on well-being of slum dwellers but the difference in satisfaction levels among slums-with-intervention and slums-without-

intervention is marginal. This gives a lesson that a key phrase of any Environment management process i.e. Plan-Do-Act-Check that has rarely being adopted where slum redevelopment is a concern. It is a requisite to identify impacts of any slum redevelopment intervention proposed beforehand, redesign the redevelopment solutions to minimize the negative impacts and then select a suitable model for redevelopment. Special emphasis upon the beneficiaries' perspective of their wellbeing improvement is a need to select appropriate environmental management strategies for slum redevelopment.

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