From Squatter Slums to Modelled Dwellings in Anthropocene: Bhubaneswar, India

Saswat Mishra, Gopal Ch. Sahoo, Siba Prasad Mishra, Kumar Ch. Sethi, Mohammed Siddique

Abstract: *Slums, the poor men paradise, are an informal settlement in Cosmo polis but part to the urban development process. Anthropocene has summoned exodus from rural to urban for food, family education and livelihood. Bhubaneswar, the capital city Odisha was established in 1949 with zero slums till 1960's, now has about 436 slum clusters in 67 wards with 304140 slum dwellers comprising 34.30% of the total population. After declaration as smart city, 2015, inter alia initiatives are taken by federal bodies for the development and resettlement of shantytown dwellers to make it slum less. The Kargil slum is significant due to its positioning, profession and living standards of inhabitants in the heart of the metropolis between airport and EC rail lines needs immediate resettlement. Present work pictures survey of slum in-situ using GIS and total station for demography, sex ratio and socio-economic status. About 1000 tenements in 25 blocks over an area of 6.23 Acres in the outskirts shall be accommodated in G+4 buildings. The geotechnical and ground water studies of the new housing area have been done. The design, drawing and scheduling by using Building Information Modelling (BIM) by Auto Cad, and DASSULT software, MS Office, MS Project, E-tabs, Safe, and D modelling by Sketch up. The scheduled period of completion from land acquisition to final handing over shall be 40 months at an affordable cost of 400K to 500 K INR per tenement.*

Keywords: *Advanced Survey, BIM Architecture, GIS Housing Scheme, Resettlement, Slum.*

I. INTRODUCTION

According to census of India, US-3 and Slum Area I&C Act, 1956, defines a slum area as cluster of informal settlements or unplanned colonies unfit for human occupancy due to disrepair, congestion, faulty activities incapable to provide congested dwellings deprived of sanitation, zigzag roads, lack of light, ventilation and sanitation amenities or amalgamation of them which are harmful to living standards, security, safety, healthiness and morals. The growth of slums

in statutory towns (>50000 people) in the heart and suburbs of the city., Industries growth also urges large scale migrants from rural to urban for food, modern living, health, education and proximity of amenities. Old cities has exhausted to expand horizontally so vertical cities are upcoming as satellite cities with onset of Anthropocene epoch in India (1945 onwards). The slums are part to these development processes and unavoidable in India. The informal dwellings called slums developed by EWS (Economically weaker section) by encroaching vacant areas, water bodies or sides of the roads and adjacent to multistoried developments.

Fig.1: Index map of the study area: Kargil Basti to Ghangapatna Area

Fig 2: Present populous Kargil slum and the proposed housing scheme at Ghangapatna

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These slums were categorized under recognized, notified and identified and the other way of classification is authorized, unauthorized and identified in India. Nallathiga R. K. et al, 2019[1] reported that, the high cost of housing is sky touching in urban areas that they are difficult for MIG (medium income) group, far reach from LIG (lower income) group and almost impossible for EWS (Economically weaker) group under building by laws in metro cities.

A. Urban population India:

India has the second largest urban population in the world.

Urban population exceeded rural from 2009, though India is an agri-based country Hind man M et al., 2015[2]. Population wise slum of the state to the India's population Maharashtra is the highest (18.09%) followed by Andhra Pradesh (AP undivided) and West Bengal (WB). The slum residents have significant contribution to urban economy and development as industrial workforce, construction workers, domestic assistance, rag-pickers, vendors and in many minor professions which is essential (Moore 2017[3]). The status are in Table 1.

Table 1: Status of state wise major slum population (>10%) of India (2011, census data)[4]

States of India	Statutory Town	slums Towns	%slum state	popl ^o of	Total Households	Slum (Identified)	Slum people	% State to India in slum
Undivided AP	125	125	361		2421268	971608		15.55
Bihar	139	88	10.53		194065	1237682		1.89
Chhattisgarh	168	94	31.98		395297	420426		2.9
Delhi	3	22	10.91		383609	1785390		2.73
Haryana	80	75	18.8		325997	1647393		2.54
Jammu and Kashmir	86	40	19.28		96990	362504		1.01
Karnataka	220	206	13.93		72877	573545		5.03
MP	364	303	28.35		1117764	5688993		8.69
Maharashtra	256	189	23.32		2449530	4653331		18.09
Mizoram	23	1	13.74		16240	78561		0.12
Nagaland	19	11	14.42		15268	34075		0.13
Odisha	107	76	22.28		350306	747566		2.38
Puducherry	6	6	16.95		35070	144573		0.22
Punjab	143	73	14.04		296482	479517		2.23
Rajasthan	185	107	12.13		383134	2068000		3.16
Sikkim	8	7	20.43		8612	31378		0.05
Tamil Nadu	721	507	16.61		1451690	1278673		8.85
Tripura	16	15	14.54		16372	15744		0.21
Uttar Pradesh	648	293	14.02		992728	999091		9.53
Uttara Khand	74	31	15.99		89398	249631		0.74
West Bengal	129	122	22.06		1393319	2665824		9.8
India	4041	2613			12506016	654946604		17.4

B. Status of slum population Odisha:

Fig. 3: Top order population wise major 11 slum cities/towns of Odisha (GOO NUHM Data)

C. Slum status of Bhubaneswar:

The novice capital city, Bhubaneswar (BBSR) is one among the official, business, educational, medical & tourism hub of the Odisha state, housing many IT, & BPM corporate organizations. Bhubaneswar (BBSR), started as capital city of Odisha from 1949 as a tier-2 city. The city was designed over a cluster of villages by Otto Konigsberger (1946), Bhubaneswar, along with Chandigarh and Jamshedpur. The 70 years old Bhubaneswar City started with 16500 people and zero slums till 1961 within an area of 20.09 Km² (BBSR NAC), which took a higher growth rate during 1970's @131.41%, in 1980's @ 171.07 % and during 1990's @107% and

in 2019 it is about one million. The number of wards in BMC was 67 according to 2011 census but with city sprawl the number of wards has increased to 81. The city has scope to grow both horizontally and vertically. There has been continuous migration from till date from 16500 people, population density 633 per/km² in 20.09 Km² area (in a NAC) in 1951 to about one million people, population density 2131 per/km² in 186 km² as projected from census report 2011. The urban agglomeration has increased rate of migration from rural areas of Odisha and other states. The slum statistics is given in Fig.1, Fig. 2 and Table. 2.

Table 2: Growth of slum households in Bhubaneswar ULB from 1971 to 2019

Year	ULBs	No Poc	Total Popul ⁿ	Slum Popl ⁿ	Slum HH	Slum Popul ⁿ	Spaces availability	Slum rehabilitation status
1971	Bhubaneswar NAC	7	105491	23	~ 6000	~ 24000	within city	was not important
1981	Bhubaneswar (M)	23	219419	24	~ 13000	~ 52000	within city	Importance given
1989	Bhubaneswar (M)	70	387893	22.4	17175	86901	within city	Importance given
1991	Bhubaneswar (M)	86	411542	23.1	21003	95000	less space	Importance given
1993	Bhubaneswar(MC)	101	458840	25.5	24318	117000	less space	Importance given
1999	Bhubaneswar(MC)	145	600734	33.3	30000	~200000	less space	Slums damaged in Super cyclone
2001	Bhubaneswar(MC)	145	648032	30.9	18048	71413	Hor. growth difficult	Many slums dented in SC-1999
2011	Bhubaneswar(MC)	377	843402	36.7	42277	163983	Vert. growth started	Slum rehabilitation given stress
2019	Bhubaneswar MC)	436	939818	33.7	80665	301611	Vert. growth rampant	Slum demolition started in the city

NB: Vrtl: Vertical, Horzl: Horizontal, NAC: Notified Area Council, M : Municipality, MC: Municipal corporation, Populⁿ: Population, Poc: Pockets, HH: Households

Source: IHS 2017[7], BMC web site data

The Bhubaneswar Municipal Corporation has identified a total of slum dwellers in the city are 308614 dwelling in 436 slum pockets (projected population 929717 in year 2018) and total household units are 60,612. The paucity of planned houses has encouraged the exploding population to go for unauthorized occupancy in slums. Out of slum pockets (436), BMC has identified recognized 320 (73%), unauthorized 116 (27%) and authorized were only one (Rout NR 2008). The total slum population is 304140 persons in 80,665 house holds. Presently ~ 30% of the population of BBSR are living in slums of low grade lining standards. BMC has identified 229 numbers of authorized, unauthorized and identified

slums in 67 wards of BMC which has been extended to 81 numbers; Industrial (Ward Nos: 68 & 69) and others are rural villages in the suburban's in Fig 3 and Table 3.

Table 3: Zone wise slum pockets/population/ total population of BBSR city (Source: BMC)

Ward No	Population	Slum Popul ⁿ	Pockets	Ward No	Population	Slum Popul ⁿ	Pockets	Ward No	Population	Slum Popul ⁿ	No Pockets
Bhubaneswar North zone				Bhubaneswar South West zone				Bhubaneswar South East zone			
1	47574	4261	3	15	25825	3030	3	28	19491	5196	5
2	13110	4334	5	22	9869	12042	13	29	18295	3959	5
3	16505	1208	5	23	11003	9983	16	30	21009	1917	3
4	16185	4327	19	24	11195	2740	4	31	14581	4206	6
5	23446	4992	8	25	14797	2828	4	32	7840	2656	4
6	14060	1163	3	27	13244	6578	4	33	11638	3374	3
7	13932	666	2	37	10078	2281	5	34	10379	6302	6
8	11344	3364	4	38	9616	1562	6	35	9259	4605	7
9	21744	7409	13	39	13375	1864	5	36	10924	839	2
10	10491	5849	14	46	9439	5030	11	40	13320	5446	13
11	12781	1541	3	47	13923	6780	10	41	9786	7379	11
12	20230	4734	6	48	8643	4670	6	42	16539	4398	8
13	17607	3173	3	49	9352	1470	5	43	9185	1470	5
14	14951	7494	10	50	13630	2878	4	44	10011	936	3
16	20230	19610	2	51	11228	3601	4	45	10871	1673	8
17	17607	8314	15	52	8492	2970	5	53	13687	8838	9
18	14951	1962	9	62	741	7027	6	54	15955	1610	5
19	13508	2504	3	63	3850	3139	6	55	12249	1404	3
20	13589	11513	3	64	2946	8436	11	56	10679	6151	10
21	15427	11086	10	65	1208	7935	NA	57	10724	2651	3
26	11117	10271	5	66	5843	2529	7	58	14736	3584	9
T	47574	4261	145	T	198858	99373	135	59	16515	1884	8
(BMC has identified 229 numbers of authorized, unauthorized and identified slums in 67 wards of BMC which has been extended to 81 wards based on Industrial (Ward Nos: 68 and 69 as industrial and other suburban's).								60	14509	NA	6
								61	13522	1985	6
								67	11707	2529	8
								T	327411	84992	156

Both skilled and unskilled work forces, labourers along with students and patients from all over the states and from eastern India flow to the city regularly.

Fig.4: Zone wise slum pockets/population with total population of Bhubaneswar city

After smart city declaration, Bhubaneswar shall be made a slum-free City and necessary plan is chalked out by JNNURM/RAY, PMAY, NUHM (National Urban Health Mission), PRAYAS, UPA (Urban Poverty Alleviation Cell), SBA (Swachha Bharat Abhijan), FSSM (faecal sludge and septage management) and AMRUT (SLIP) shall be implemented by the BMC. Municipal Commissioner I/C of

Slums/Urban Community Development/Planning under the Slum-free City Cell being coordinated by NRSC, ISRO and other agencies shall coordinate with other agencies to make the target achievable. The details of slum statistics of Bhubaneswar city is in Fig. 4, Table 3.

II. REVIEW OF LITERATURE:

Rout NR, 2008[8] studied slum colonies development till 2001 (data oversized) and the heal of the slum dwellers in Bhubaneswar. Das VA 2017[9] reported that the extent of satisfaction of slum dwellers have proved that though they are poor, hard up, socially downtrodden, culturally subjugated, politically passive, disheartened, abused but spiritually strong and satisfied in the slum community environment. The Census 2011[5] data reveals that the city and it's outgrowth comprises of 885363 out of which major people are Hindu(95.21%) followed by Muslims 3.29% and Buddhist's (0.92%). Sorate R.R., et al., 2014[10] emphasized Aluform technology (Tunneling) and rapid walling) are effective methods for rehabilitation which reduces the time, price and resources of construction..

Anand G. et al., 2017[7] reported that BDA was formed in 1983 of area 135 km² (67 wards), annexing parts of Khordha and Jatni area of 233km² at present with a master plan to join Cuttack city to form BBSR-Cuttack complex by 2030 joining BMC, BDPA Rural,

Khorda and Jatani of area 419.10km². Slum dwellers owning their housing land are $\approx 39.78\%$ whereas 52.33% have constructed tenements or kuccha houses on encroached govt. lands. Government lands or staying in the rented houses within the slum areas, (about 78% pucca and 22% kuchha built) Pattanaik I, 2015[11] According to report given to Honorable High Court, Odisha there are 377 numbers of recognized slums within the greater BMC area, 99 slums are on own land and rest 278 are encroached land <https://www.telegraphindia.com/states/odisha/twin-slums-under-court-scanner/cid/362176>. There is diurnal/seasonal variation of SAT of Bhubaneswar, which greatly influence the zonal temperature variation of about 30C between present and previous areas within 25 x 30 km creating an UHI (Swain D et. al., 2016)[12].

The Study Area:

The Kargil slum runs between the Bhubaneswar airport and east coast railways, covers an area of 18494.143m². Kargil Slum Area is under Bhubaneswar Municipality Corporation (BMC) Ward No- 62 (25° 2' 0" N lat. and 88° 9' 0" E long.). Bhubaneswar was formed from a cluster of villages in 1950, and developed today to a smart city with population about one million. The Kargil Basti (Slum) in ward no 62, has developed over a past uninhibited literate quarry surrounding two water bodies lies in the SE zone of BMC. The Kargil slum has about 1200 slum houses giving shelter to about 7000 people. The slum people have inadequate access to minimum services like drainage water, electricity, roads and drainage system, health and education services, the basic need of the inhabitants of the Basti people in spite of NGO's or federal sustenance, poverty alleviation programmed, still persists.

Need for Study:

Bhubaneswar's constitutes old town which was in existence before the shifting of the capital; the planned capital city; and now the unplanned sprawl.. The BMC is spread over an area of 135 Km², covering 67 administrative wards with 885363 people (Census 2011). The slum' population was 163983 people (18.5 per cent). Population wise the most urbanized top five cities in Odisha are Khurda (48.11%), Jharsuguda (39.89%), Sundargarh (35.50%) Sambalpur (29.81%), followed by Cuttack (27.94%), According to 2019 data the slum dwellers in BBSR city are 308614 (33.74% of total people) ranked 4th among Indian cities (Greater Mumbai 54.1%, Faridabad 46.5%, Meerut 44.1%) Sawhney U, (2013)[13]. From 2011 to a recent study on the slum dwellers of Bhubaneswar (during 2019) has increased from 18.5% to 34.01% which is alarming. After declaration of BBSR as a smart city, it demands the metropolis should be made slum free. Due to the location of Kargil slum, land value it ranks the first priority to plan for alternative settlement for these slum dwellers.

III. METHODOLOGY

The methodologies adopted in the study are the in situ reconnaissance survey of the slum dwellers in Kargil slum and their present socio-economic status, sex ratio, environmental status, health issues. The various survey works undertaken are the advanced Survey (Satellite Survey, Field survey using Total station), primary data collection by field survey (House no., Ownership Status, Designation, Sex, Income), analysis of primary and secondary data

(Source: EWS schemes). The survey that shall be conducted are Reconnaissance survey, Preliminary Survey, Location Survey) for the resettlement Place. The laboratories works shall be taken up are the water, soil investigation Fig 5.

Fig 5: The flow chart of the resettled housing scheme for Kargil slum dwellers of Bhubaneswar

The different Autodesk works has been taken and designed with Building Information Modelling (BIM) by Auto Cad, E-tabs, Safe, Arc GIS, #D modelling by Sketch-up, block-wise Design (Beam, Column, Slab, Stair, Footing) etc in 25 Blocks (1000 units) to be designed over 6.23 Acre. The schedule for the work is to be chalked out. The estimate is to be prepared at the current scheduled of rate to find out cost of each unit so that resettled people can have roof over their head.

In-situ Satellite Survey:

Before proceeding for the sample survey, the satellite survey was done by downloading the slum area map and was geo referenced. The GIS map of the slum area is prepared by using the Q-GIS Software. The Kargil area was initially developed due to two water bodies within the slum (Fig-7). The prima facie of the formation of the slum is due to its nearness to the Railway station, bus stops and well communicated to all the business hubs. The murky atmosphere is found in the Kargil slums (20°14'15"N, 85°49'00"E) shown in Fig 1. The Shanty settlement (Ward No. 62) is presently developed from 1970's covering an area 11.82 Ac constituting 1035 Household (HH) Fig 6.

Fig 6: Geospatial map of Kargil slum at Bhubaneswar, Odisha

A. Sample Survey Kargil Slum Area:

In spite of BMC restrictions the numbers of houses are increasing as the location is in the heart of the city. A population survey was conducted based on the slum habitats of 1027 families considering population, sex, numbers of houses, income, profession and their base of owning the land

as variables. A detailed sample survey in the field was done for 1029 families in 1017 nos. of houses in an area in 18494.143 m². The highest numbers are found the masons/carpenters followed small business community (Hawkers) and the road side food plaza owners. As urban slums add to the process of urbanization and main workers are skilled labour class namely Masons or carpenters and plumbers that constitute the Kargil slum Fig 7.

The major portions of the slum dwellers are from housing sector and male labours are dominating, the sex ratio in the slum area as per present sample survey in 2019 indicates the male female ratio is 53%: 47%. Some families, who are homeless and financially stable can shift to the planned satellite area within the smart city either on sharing cost, concessional cost or cost relief basis. The slum dwellers are mostly migrants from inside and the outside states. The annual average income of 998 families out of 1027 families surveyed are less than 8lakhs and the rest 29 families have more than 8lakhs/ annum. The present housing scheme envisages the dwellers are from EWS group and are not capable to construct their own house at the peak land and construction cost of the city

Fig.7: Result Of Population Survey, The Families Residing In The Kargil Slum

B. Resettlement options:

Alternate resettlement colonies are needed in the out skirt of the township. After selection of four sites towards SW zone, some barren lands were located from the google map. The suitability of an alternate area from these four scrub lands were selected .Among them, Ghangapatna area is befitting as it is just adjacent to NH 16, outskirts of the city, and surrounded by many multistoried building and satellite cities.

Fig. 8: Contour plan with a 3-D view of one unit proposed Resettlement area at Ghangapatna

An alternate housing scheme has been structured to scale up the delivery of civil amenities and provision of all utilities and basic services to slum dwellers including security of occupancy at affordable prices, better housing, health, water supply, and sanitation by ensuring them assured value-added life style, education, health and social security. The rehabilitation of the dwellers of Kargil slum area has been selected to shift to the Ganga Patna area for the safety of the International Airport and to protect highly Government land of towering value. The newly selected place is nearest to the Revenue Officers Training Institute and about 15Km from the city.

Reconnaissance Survey:

The proposed area was surveyed in details with total station with subsidiary contour interval - 5 meter and the major contour interval of 10 meter. The contour map of the area is prepared Fig 8.

Table 4: Status of Soil at Rehabilitation (Ghangapatna)

Types of soil	Latosol
Water content	34.39%
Specific gravity	2.81
Max dry density	5.74
Optimum dry density (OMC)	12.9
Unconfined comp. strength (UCS)	1.07 kg/cm ²
Shear strength of the soil	0.535kg/cm ²
Grain Size Distribution : Gravel = 36.4%, Sand = 63.4 % & Fines = 0 %	
Safe Bearing Capacity (SBC) for Raft Foundation depth above 3m	16.85 t/m ²

Primary Soil Data Exploration:

The soil samples from the area were collected and laboratory and in-situ tests were conducted and the soil test results are in Table 4. The soil of the resettlement site is suitable for foundation of high rise buildings of G+4 (Height >24m)

Geography:

Geographically the area lies in Eastern Ghats hills range with 5-15m laterite rock as capping over country rocks of Athagarh formation and 1-2 m of forum as over burden. There is scanty bushy vegetation of tropical savanna climate and classified as Aw (wet & dry climate tropical) as per Köppen and Geiger exists in the area Mishra S. P. 2019[14].

Seismology:

The land lies in the earth quake zone II and lies in the south of the Mahanadi shear zone and the chance of earth quake is less. In past the area had got mild tremors of magnitudes in richter,s scale (RS) were 1982 (5.5 RS), 1986 (4.4 RS), 2014 (6.0 RS), 2015 (5.8 RS).

Meteorology:

The average rainfall is found to be 1306.51mm (1979 to 2019) and the highest maximum and minimum temperature recorded were 46.50C and 8.00C respectively. The area gets occasional hailstorms, winds from thunder squalls and cyclones slamming Odisha coast.

Hydrology: Terrain wise the area is in hill slope and leeward side of the Khandagiri Hills. No large water body or major drain exists in the area. The pre and post-monsoon geo- hydro logical maps indicate that the GWL lies 5-10m mbgl and average yield is <3-5lps (CGWB-2013)[15].

C. Ground Water Quality:

Some physio-chemical characteristics of the ground water were examined in the laboratory for physical and chemical properties from deep well and the results are in Table -5

Table 5: The physico-chemical properties of ground water under Ghangapatna housing scheme

Place	Block	Dist.	Well	pH	EC m-hos /cm	TDS mg/l	Ca+, mg/l	Mg++, mg/l	Na+, mg/l	K+, mg/l	Cl-, mg/l
1	2	3	4	5	6	7	8	9	10	11	12
G Patna	BBSR	Khurda	DW	5.54	135	99	14	4.86	6.1	3.1	14.18
SO ₄ --, mg/l	CO ₃ --, mg/l	HCO ₃ --, mg/l	F-, mg/l	NO ₃ , mg/l	Fe, mg/l	Ca, meq/l	Tot cations	T.+Anio n(An)	(col 20- col 21)	Na/ Cl	TDS/EC
13	14	15	16	17	18	19	20	21	22	23	24
0	0	36.6	0	17.97	0.755	0.7	1.445	1.29	0.057	0.66	0.73

From the lab tests it is instituted that the tube well water is not harmful for human portability except the concentration of Iron.

Application Sequence		Normalisation factor 3.659									
Position		<Omnian>									
Measurement time		1 of 1									
		Large sample									
		23-Dec-2019 16:31:04									
Compound	Al2O3	SiO2	P2O5	SO3	Cl	K2O	CaO	TiO2	V2O5	Cr2O3	MnO
Conc	13.959	72.294	1.026	854.1	0.110	1.525	0.406	2.404	524.2	283.7	0.199
Unit	%	%	%	ppm	%	%	%	%	ppm	ppm	%
Compound	Fe2O3	NiO	CuO	ZnO	Ga2O3	As2O3	Rb2O	SrO	Y2O3	ZrO2	Nb2O5
Conc	7.513	86.7	144.7	136.6	44.4	9.5	100.1	40.3	44.0	0.225	54.7
Unit	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
Compound	SnO2	Eu2O3	Yb2O3	IrO2	PbO	ThO2	CO2	Re			
Conc	124.0	718.0	76.9	4.8	56.6	89.6	0.0	4.5			
Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm			

Fig. 9: Oxides of heavy metals, metalloids, rare earth metals present in soil at Ghangapatna

Hence to find the concentration of Heavy and toxic metals it is felt necessary to conduct by X-Ray Fluorescent (XRF) spectroscopy and the observation results are given in Table 6: The water contaminants as metal oxides are Aluminum (Al), Iron (Fe), Ammonia (NH₃), Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium (Cr), Copper (Cu) and others like Fluoride (F), Bacteria/Viruses, Lead (Pb) and Mercury (Hg). The Oxides of radioactive elements are Radium (Ra), Selenium (Se), Silver (Ag) and Uranium (U) (<https://www.wqa.org/learn-about-water/common-contaminants>) and the ground water quality is poor for the flora and fauna Das and Mishra S. P, 2019[16] Since the soil/water from deep wells of the area contains mostly oxides of heavy metals, the water source may be taken from alternate Municipal water supply scheme.

D. Overall Planning:

The barren land of 6.23Ac is selected to construct 1000 units to accommodate 25 blocks. The satellite image of the Ghangapatna area was down loaded. That image was subjected to digitations process followed by buffering to get the buffered image as a final output. The houses, ponds, main/colony road, vegetation etc were located. The resettled site plan is in Fig 10.

Fig. 10: Overall site plan of the proposed resettlement colony at Ghangapatna

Tenement Plan:

It is planned that the single unit shall have carpet area = 21.64 m² and the super buildup area = 30.20 m²

Fig. 11: The single tenement and block plan in proposed resettled village

The openings shall have sizes for doors (d_1) = 915 x 2134 mm, (d_2) = 610 x 2134 mm, windows (w) = 915 x 2100mm and ventilators (v) = 610 x 610 mm.

Load details:

The dead load, live load, wind load and seismic loads provided during BIM modelling are Dead Load = 6 Kn/m², Live Load = 5 Kn/m², Seismic Zone = II, Z factor = 0.1, Load Combination= 1.5 (DL+LL), =1.2(DL+LL+ELX) =1.2(DL+LL-ELZ) =1.5(DL-ELX) =1.5(DL-ELZ) =0.9DL-1.5ELX =0.9DL-1.5ELZ.

Dead and Live loads:

1. Self-weight of the individual components.
2. Self-weight of the beam & column
 - a. 0.5m*0.3m*1m*25kn/m³
 - b. 3.75kn/m³(taken by software by default)
 - c. Self-weight of the slab=152m*25kn/m³ @ =3.8kn/m²
 - d. Floor finishes =1kn/m²
 - e. Furniture & equipment loads=1kn/m²
 - f. Total dead load given =5.8kn/m²
 - g. Live load=3kn/m² As per IS-875 Part 2

Seismic Load:

The impact of earth quake on structure depends on the stiffness of the structure, stiffness of soil media, height and location of the structure. According to Annex E,IS-1893(part -1):2002, Bhubaneswar belongs to zone II. Zone factor, Z= 0.16, h = total height of the building, Time period in x direction, T=(0.075*h)=0.75.

Fig 12: Layout of a block of the proposed block of the resettlement colony at Ghangapatna

Wind Load Calculation:

Wind analysis is done based on recommendation given in IS-875(part 3) ,1987. The design wind speed can be calculated as : $V_z = V_b * K_1 * K_2 * K_3$:Where: V_b – basic wind speed in m/s, V_z – design wind speed at any height z in m/s, K_1 – risk factor, K_2 - factor to obtain design wind speed depending upon height of the building & terrain, K_3 -topography factor, DalglishW. A., et al., 2019[17]

Design and Detailing:

Foundation: As the bed of the site is continuous laterite formation, provide mat foundation to the structure as the bearing capacity is very week. SBC is 16 ton/m² and the building axial load is 881kn, so mat foundation has been proposed.

Column Details:

The size of the column to be provided as per BIM modeling are 0.300 x 0.460m, with stirrup is 0.230 x 0.380 m, 0.380m, 0.220 x 0.230 m. The reinforcement details are total = 12 # 20mm qp and Stirrups = 10mm qp @ 200mm c/c.

Beam details:

The sizes of the beams as per the BIM model are 0.380 X 0.500 m with stirrups of 0.280 x 0.410 m and the reinforcement details are top Bar = 2 # 18mm qp, bottom bar = 2# 18mm qp, Mid bar = 2# 10mm qp and Stirrups = 10mm qp @ 180mm c/c, 2 legged.

Slab Details:

Concrete slabs are common structural elements of contemporary constructions, consisting of flat, horizontal surface made of cast concrete. Steel reinforced slabs, typically between 100 and 500 mm thick, are most often used for floors and ceilings.Ultimate moment = 2 kn-m, bar-bend details = 8 mm # @ 200 mm C / C, Clear Cover = 15 mm and Thickness of slab = 150 mm

E. Architectural view of the project:

On visualization, the top view, the front view and the aesthetic view of the proposed housing scheme for resettlement of Kargil slum to Ghangapatna shall be as in Fig 13 (a) to Fig 13(d).

Fig 13(a): Top view of the proposed Apartment

Fig 13 (b): Front view of the Apartment

Fig 13(C): Side View of the Housing project

Fig 13(d): Aesthetic view of the project

ID	Task Mode	WBS	Task Name	Duration	Start	Finish
0		0	DESIGN OF SATELLITE SLUM AREA (LOW COST HOUSING WITH ALL THE FACILITIES)	1213.5 days?	Tue 22-12-24	Sat 23-12-24
1		1	SITE SELECTION	8 days	Tue 29-10-19	Wed 06-11-19
2		1.1	SELECTION LAND AREA KARGIL THROUGH GOOGLE MAP	1 day	Tue 29-10-19	Wed 30-10-19
3		1.2	DOWNLOAD MAP BY UMD SOFTWARE	1 day	Wed 30-10-19	Thu 31-10-19
4		1.3	MARKING & PLACING ROAD, HOUSE, SHOP, POND, TREES THROUGH ARC GIS SOFTWARE	4 days	Thu 31-10-19	Wed 06-11-19
5		2	PLANNING	7 days	Tue 22-10-19	Thu 31-10-19
6		2.1	BLOCK PLAN	4 days	Tue 22-10-19	Sat 26-10-19
7		2.2	BLOCK ELEVATION	1 day	Mon 28-10-19	Tue 29-10-19
8		2.3	BLOCK SIDE AND REAR VIEW	1 day	Tue 29-10-19	Wed 30-10-19
9		2.4	PLANNING OF SHOP	1 day	Tue 29-10-19	Tue 29-10-19
10		2.5	PRESENTATION	1 day	Wed 30-10-19	Thu 31-10-19
11		3	RE PLANNING	8 days	Mon 04-11-19	Thu 07-11-19
12		3.1	BLOCK PLAN	3 days	Mon 04-11-19	Thu 07-11-19
13		4	SURVEY	30.75 days	Fri 08-11-19	Wed 25-12-19
14		4.1	POPULATION SURVEY	1 day	Fri 08-11-19	Fri 08-11-19
15		4.2	ANALYSIS DATA OF POPULATION SURVEY	30 days	Sat 09-12-19	Wed 25-12-19
16		5	DESIGN AND DETAILING	19.75 days	Tue 29-10-19	Thu 28-11-19

Fig 14: Work Schedule for the Proposed housing scheme

The work schedule has been prepared taking the help of Ms Office and Ms Project software considering the workforce, materials, machines and the cash flow and the total project duration was found to be 3 Years 4 Months. The schedule is in Fig 14.

Estimate cost of the project:

The total cost for the project was estimated unit wise using AutoCAD and E-tabs and the cost involved segment wise like foundation, ground floor, 1st floor to 4th floor with lofts,, water tanks and staircase etc. for each unit comes to 440.3millions in INR, the land development costs shall be 2.9 million INR including road, boundary wall, Road, parking, and overall cost shall be about 440million INR. The individual dwelling unit per family shall be only 440K INR which is a small amount for the each family under installment payments.

Discussion:

Information Education Communication (IEC) activities are taken up in to consideration for the proposed settled area to see that slum dwellers shall live in healthy and hygienic conditions to provide social awareness and community development with the help of CBO/ NGO's parallel to different states of India, The s recent ordinances, the Odisha Land Rights to Slum Dwellers Ordinance, 2017, assures land to the urban poor in municipalities and NACs.

On SWOT ANALYSIS, it is inferred that, the *strength* shall be provision of colonial living, Pucca buildings, and basic amenities like safe drinking water, electricity, and sewerage system which they were lagging and leading to quality and safe living with harmony and IEC activities. The *opportunities* shall be entrée to further income generating resources, organizational culture inculcation, improving colonial lifecycle standards. The *weakness* are income shall mismatch their living standard, affecting zoning, time waste in transport, improper disposal of solid wastes, more people in less space endangering peace and tranquility. The *threats* shall be muscle and money power shall invite attrition.

IV. CONCLUSION

From the above study, we conclude that even though government is taking so many efforts to improve the quality of life of people living in the slum, at certain level government is still failing to achieve its goals. Good housing, water supply, sanitation and health these basic needs are not being fulfilled. Due illiteracy people in the slums are not getting proper employment resulting into deprivation in their quality of life. This issue is to be addressed at micro level and therefore there is a need to frame a systematic program. So, the aim of the project is to give a suitable life and other facilities. The suitable measures shall improve their quality of life. So similar resettlement plans can be made to provide basic requirements of the quality life at a subsidized cost to the slum dwellers so that the slum clustered city shall be slum less.

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Important Links

- <https://www.youtube.com/watch?v=pZo1tKbEHGs>
- https://www.youtube.com/watch?v=9NBMeQPhS_E
- <http://iihs.co.in/knowledge-gateway/wp-content/uploads/2017/11/Bhubaneswar-Final.pdf>
- https://www.researchgate.net/publication/252627016_Slum_Growth_in_Bhubaneswar_A_Problem_or_Solution
- <https://youtu.be/zADj0k0waFY>
- <https://www.youtube.com/watch?v=LPIMPCswlwz>
- <https://umbc.org.in/index.php/page?name=kargil-basti>
- <http://iihs.co.in/knowledge-gateway/wp-content/uploads/2017/11/Bhubaneswar-Final.pdf>
- <https://smartcities.data.gov.in/catalog/housing-and-slum-population-bhubaneswar>
- <https://www.census2011.co.in/census/city/270-bhubaneswar.html>

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