Strategic Development by SWOC-SPACE-QSPM Matrix Analysis for Smart and Sustainable Rurbanization of Chandipur-Erashal Baby Townscape in West Bengal

*Rabin Das, [#]Jibanananda Samanta

UG and PG Dept. of Geography, Bajkul Milani Mahavidyalaya, Purba Medinipur, West Bengal *dasrabin0@gmail.com, #jsamantavu@gmail.com, *Corresponding Author

Abstract - The world is transforming quickly whereas rurbanization is a path with practice of rural alteration usually evidenced by developing world. Hence, changing rural features, functions and interactions generate newer rurban landscape experienced by rapid growth having a huge opportunity and challenges to the way of life. So, urgent strategy with proper plan and policy is needed to prosper that rurban seed into a smart and sustained urban tree. Chandipur-Erashal *townscape* declared as one census town (2011) of Purba Medinipur in Bengal is reflected as a newborn growth centre with its babyhood structural and functional urban behaviour. Presently, it has been acted as the development engine to periphery influencing regional development. Sprawling cum rapid rurbanization draws the transformations of *life, livelihood and landscape (3-L)* gifting strengths and prospect to the region. But on the other side of hope, illegal and haphazard growth results some rurban dilemma challenging its development and potentiality. The purpose of this paper is not only to examine the relationship between rurbanization and regional development, but to build the SWOC understanding and find out the pathways towards its sustainability. Methodologically, extensive literature review, intensive quantitative and qualitative data mining, relevant *RS-GIS-GPS* database and techniques, analysis of *SWOC-SPACE-QSPM Matrix, Smart Urbanization Indices,* Anti-sprawling *10_E* and *SUDr-s-10* have been the apt and *able means and measures* for the strategic development due to *smart rurbanization* and *townscape sustainability* of this promising growth centre.

Keyword: Smart Rurbanization, townscape sustainability, growth centre, 3-L and means and measures.

I. INTRODUCTION

Typically, India lives in its rurality having the rural areas as the backbone characters of this nation. From the first wave of past industrial revolution to recent digitalization, rural India has been transforming through various economic reforms with noteworthy LPG (Liberalization, Privatization and Globalization) over time. The rapid urbanization leads to the migration of rural people to urban destinations gifting the newer scale and opportunities for labour, employment and other facilities. Hence, rurbanisation plays a crucial role and persistent development of the nation to adjust this ruralurban exchange, transformation and migration.

Rurbanization in terms of regional development shows the rurbanscape with fresh environment and good-looking surrounding alongwith increasing facilities of basic amenities, scope to employment opportunities, integrated people participation with the development plan, programme and process. Functionally, rurbanization has the ability to re-shape the socio- economic set up of adjacent periphery providing not only basic and modern amenities, but also better livability, the quality of life and ways in livelihood. According to Ramesh (2018), rurbanization has the capability for women empowerment also providing better healthcare, employment and other advanced opportunities which associate them with the superficial progressive world. Significantly, rurbanization acts the bright spot in rural areas development and contributing to the growth of our country [27].

In different developing countries like India urbanization is an important phenomenon. According to the census 2011, the rate of urbanization is 31.16% in India and it increases very rapidly [20]. The different functional activities are key factors for developing any urban area. The urban center is a mother / nodal point in any urban area, from where the development processes are spread out and this development process is known as urbanization.

City life has become the norm for most of the global population and building sustainable cities is a growing trend, together with an increased focus on healthier lifestyles in urban settings. Given this framework, the concept of 'rurbanization' is gaining momentum as more



and more people are interested in bringing natural green spaces within the urban setting [24].

The study area, Chandipur-Erashal urban cum growth center is reflected as one proto-urban region or center having with its childhood structure and function whereas Erashal has been declared as one of the census towns of Purba Medinipur district in 2011. Our nation, India is a faster country in the techno-centric world from the viewpoint of population growth and urbanization. In this perspective, the development of enormous growth points having urban character is the typical feature of this advanced developing nation. Bengal is not backward from this event also. The explosive population of West Bengal is always finding out the proper shelter and job opportunities in terms of settlement and occupation. As the result, the transformation of rural landscape into a rurban or urban another has been the way of settling and functioning of a huge population over time. We have chosen such a type of place featured by the rural-urban linkage of a rurban entity. Not only that, now Chandipur-Erashal urban area has flourished as the urban centre or development engine to peripheral advancement in terms of the growth of the buffer and hinterland. The behavioral attitude of the selected urban area is just like the growth center to regional development since it influences most of the socio-economic and service sectors facilitated by not the only periphery, but also most of the neighborhood nodes and urban centers as well as growth points. In this perspective, our fieldwork tries to investigate the nature and status of this urban entity cum growth center considering different quantitative and qualitative scales and theories regarding urban growth and regional planning and development. Here lies the essence of this study.

II. Conceptual Framework and Theoretical Base

There are several theories of regional development such as Spatial Diffusion Theory of Hagerstrand, 1968 [10], Growth Pole Theory of Perroux, 1955 [25], Cumulative Causation Model of Myrdal, 1957 [21], Economic Development Theory after Hirchman, 1958 [13], Stage of Economic Growth Model by Rostow, 1960 [29] and Core-Periphery Model of Friendmann, 1964 [9] which directly or indirectly explain the relationship between urbanization and development and, thereby, the processes operating in creating regional disparities [4]. If we consider the life cycle of any urban area, therefore we found mainly four stages: initial stage, acceleration stage, deceleration stage, and terminal stage. Our study area belongs to the second (acceleration) stage naturally after Klaassen, 1981 [17].

Orindaru, et al., 2020 focused on Romanian youth perspectives on 'rurbanization' in order to identify the actions young people are willing to take towards making their city greener and they designed and implemented a quantitative research project (based on an online survey), in order to also have the ability to identify correlations between factors and actions, thus building a conceptual model for actions towards 'rurbanization.' They showed that young people think about leaving the city area due to problems with air quality, greenhouse effect, or disconnection from nature. All these urbanization issues can be addressed with a proper 'rurbanization' strategy that will make the city greener. [24]

In many developed countries urban sprawl leads to the complete absorption of the surrounding rural areas and the transformation of "rural life". This is particularly true of the periurban zone of the most dynamic cities. This has been conceptualized as the "newrurality" or "rurbanization" that is replacing the previous center-periphery model of development and describes a new global order which is leading to the spatial forms that are characterized by homogeneity and diversity.

Rurbanization is a slow, low-key change and growth process. The changes do not appear dramatic or significant to start with. The slow speed of change can be steady or uneven. Rurban activities have remained undetected for a long time. Rurbanization is an emerging and potentially most important transformative process, observed in few pockets of the large third world, developing countries. It is fundamentally a process of transformation of rural areas by introduction of certain urban characteristics. It brings about differential growth patterns. However it is not based on the domination paradigm (domination of man over nature or state over citizens) and is fundamentally not an exploitative process. It is more of a regenerative, restorative and revitalizing process. Its emphasis is on healing the wounds suffered during the colonial rule. It positively affects people and environment. Its emphasis is on judicial consumption of resources. It combines traditional knowledge and practices with modern technology. It is a distributive and participatory process, which brings about changes in the lifestyles of participants. Modern technologies such as telecommunication and information technology can further and strengthen the process. It has potential of combining local actions with a global vision. Future oriented rurbanization can make the world a better place to live. (Mahajan, 2018) [14]

Mahajan (2018) described some of the salient features of the process of rurbanization, indicating its origin, and discussed some of the effects the process has brought about. According to him, by borrowing metaphor from biology, one can describe suburban sprawl as process of grafting urban lifestyle on rural space. He defined rurbanization as a process of altering rural forms with pre-selected urban patterns and lifestyles, which creates new genetically altered rurban forms [14].



A basic principle of the quantitative strategic planning matrix (QSPM) is that businesses need to systematically assess their external and internal environments, conduct research, carefully evaluate the pros and cons of various alternatives, perform analyses, and then decide upon a particular course of action [6].

A SWOT analysis can help any business enterprise, including farms and ranches gain insights into the past and think of possible solutions to existing or potential problems, either for an existing business or for a new venture [39] [22]. Riston (2008) pointed out that the benefits of external analysis in SWOT include increasing managerial awareness

of environmental change, improving resources' allocation decisions, facilitating risk management, acting as an early warning system and focusing on the primary influences of strategic change [28]. Akca (2006) used SWOT for assessment of rural tourism in Turkey whereas Singh (2010) conducted SWOT analysis in identifying strategies for community development in farm depended villages [3]. According to Ommani (2011), SWOT analysis is used to identify strategies for agricultural development, especially prioritizing the strategy in farming system management, and they help the researchers or planners to manage and prioritize them for achieving food security [23].



III. Location of the Study Area



Our study area (Fig. 1), Chandipur-Erashal urban cum growth center of Purba Medinipur district in West Bengal is reflected as one of the rural-urban landscapes over Keleghai-Haldi-Hooghly interfluves cum fluvial plain having the average elevation as 6.59 m from MSL (ranged between 3.73m and 9.45m) under the most recent fluvial-coastal formation of the Quaternary Age over the South Bengal Basin [18]. Administratively, it has been recognized as one of the census towns of this district in 2011. Geographically, this study area is situated within the extension of 22004'55.51''N to 22005'47.99''N latitude and 87051'10.51''E to 87051'43.65''E longitude. From the administrative and political point of view, this townscape includes Chandipur and Erashal Mouzas from Brindabanpur-I GP and Kalikakhali from Usmanpur GP. Side by side, this region belongs to 577479 sq. meter of its spatial existence along with its buffer potentiality of 941389.6 sq. meters.



IV. Aim and Objectives

Aim:

Assessment of the spatio-temporal journey of 'Chandipur-Erashal Townscape' through rapid rurbanization and development as 'Regional Growth Centre' influencing its periphery

Specific Objectives:

- ✤ To estimate the demographic and LULC changes of the study area with time;
- To investigate and explore the stimulating force and factors for the development of this townscape as the regional growth centre;
- To look into the problematic scenario for townscape sprawling through rapid urbanization;
- To assess the potentiality of this urban landscape through SWOC analysis; and to build up an outline of new pathway towards sustainable development of this urban landscape.

V. Materials and Methods

The study focuses the intensive data collection through various separated and integrated quantitative and qualitative surveys and interviews. Side by side, different updated and contemporary approaches, theories, tools and techniques have been used for data analysis and interpretation using proper software and relevant database. Methodology for our study follows the frame and ways as mentioned in following tables 1, 2 and 3 and flow chart 1:

		Table 1: Stage wise Metho	ds, Tools and Techniques					
Stag	e -I	Stage - 1	П	Stag	Stage -III			
Preparato	ry Phase	Collecting F	Phase	Processing &	Analysis Phase			
Planning	Reviewing	Construction of Techniques and Tools for Data Collection & Pilot Study		Data Processing	Data Analyzing & Interpretation			
Selection/ Formulation of research Problem	Review of Book, papers, articles, reports, drafts & historical documents	Using available information, observation, Fact Specific Interviewing, Target and Focus group discussion	Observation, Sampling and group specific survey for data collection	Data gathering, comp (Data input, editing, c mal	ilation & organization oding and spread sheet king)			
Statement of the Research Problem Preparation of Research Design	Review of Research Work on same place/ same study	Administering written data collection tools and construction of survey schedule/ lab. book and making the attitude scale	Different kinds of Socio- economic, Traffic, Market, Employee, Customer and Public Survey, Vegetation, Leveling and Landscape Survey, Growth Status and Problem based Survey, Growth Centre Influence Survey, Node Specific Function and Dependency Survey, Photo Documentation, etc.	 In-home and I collected sample organized data (as Various Statistical with proper statisti 	aboratory analysis of s & documented and per necessity) analysis and presentation cal and GIS software			
Time, Labour and Expenditure Budget Making Time, Labour and Expenditure Budget Making Figures/ models and previous data		Fixation of sampling techniques, constructing the techniques for instrumental survey	Photo Documentation as per necessary	 Mapping and Stati other database: I economic Scenar Influence, LUI Transformation, I Sprawling, Growt proper GIS and sta Interpretation of mapping analysis 	stical Analysis of RS and Physical Set up, Socio- io, Growth Status and LC and Landscape Problematic Dimensions, h Potentiality, etc. with tistical software all above statistical and			
Functional Emphasizing: Intensive literature review in extensive way, collecting and gathering secondary database for field survey and preparation for survey tools and techniques		Functional Emp Stratified, Systematic and Purposi collect the required primary da surveys and interviews for collec qualitative data as per	hasizing: ve Sampling Techniques to ta and purpose oriented ting both quantitative and its proper ways	Functional 1 Objective wise analysi Earth Image Database Maps, organized Pr Database, etc. with the Arc GIS 10.4.1	Emphasizing: s of Landsat and Google , Corresponding Mouza imary and Secondary help of MS Excel, SPSS, l, GPS Software tthos's Own Construction			



Ta	ible 2: Parameter wi	se principles/ methods to e	estimate the site, situation and growth status, influence and	potentiality of the study area
Sl. No.	Parameters	Methods	Principle/ Formula	Applied Database, Tools & Techniques
1.	Location, Site, Situation and Status	Locational and Status Analysis	GIS Software Analysis	 IGISMAP, ISGPP & Google Earth Imagery (2020) ArcMap (v. 10.4.1) & Google Earth Pro (v. 7.0) & Adobe Photoshop (v. 7.0)
2.	Relief, Vegetation, Construction and Water Bodies	Parameter or Index Analysis (DEM, NDVI, NDBI, NDWI)	★ DEM NDVI= $\frac{NIR (B4)-R (B3)}{NIR (B4)+R(B3)}$ Where, NIR=Near Infrared & R=Red ★ NDBI= $\frac{SWIR1 (B6)-NIR (B5)}{SWIR1 (B6)+R(B5)}$ Where, SWIR=Short Wave Infrared MNDWI = $\frac{Green (B3)-SWIR1 (B6)}{Green (B3)+SWIR1 (B6)}$	 Google Earth Imagery (2020) NDVI (Landsat-8 OLI/ TIRS C1 Level-1) NDBI (Landsat-8 OLI/ TIRS C1 Level-1) MNDWI (Landsat-8 OLI/ TIRS C1 Level-1) Arc Map (v. 10.4.1), Google Earth pro (v. 7.0) & TCX Converter (v. 2.0.30)
3.	Land Use and Land Cover	Change Detection and Analysis	(GIS Software Analysis)	 Google Earth Imagery (2005 to 2020) Google Earth Pro (v. 7.0)
4.	Landscape	Landscape Profiling and Analysis	Representing cross-sectional and longitudinal scenario of urban landscape prepared based on GPS Survey, LULC Survey and Mapping Analysis	 IGISMAP, Earth Explorer- USGS, Google Earth Imagery (2020) ArcMap (v. 10.4.1), Google Earth Pro (v. 7.0), Paint (v. 6.1), TCX Converter (v. 2.0.30) & GPS Visualizer
5.	Demography	Parameter or Index Analysis (Statistical and GIS Software Analysis) [34] [35]	 ★ Demographic Force/ km² F_d = ^{P_{1×P2}/d²} ★ Demographic Energy/ km E = ^{P_{1×P2}/d} ★ Demographic Potential/ km PN1=N₂/d ★ Demographic Gradient/ km² (N/km²) 	 ISGPP, Google Earth Imagery (2020) & Synthesized Data ArcMap (v. 10.4.1) & Google Earth Pro (v. 7.0)
6.	Growth Centre Status	Demarcation of Concentric (Multi Ring) & Polygonal Buffer & Hinterland (GIS Software Analysis)	 Circle Buffering: Core point to hinterland is 2 km and core point to buffer is 1 km. Polygon Buffering: Growth centre Boundary to hinterland is 160 m and growth centre to buffer is 80 m. 	 Core periphery Structure (Circular & Polygonal) Analysis ArcMap (v. 10.4.1)
7.	Growth Centre Influence on Periphery	Mass-momentum, Gravity and Influence Analysis	 Systematic Random Sampling, Stratified Random Sar Perception and Quantitative Study due to influence asses GIS Software Analysis 	npling and Purposive Sampling for sment
8.	Problems and Issues	Problem Specific Analysis	Residential cum CBD Congestion Region, Poor & Interrupted Drainage Sectors, Illegal and Haphazard Dumping Sites, Urban Sprawling & Traffic Congestion Zones Observation, Selection & Mapping Analysis	 Google Earth Imagery (2020) Arc Map (v. 10.4.1) & Google Earth Pro (v. 7.0)
9.	Transport	Efficiency & Accessibility Analysis (Statistical & GIS Software Analysis)	 Detour Index DI= (AD/SD)*100 Where, AD = Actual Route Distance SD= Straight Distance D-Matrix/ Shimbel Accessibility Matrix through Shortest path Analysis (Based on Nodes) D-Matrix/ Shimbel Accessibility Matrix through Shortest path Analysis (Based on Distance) Vehicles Flow Analysis 	 GPS Survey & Google Earth Imagery (2020) Garmin GPS etrex10, GPS Tracker (V. 5.28.4), Latitude Longitude (v. 1.28), Arc Map (10.4.1), Google Earth Pro (v. 7.0) & TCX Converter (v. 2.0.30)
10.	Urban Sprawling	Sprawling Dimension and Rate Specific Analysis	GIS Software Analysis	 GPS Survey & Google Earth Imagery (2020) ArcMap (v. 10.4.1), Google Earth Pro (v. 7.0) & Adobe Photoshop (v. 7.0)
11.	Growth Centre Potentiality	Potentiality Index Analysis (Statistical &	GCPI= $\Sigma n / \Sigma N$ Where, Σn = Sum of the obtain scores from dignifying	Synthesized Data (Qualitative Techniques)



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	Mapping Analysis)	parameters	
		ΣN = Sum of the Scores of Dignifying Parameters	
	SWOC –SPACE –QSPM		
	Framework Analysis [3]	Statistical Qualitativa Analysia	Synthesized Data (Qualitative
	[6] [23] [24] [32] [37]	Statistical Qualitative Analysis	Techniques)
	[38] [39]		
			Source: Author's Own Construction

	Table 3: Major Database for this Study								
Sl. No.	Satellite Image and Other Map/ Image Data								
1	Satellite Image: Landsat-8 OLI/ TIRS C-1 L-1, 2020								
1.	C: Collection, L: Level, OLI: Operational Land Imager, TIRS: Thermal Infrared Sensor								
	Source: www.earthexplorer.usgs.gov								
2.	Google Earth Imagery (2005, 2010, 2015 and 2020)								
	Source: SIO, NOAA, U.S. Navy, GEBCO, US Department of State Geographer								
3.	Corresponding Mouza Maps								
	Source: BLRO, Local Surveyor, Amins, etc. (Manual) and IGISMAP and ISGPP (Online)								

Table 4: SWOT analysis matrix										
	Strengths	Weaknesses								
Opportunities	How do I use these strengths to take advantage of these	How do I overcome the weaknesses that prevent me from taking								
Opportunities	opportunities?	advantage of theseopportunities?								
Threats	How do I use my strengths to reduce the magnitude of	How do I address the weaknesses that will make these threats a								
Threats	challenges?	reality?								
		Source: Whalley, 2010 [37]								



Fig. 2: The Process of SWOC Analysis after Riston, 2008 [28]

VI. Result and Discussion

6.1 Demographic change of Chandipur-Erashal Townscape and its growth status with respect to surroundings:

	Table 5: Variation of Various Demographic Aspects in the Study Area from 1991 to 2021*											
1.	Years	1991	2001	2011	2021*							
2.	Dignity	Rural Mouza	Rural Mouza	Census Town	Townscape							
3.	Population	1294	1786	5332	15326							
4.	Male Population	665	909	2705	7851							
5.	Female Population	629	877	2627	7475							
6.	Area (sq. km)	1.09865	1.42376	3.75050	6.49182							
7.	Population Density/ sq. km	1177.81	1254.42	1421.68	2360.82							
8.	Sex Ratio (per 1000 Male Population)	946	965	971	952							
9.	Literacy Rate (%)	61.83	76.44	87.78	90.90							



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10. % of Schedule Caste Population	9.7	10.1	9.9	10.2
11. Working Participation (%)	35.1	36.2	39.5	43.6
12. Number of Households	216	327	1149	3606
13. Separated Houses	181	274	1047	3342
14. House Density/ sq. km	164.75	192.45	279.16	514.80
15. Household Density/ sq. km	196.60	229.67	306.36	555.47
16. Family/ Household Size	5.99	5.46	4.64	4.25
17. Crude Birth Rate (%)	34.75	31.04	26.69	20.81
18. Crude Death Rate (%)	10.12	9.34	8.04	7.14
19. Children per Woman (Fertility Rate)	4.11	3.25	2.54	2.18
20. Ratio of working age to non-working age population	1.49	1.68	1.89	2.21
*indicates the compiled data of administrative/ institutional draft/ final 1	report and predicted infor	mation	•	
Source: Compilation of Primary Data (Mapping Analysis for Spatial D	Data) and Secondary Data	a (Different Census -1	991, 2001 & 2011 [8	3] [31] [5] [36] and
Different Administrative Draft and Final Report-2005, 2010, 2015 and 2	2020)			

Table 6: Change Rate of Various Demographic Aspects in the Study Area from 1991 to 2021*										
Changing Period	1991-2001	2001-2011	2011-2021*							
1. Decadal Growth of Population (Number)	492	3546	9994							
2. Decadal Population Growth Rate (%)	38.02	198.54	187.43							
3. Annual Population Growth Rate (%)	3.80	19.85	18.74							
4. Decadal Growth of Area (sq. km)	0.32511	2.32674	2.74132							
5. Decadal Areal/ spatial Growth Rate (%)	29.59	163.42	73.09							
6. Annual Areal/ spatial Growth Rate (%)	2.96	16.34	7.31							
7. Change in Density (%)	6.50	13.33	66.06							
8. Change in Sex Ratio (%)	2.01	0.62	-1.96							
9. Decadal Change in Literacy (%)	14.61	11.34	3.12							
10. Annual Change in Literacy (%)	1.46	1.13	0.31							
11. Decadal Change in Working Participation (%)	1.1	3.3	4.1							
12. Decadal Change in Household (%)	111	822	2457							
13. Decadal Change in House Density/ sq. km	27.70	86.71	235.64							
14. Decadal Change in Household Density/ sq. km	33.07	76.69	249.11							
15. Decadal Change in Family Size	-0.53	-0.82	-0.39							
*indicates the compiled data of administrative/institutional draft/final re	port and predicted information	n	-							

Source: Compilation of Primary Data (Mapping Analysis for Spatial Data) and Secondary Data (Different Census -1991, 2001 & 2011 [8] [31] [5] [36] and Different Administrative Draft and Final Report-2005, 2010, 2015 and 2020)





According to the table 5 and 6 prepared from the compilation of Primary Data (Mapping Analysis for Spatial Data) and Secondary Data including different census [8] [31] [5] and different Administrative Draft and Final Report-2005, 2010, 2015 and 2020, there is shown that the various demographic changes along have been occurring in fabulous manner which indicates the quick population and areal growth of the study area over time.

The fig. 3 and 4 show the status of the Chandipur-Erashal Urban cum Growth center region with respect to surrounding and neighborhood nodes and urban centers, the Chandipur-Erashal Urban region has been reflected as 1st order core whereas others have been categorized as 2nd order, 3rd order, and 4th order as per the rule of Core-Periphery Model of Friedman. Here, Nandigram and Haria have been considered as 2nd order, Bhagwanpur, Narghat, Bajkul, Reyapara, Hanschara have been estimated as 3rd order and Magrajpur and Kalaberia have been reflected as 4th order growth centers respectively.

The study area belongs to **6491820** sq. meter of its spatial existence along with its buffer potentiality of 13036300 sq. meters. The hinterland of this urban area is signified by the whole of the Chandipur Block, a little bit of Nandigram-I and II, Bhagwanpur-I and II, and a little portion of Nandakumar CD Block (Fig. 4).



Fig. 4: Status Map of Chandipur-Erashal Townscape with respect to its Buffer and Hinterland (Polygonal & Concentric Methods)

6.2 Spatio-temporal Change in LULC(from 2005 to 2020) of the Study Area:

The table 7 and figure 5 reflect the Spatio-temporal change of major land uses in the study area, Chandipur-Erashal Urban region. The changing scenario shows that the road infrastructure has been increased over time whereas the existence of the canal is more or less consistent over time. The amount of agricultural land has been drastically declined from 2005 to 2020. Specifically, before 2011 of recognizing as a census town, the amount of agricultural land was higher whereas it has been declined after 2011 at a quick rate. On the other hand, the magnitude of settlement and other construction growth is moderate to high in the study area. Specifically, after 2011, it has been increased a higher rate due to quick r-urbanization and growth center development. Vegetation cover in the study area has also been changed over time. But, this change is mixed in nature. Because, if we consider the time early 2011, the vegetation cover was between 15-16%. But, after 2011, it has been increased to 31.36% which is mainly due to a higher level of spatial change of growth center or urban region. Later on, in 2020, the vegetation cover has been enormously declined again due to urban infrastructural development mainly. The amount of wasteland has been changed from 2005 to 2020 whereas vacant lands have been changed as more or less in amount with its up and down scenario. The amount and magnitude of water bodies have been changed before and after 2011 along with its higher and lower existence maintaining census year. But, after 2011, the existence of water bodies has been squeezed at a higher rate due to different growth center development activities. Overall, the land uses of the study area have been changed spatially and temporally. But, ecologically important land use and land covers have been declined at a higher rate while the urban infrastructure, settlement, and commercial construction has been increased with higher magnitude. So, the Spatio-temporal change of land uses have been occurred following the general nature of any urban area and also growth center development.





Fig. 5: Spatio-temporal Existence of Study Area and Change in LULC (2005-2020)

	Table 7: Amount (%) of Major Land uses in the Study Area over Time (2005-2020)													
		Amount (%) of Major Land uses												
Years	Road	Canal	Agriculture	Settlement& other construction	Vegetation	Wasteland	Water Bodies	Wetland	Vacant Land	Play Ground	Others			
2005	1.33	0.08	10.09	18.04	15.64	5.84	1.25	19.93	18.10	6.06	3.84			
2010	1.55	0.28	4.35	16.36	16.12	5.44	4.17	14.50	28.65	4.17	4.40			
2015	1.52	0.31	2.37	25.15	31.36	3.08	11.47	2.34	17.31	3.48	1.61			
2020	1.55	0.29	1.03	24.98	15.31	0	6.22	5.65	38.70	2.85	3.41			
Mean	1.49	0.24	4.46	21.13	19.61	3.59	5.78	10.61	25.69	4.14	3.32			
SD	0.11	0.11	3.99	4.59	7.84	2.69	4.31	8.06	10.10	1.39	1.21			
r	+0.767	+0.793	-0.942	+0.832	+0.235	-0.956	+0.665	-0.880	+0.645	-0.959	-0.436			
\mathbb{R}^2	0.589	0.629	0.888	0.692	0.055	0.913	0.442	0.775	0.416	0.920	0.190			
									Source:	GIS Softwar	re Analysis			





Source: Google Earth & Landsat 8 OLI/ TIRS C1 Level-1

Fig. 6: Comparative Scenario of Land uses, NDVI, NDBI and MNDWI in the Study area, 2020

6.3 Driving factors for growth centre development in terms of life, livelihood and landscape (3-L) transformation through rurbanization:

The field survey tried to investigate the major causes of why this region has been developed as an urban cum growth center over time. Since there is not any well documentation regarding the urbanization of the study area and also lacking the literature on the study area is well observed; we have conducted a perception study to take the remarks on the causes of urbanization or growth center development here. This study has been considered on the target group as older/ senior and experienced people who have been experienced such events over time. Without them, we have considered the people related to trade and commerce, small businesses, shopkeepers, vendors, etc. from the market area and local and migrated residents who are existed now. We have taken the interviews of different officials from different socio-economic, administrative, and political institutions.

The perception study reflects that nodal existence and good accessibility of transport-communication, regional market and business facility, the regional center of basic & modern amenities (goods & services), agglomeration of rural economies (formal & informal), tri-functionaility as a business, residence, and communication, potentiality of buffer & periphery, the interest of local and small entrepreneurs in investment, low land rent at primary stage, development & opportunity of different socio-cultural facilities/ services, dignifying the place as important one from the sites of administration, politics, entrepreneurship, trade and commerce & socio-cultural dimensions, regional & occupational immigration, infrastructural development & better occupational cum residential opportunity after 2000 AD, etc. are the major responsible causes to the urbanization and growth center development in the study area. From the perception study, most of the above facts have been dignified as very high, high, and moderately responsible causes for urbanization and growth center development in the study area.





The above figure 6 shows the land-use scenario along with the corresponding maps on NDVI, NDBI, and MNDWI. The mapping analysis reflects that the NDVI is lower in the case of a settlement, commercial sectors, transport, and other built up areas whereas the vegetation area is featured by higher value of NDVI and grazing lands, agricultural lands, and wetlands with water bodies ensure the moderate to the higher value of NDVI. Hence, urbanization indicates a declining trend in vegetation magnitude and also the NDVI. So, the relation between Urbanization cum growth center development and NDVI is inversely proportional to each other.

Further, side by side existence of land use and NDBI maps shows that the NDBI is higher in case of a settlement, commercial sectors, transport, and other built up areas whereas it is lower in and on the grazing field, vacant land, wasteland, vegetation cover, wetland, water bodies, etc. Hence, urbanization indicates an inclining trend in construction and concretization magnitude and also the NDBI. So, the relation between Urbanization cum growth center development and NDBI is directly proportional to each other.

Another map on MNDWI shows that it is highest in the case of deepwater bodies and wetlands whereas it is higher in the case of grazing field and vegetation cover. It has been reflected as moderate in the case of vacant land, wasteland, playground, etc. while it is moderate to lower in the case of built-up and concretization zones. Hence, urbanization indicates a declining trend in MNDWI. So, the relation between Urbanization cum growth center development and NDBI is inversely proportional to each other.

The figure 16 reflects the longitudinal and cross-sectional landscape profiles of the study area whereas in every case, concentration and accumulation of constructions having settlement, market, hotel and restaurants, business centres, various institutions, etc. have been well observed at the central zone and towards periphery occupying the wetlands, vegetation lands and other ecologically sensitive land cover. Hence, this scenario indicates the sprawling trend towards buffer and surroundings capturing blue-green belt of rural entity throughout the time.

CROSS-SECTIONAL AND LONGITUDINAL LANDSCAPE PROFILES IN THE STUDY AREA



Source: Institutional Strengthening of Gram Panchayats (ISGP), GPS Survey and Google Earth Imagery, 2020

Fig. 8: Longitudinal and Cross-sectional Profiles for showing the Urbanization and Landscape Scenario



Transport Efficiency and Accessibility of Chandipur-Erashal Urban/ Growth Pole Region:

Fig. 9: Efficiency of Transport Network, Accessibility of Transport Network of Chandipur-Erashal Urban cum Growth Centre



The figure 9 shows the Detour Index and Shimbel Index to assess the efficiency and accessibility of the transport network of the Chandipur-Erashal urban cum growth centre with respect to its neighbourhood nodes or sub-centres. The statistical and mapping analysis reflects that the transport efficiency is higher at this townscape and its near surroundings including Chandipur, Hanschara, Bajkul, Kalaberia, Magrajpur, etc. and it has been declined towards far distant nodes and periphery like Haria, Nandigram, Reyapara, Chowkhali, and Bhagwanpur.



6.4 Demographic Influence of Chandipur-Erashal Urban cum Growth Centre:

Fig. 10: Demographic force, energy, gradient and potential in between the study area and neighbourhood nodes and surroundings

The figure 10 shows the demographic force, energy, gradient and potential to assess the demographic attraction and influence of the Chandipur-Erashal urban cum growth centre on its neighbourhood nodes or sub-centres and periphery. This statistical and mapping analysis reflects the higher attraction and influence on Chandipur, Hanschara, Bajkul, Kalaberia, Magrajpur, etc. and it has been diluted towards far distant nodes and periphery like Haria, Nandigram, Reyapara, Chowkhali, and Bhagwanpur.

6.5 Goods and Service Influence of Chandipur-Erashal Urban cum Growth Centre:



Fig. 11: Influence of study area on neighbourhood nodes and surroundings for different goods supply

The figure 11 and 12 show the goods supplying and service providing scenario to assess the goods and service related attraction and influence of the Chandipur-Erashal urban cum growth centre on its neighbourhood nodes or sub-centres and periphery. This statistical and mapping analysis also exhibit the higher attraction and influence on Chandipur, Hanschara, Bajkul, Kalaberia, Magrajpur, etc. and it has been diluted towards far distant nodes and periphery like Haria, Nandigram, Reyapara, Chowkhali, and Bhagwanpur. But, it is undoubtedly clear that for most of the essential goods and services, neighbourhood nodes and surroundings are more or less depended on this townscape cum urban centre.

6.6 Potentiality Analysis of Chandipur-Erashal Urban cum Growth Centre:

The figure 13 shows the **Urban cum Growth centre Potentiality Index (UGCPI) of the** study area with respect to its periphery. On the basis of compiled and synthesized data regarding order and status of growth centre, demographic and areal mass volume, demographic force, energy, gradient and potential, transport connectivity, efficiency and accessibility, influence on goods and service supplying and providing, etc., the UGCPI of this townscape and neighbourhood nodes have been justified. The figure 20 indicating the growth centre potentiality index shows the higher opportunity in this townscape sequentially followed by Haria, Nandigram, Bajkul, Bhagwanpur, Kalaberia, Hanschara, Chowkhali and Magrajpur. So, this potentiality is enough to justify the growing dignity of this urban centre day after day.





Fig. 12: Maps showing the influence of study area on neighbourhood nodes and surroundings for services





Fig. 13: Urban cum Growth centre Potentiality Index (UGCPI) of the Study Area with respect to Its Periphery

- 6.7 Major Problems and Issues existed in Chandipur-Erashal Urban cum Growth Centre:
- (a) Possession of a critical population mass at the core and congestion of both settlement and market at the center of urban gravity are reflected here. Generally, excessive urban concentration creates congestion and higher cost for production and degradation of the quality of life, while insufficient urban concentration prevents the synergistic effects of economies of scale and a dense customer base. Here, the critical mass population is concentrated at the core or CBD zone



where the market and business-related activities are strong in function. As the result, the core region is faced with critical stress of both commercial and residential activities.



Fig. 14: CBD Congested Zone, Illegal, Haphazard and Unscientific Urban Sprawling and Dumping Sites

- (b) A favorable economic environment for fostering growth-mind entrepreneurs and essential urban sprawling destroying buffer and hinterland potentiality are process-response scenario in the study area whereas undermining impacts on agricultural economy and ecosystem, wetland, wasteland, vegetation cover, etc. have been developing as the consequential problems over time.
- (c) Prospering but problematic in the prevalence of the capacity for innovation in the study area is another major problem. The development of urban cum growth center is undoubtedly beneficial, but lack of institutional and implementing opportunity, enriched entrepreneurs, better-minded youths and qualitative human resources are not interested to involve in this way of lifestyle named as urban cum growth center development here.
- (d) Drainage interruption with its poor structural layout reflects the evil situation to sustainable infrastructure in the study area. Here, a very poor drainage situation acutely affects the residential cum central business zone during the rainy season. Illegal horizontal and vertical overcrowding of settlement and market infrastructure without proper drainage facility reflects the poor drainage facility here. There is existed one north-south canal passing through the growth center region which has been tremendously interrupted now by illegal and haphazard settlement expansion and other construction.
- (e) Traffic congestion in terms of problematic transport draws the bottleneck situation of urban dynamics of the study area. Whereas the strengthening urban transport is just like the well functioning of the artery and vein in a living body, the different nodes having various routes are conventionally featured by the irritating traffic congestion and accidents.
- (f) Illegal and haphazard dumping sites results the unhealthy state of affairs to urban livability and environment here. Unfortunately, there is not any fixed dumping site for waste disposal or sewerage management. As the result, huge wastes are dumped were and there not maintaining any rule or order of concerned authority.

(g) Other existed problems are:

- Unstable economy having dominated lower circuit with non-basic economic activities rather than weaker upper circuit with basic economic activities for urban development;
- Conflicted political institutions and antagonistic attitudes of politics and policy in the planning and development;



- Unavailability of public facilities/infrastructure including transportation, potable water, sanitation, and waste management systems;
- Inefficient urban governance;
- Lack of comprehensive growth management policies for sustainable urban growth, and reduction of social and environmental problems;
- Lack of provision of information technology and faster diffusion of knowledge;
- ✤ Disrespecting the rights of women and the urban poor;
- Unavailability of jobs and the urban ability to match them with available skills, both local and expatriate labor force, etc.

6.8 Efforts and Gaps to the Management of Problems in the Study Area:

The following fig. 15 from the Perception Study and Field Work shows the role of different sites for management of the existed problems in the study area. 210-respondents have gifted their responses cum feedbacks on the major managemental efforts for declining the observed socio-economic, cultural, infrastructural, administrative, and environmental problems as per the survey schedule/ questionnaire. But, in the first four cases of the management, there are not observed the well or satisfactory efforts from different govt., administrative, political, and non-government sites. Most of the people are not satisfied with them or those institutions. The roles of local administration and selected members from different levels of democracy are not satisfactory here. There is no emphasison any kind of specific plan or project from all those characters for the far-sighted development of this potential region. The study area which is lightening the candle of hope and esteem for the management of the issue in the study area. Hence, this picture is clear cut that the huge gaps in between problems and efforts from different sites are the key problem for the management of the problems and obstacle to the study area and regional development.



Fig. 15: Role of Different Sites for Management of the Problems in the Study Area



Respondent's Perception on the Expected Management for Sustainable Development:





The above fig. 15 and 16 reflect the managemental ways proposed by the sample respondents (210) in the study areas. This is very interesting that most of the respondents (>50%) have given their proposal for the management of the existed problems in the study area. The responses coming from the perception study show a very high and higher magnitude in most of the cases. They have dignified the roles of government and local administration specifically. It is interesting that most of the people in the study area expect the liberal co-existence of all political parties in one envelop named urban cum growth center development. Since the transport and drainage infrastructure is one of the major problems here, the sample respondents demand its solution urgently. Although the study area has been recognized as the census town as per the 2011 census, there is not provided any higher-level institution having general, technical, management, and socio-cultural education. Hence, most of the people have put their feedback for it. So, the perception study for getting the managemental proposals for recovering the problems in the study area reflects the relevant and most demandable ways to local and regional development which should be emphasized in the schedule of planning, project, and development of local and higher administration, government and selected public representatives [1].

VII. Strategy Formulation through Matrix Analysis for Smart Rurbanization and Sustainable Growth of the Study Area:

7.1 Designing External and Internal Factors EvaluationMatrix:

Table 8: External Factor Evaluation Matrix (EFEM) for the study area Weighted Score **Rating Grade on** Dimension Weight (W) **External Factors** 5-Point Scale (R₅) (W_{Sc}) Opportunity for climax development since it is at initial phase and scope to 4.0 0.13 0.52 convert into municipality or planned town Opportunity to develop as the regional growth pole from centre in scientific 3.0 0.06 0.18 and systematic ways Opportunities 0.42 1.48 Opportunity to reflect its optimal liveability and healthy environment 3.0 0.08 0.24 drawing the scope of sustainable townscape or planned city in near or far future Dpportunity to be the large platform of all types of capitalist, entrepreneurs, 4.0 0.09 0.36

7.1.1 Internal Factor Evaluation Matrix (IFEM) Analysis:



	manufacturers, businessman, etc.					
	Opportunity to make it as better urban morphology and economy with potential buffer and hinterland, etc.	3.0	0.06		0.18	
Challenges	Poor and hazardous drainage, sanitation and transport infrastructure along with no specific waste disposal facility	2.0	0.14		0.28	
	Lack of demand based higher educational, technical and management based education and other institutional facilities	2.0	0.14		0.28	
	Fragile and weak institutional and organizational facility with poor governance	2.0	0.10	0.58	0.20	1.07
	Overcrowding CBD at the centre and illegal and haphazard sprawling having with illegitimate land business towards periphery	2.0	0.11		0.22	
	Lack of plan, policy and project for urban/ growth centre development and huge gap among public, politicians and plan makers, etc.	1.0	0.09		0.09	
Total				1.00		2.55
Population Size	$(N) = 2570$ and Sample Size $(n) = 625$ [Residents $(n_R) = 75$, Businessmen (n_B)	=125, Customer (r	$n_{\rm C}$) =75, Se	rvice Man	$(n_s) = 50, T_s$	ransport
	Workers $(n_T) = 75$, Officials $(n_O) = 75$, Institutional Staff $(n_I) = 75$	=75 and Others (n _c	_{ot}) =75]			
Sou	rce: Compilation of Primary & Secondary Data from Observation, Field	Survey, Perceptio	n Study &	Official S	Sources	

7.1.2 Internal Factor Evaluation Matrix (IFEM) Analysis:

	Table 9: Internal Factor Evaluation Matrix (IFEM) for the study area										
Dimension	Internal Factors	Rating Grade on 5-Point Scale (R ₅)	Weig	ht (W)	Weighted Score (W _{Sc})						
	Accumulation and concentration of local and regional small to medium businessman, entrepreneurs and capitalists	4.0	0.12		0.48						
	Flourishment of childhood phase with huge regional interest and initiatives	3.0	0.07		0.21						
Strength	Leading node and growth centre with respect to surroundings/ neighbourhoods and large existence of buffer/ hinterland/ periphery	4.0	0.09	0.43	0.36	1.54					
	Site suitability from the view point of its geography, environment, topology (road & railways) and human resource	4.0	0.07		0.28						
	Not only manufacturing, but market and service based urban improvement stimulating regional development	3.0	0.07		0.21						
	Traditional political chaos and conflicts along with the dominance of promoters and protractors	2.0	0.15		0.30						
	Loosened and fragile administration, lack of plan, policy and prime interest and lacking the provision of information technology and faster diffusion of knowledge	2.06	0.13		0.26						
Weakness	Influence of large towns and cities like Haldia, Contai and Tamluk and lacking the goods, service and infrastructural facilities comparing to those	2.0	0.09	0.57	0.18	1.04					
	Lack of comprehensive management policies for sustainable urban growth, and reduction of different environmental problems	(ch ¹⁰ 2.0	0.10		0.20						
	Unavailability of sufficient economic ways, job opportunity and the city's ability to match them with available skills, both local and expatriate labour force, etc.	2.0	0.10		0.10						
Total				1.00		2.58					
Population Size	$(N) = 2570$ and Sample Size $(n) = 625$ [Residents $(n_R) = 75$, Businessmen (n_B)	=125, Customer (no	=75, Se	rvice Man	$(n_s) = 50, T$	ransport					
	Workers $(n_T) = 75$, Officials $(n_O) = 75$, Institutional Staff (n_I)	=75 and Others (not) =75]								
So	Irce: Compilation of Primary & Secondary Data from Observation, Field	Survey, Perception	Study &	: Official S	ources						

7.2 Strengths, Weaknesses, Opportunities and Challenges (SWOC) Matrix:

The crisscross perception survey using thoroughly sampling techniques and qualitative data analysis shows the major strength as the developing facts and features in the study area where sufficient weakness is also existed within the same envelop breaking the tone of its progress. The opportunity scale has been dignified with higher magnitude along with the notable alarm from its challenging future. Hence, the journey of potentiality is very significant featured by inspiring development, unfortunate problems and huge prospect.

The table 7 ad 8 prepared from qualitative survey and data analysis reflects the SWOC Index analysis to assess the townscape potentiality justifying the existed strengths and probable opportunities against observed weakness and possible challenges in terms of resistance in the study area. The SSI and OSI show the indices as 74% and 82% dignifying the stimulating development and large scale potentiality of the townscape cum growth centre whereas WSI and CSI having the indices as 81% and 84% decelerate the mass momentum of its journey as the emerged problems at present and upcoming challenges in future. Thus, weakness and challenge slow down the strength and opportunity in its potentiality due to the non-



experienced, unplanned, unscientific and haphazard development of this urban landscape. SWOC Index as 62.5% shows the significant measure of higher scale potentiality which depicts the challenging journey of townscape cum growth centre with its huge prospect over time.



Fig. 17: SWOC Matrix for Strategy Fixation for the Study Area

7.3 Strategic Position and Action Evaluation (SPACE) Matrix:

As per factorial analysis (Table 8 and 9) for SWOC matrix assessment, six weaknesses- challenges (WC) strategies have been formulated for the study area (Fig. 17) whereas SPACE Matrix analysis suggests the conservative and competitive strategic positions (Fig. 18) in one envelop.



Fig. 18: SPACE Matrix for Strategy Defining/ Making for the Study Area



7.4 Quantitative Strategic Planning Matrix (QSPM)

	Table 10: Quantitative Strategic Planning Matrix (QSPM)												
Koy Fastor	Woight	WC ₁		W	C ₂	W	/C ₃	W	C ₄	W	/C ₅	W	'C ₆
Key Factor	weight	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS
O ₁	0.13	2	0.26	2	0.26	2	0.26	3	0.39	4	0.52	2	0.26
02	0.06	2	0.12	2	0.12	1	0.06	1	0.06	2	0.12	2	0.12
03	0.08	3	0.24	2	0.16	4	0.32	3	0.24	3	0.24	3	0.24
O ₄	0.09	4	0.36	2	0.18	1	0.09	1	0.09	3	0.27	3	0.27
0 ₅	0.06	4	0.24	4	0.24	2	0.12	4	0.24	3	0.18	4	0.24
C ₁	0.14	4	0.56	2	0.28	2	0.28	2	0.28	2	0.28	4	0.56
C ₂	0.14	4	0.56	3	0.42	2	0.28	2	0.28	3	0.42	4	0.56
C ₃	0.10	2	0.20	1	0.10	1	0.10	1	0.10	3	0.30	3	0.30
C ₄	0.11	2	0.22	2	0.22	4	0.44	4	0.44	2	0.22	2	0.22
C ₅	0.09	2	0.18	2	0.18	2	0.18	1	0.09	1	0.09	3	0.27
S ₁	0.12	1	0.12	1	0.12	1	0.12	1	0.12	1	0.12	1	0.12
S_2	0.07	2	0.14	2	0.14	2	0.14	2	0.14	3	0.21	2	0.14
S ₃	0.09	2	0.18	2	0.18	1	0.09	2	0.18	2	0.18	2	0.18
S ₄	0.07	1	0.07	2	0.14	2	0.14	2	0.14	3	0.21	1	0.07
S_5	0.07	3	0.21	2	0.14	1	0.07	1	0.07	2	0.14	3	0.21
W ₁	0.15	3	0.45	2	0.30	3	0.45	3	0.45	3	0.45	3	0.45
W2	0.13	3	0.39	2	0.26	3	0.39	3	0.39	2	0.26	3	0.39
W ₃	0.09	3	0.27	3	0.27	3	0.27	2	0.18	3	0.18	3	0.27
W4	0.10	3	0.30	3	0.30	2	0.20	2	0.20	2	0.20	3	0.30
W ₅	0.10	4	0.40	3	0.30	3	0.30	3	0.30	4	0.40	4	0.40
STAS			5.47		4.31		4.30		4.38		4.99		5.57
Priority			2		5		6		4		3		1
AS = Attractiver	ness Score, TAS	= Total At	tractivenes	s Score &	STAS = S	um of the	Total Attra	activeness S	Score				

Categories of Attractiveness Scores (AS):

1 = Not/ little bit Attractive, 2 = Somewhat Attractive, 3 = Reasonably Attractive, and 4 = Highly Attractive

Source: Compilation of Primary and Secondary Data from Observation and Field Survey & Data Analysis (Table 10 & 11)

The table 10 shows the Quantitative Strategic Planning Matrix analysis resulting 6th, 1st and 5th Weakness-Challenge strategies as the prior in the consideration of sustainable urban planning for the study area. Synchronizing policy-policy maker, plan-planer, politics-politician, academics-academician, public-private sectors, programme-project, demand-production-supply and population-potentiality-development-environment has been emphasized as the 1st prior strategy whereas development of a good governance and colourless administration and developing well morphology with updated economy and restored ecology have been detected as the 2nd and 3rd prior strategies for the sustainable urban development of this growth centre.

VIII. Smart Urbanization Index Analysis for considering the Urban Smartness and developing the Sustainable Approach for the Study Area:

Smart urbanization is an important component of smart city development whereas it is one of the major components economic growths for communities worldwide. A key requirement of tourism has been to attract more and more tourists from different parts of region, nation and world. Smart urbanization refers to the application of information and communication technology (ICT) for developing innovative tools and approaches to improve tourism where the whole of the process is reliant on core technologies like ICT, mobile communication, cloud computing, artificial intelligence and virtual reality. In case of this study area, the analytical data table 11 and 12 show that the Smart Urbanization Technological Index (SUI) and Smart Urbanization Index (SUI) are very poor. So, there should be needed to support the integrated efforts to find innovative ways to collect and use data derived from physical infrastructure, social connectedness and government and non-government organizational sources, and users in combination with advanced technologies to increase efficiency, sustainability and experiences.

Tal	ble 11: Assessment of Technological Foundation	ns of Smart Urbanizatio	on in the study are	a	
Major Technological Foundations	Details in Smart Urbanization	Status in the Study Area	Grade on 5-point Scale	Smart Urbanization Technological Index (SUTI) in %	
Sphere	bridging digital & physical spheres	A little bit	1.0		
Core technology	sensors & smart phones	Partial	2.0		
Transport & Travel phase	during trip, transport and travel	Partial	2.0		
Lifeblood	big data	Negligible	0.5	30.00	
Paradigm	technology-mediated co-creation	Negligible	0.5		
Structure	ecosystem	Partial (Moderate)	2.5		
Exchange	public-private-consumer collaboration	Partial	2.0		
Source: Compilation of Primary & Secondary Data from Observation, Field Survey, Perception Study & Official Sources					



Table 12: Smart Urbanization Index Analysis for the study area					
Smart Urbanization Dimension	Smart Urbanization Indicators	Status in the Study Area	Grade on 5-point Scale		Smart Urbanization Index (SUI) in %
Consumption -	Privacy concerns	Partial	2.0	8/20	32.50
	Attitudes toward co-creation	A little bit	1.0		
	Value derived	A little bit	1.0		
	Physiological penalty of ubiquitous connectivity	Negligible	0.5	0/30	
	Need/desire for escape from technology	A little bit	1.5		
	Technology access	Partial	2.0		
Service Provision	Value of data/information	A little bit	1.5		
	Exploitable technology-market combinations	A little bit	1.0	12.5/35	
	Suitable business models	A little bit	1.5		
	Innovation capacity	A little bit	1.5		
	Human resources implications	Partial	2.5		
	Collaboration/coordination mechanisms	Partial	2.0		
	Market dynamics	Partial	2.5		
Facilitation	Information governance	Negligible	1.0		
	Infrastructure requirements	Partial	2.0		
	Social and environmental cost	Partial	2.5	12/35	
	Artificial intelligence	Partial	2.0		
	Public-private-consumer collaboration	A little bit	1.5		
	Structural-functional inter-linkage & facility	A little bit	1.5		
	Cost-Benefit Urbanization & Valuation of Ecosystem	A little bit	1.5	1	
Sourc	ce: Compilation of Primary & Secondary Data from Observation	on, Field Survey, Pero	ception Stu	dy & Offici	al Sources

Table 12: Smart Urbanization Index Analysis for the study are

IX. Suggestions towards an anti-sprawl urban policy

Sprawling is one of the behavioural aspects of any urban cum growth center. In the case of our study area, this is not exceptional also. But, if we consider the growth rate or magnitude towards different directions on and along different routes, this is higher in the case of Chandipur-Nandalumar-Mechheda-Kolkata and Chandipur-Digha routes (NH 41). This is clear that after recognition of census town (2011) and taking the opportunity from new govt. (after 35 years); sprawling has been accelerated towards the south along Chandipur-Digha road alongwith its gigantic infrastructural and remarkable population growth. The figures 19 and 20 reflect the nature, direction and rate of urban sprawling from 2004 to 2020 in the study area.









SPATIO-TEMPORAL SPRAWLING RATE FROM 2004 TO 2020 [On and along Different Routes towards Different Directions Derived from Selected Growth Centre]



Source: GPS Survey and Google Earth Imagery (2004, 2009, 2011, 2015 & 2020)

Fig. 20: Sprawling rate and magnitude of the growth centre towards different directions (from 2004 to 2020)

Strategic and Suggesting Essential Ten (10E) on the way forward against urban sprawling:

Essential 10 ways against urban sprawling in the study area may be adopted to control the free frog expansion of this townscape cum growth centre. Government and local administration should be more hard and restricted to maintain the proper land use and land conversion policy in this case.



Fig. 21: Essential Ten (10_E) on the way forward against urban sprawling

Hence, we can recommend for not stopping the urban or growth center sprawling, but also introducing the planning controlling this evil process. So, the suggestions towards anti-sprawl urban policy may be made of as followings (Table 13):

Table 13: Major suggestions towards anti-sprawl urban policy				
Ŕ	Restricting the illegal land use conversion maintaining the land use policy as per govt. rules and regulation;			
Ŕ	Restricting the illegal encroachment and forceful capturing of wetland, vegetation cover, wasteland, agricultural lands, etc. for the haphazard			
	development of the growth center cum urban region;			
Ŕ	Stopping the dominance of promoters and protractors in case of land business;			



Ŕ	Rectifying the government and administrative negligence in case of unplanned and unscientific sprawling;
Ŕ	Maintaining the ecological footprint and landscape susceptibility in case of free frog urban expansion;
Ŕ	Reconstructing and reforming the urban and growth center morphology adjusting with its functionality;
Ŕ	Synchronization of policy, public and plan for sustainable growth and expansion of growth center region [11];
Ľ	Providing the specific rules for settling as the residents the migrant people in the study area; [16] [12], etc.

X. Policy recommendations and strategic options for the Sustainable Urban Development:



Fig. 22: Policy recommendations and strategic options for the Sustainable Urban Development in the Study Area

The above figure 22 shows the recommended policies and strategic options for the smart and sustainable urban development in the study area. Here ten policies cum strategies have been formulated as per the SWOC-SPACE-QSPM Matrix, Smart Urbanization Indices (SUI) and anti-sprawl urban ways considerations and analysis.

XI. Conclusion

Our study area, the Chandipur-Erashal growth centre cum townscape has been experiencing childhood to adoalescent phase of life cycle having various types of problems mentioned above just like any Indian growth center, ruralurban area, and peri-urban areas. The respective local governments (rural and/or urban) within whose jurisdictions the rurban and growth centre lies should have with them a guiding document (such as a local area plan) that helps in future planning and development of the periurban, rural-urban, and growth centre. As Chandipur-Erashal townscape cum growth centre is urbanizing, the concern is growing over the adverse conditions created by uncontrolled growth and unregulated development in the urban region. The government's approach and response over the years like policy documents (i.e., erstwhile Five-Year plans of the Planning Commission), legislations (e.g.,

Seventy-fourth Constitution Amendment Act, 1992), programs/schemes (Jawaharlal Nehru National Urban Renewal Mission, 2005, Atal Mission for Rejuvenation and Urban Transformation, 2015, National Rurban Mission, 2016) [19] and initiatives of town and country planning departments, regional planning, and development authorities, state and local governments [7], etc. may be considered in case of sustainable townscape development of this growth centre. Under this scope to facilitate the urban region, the recommendations for more effective governance of the growth pole and rurban region may include planning for rural-urban/ peri-urban/ growth centres areas, providing a rational regional land use pattern, formulating an effective regulatory regime, provision of affordable housing, basic services, regional transport corridors, and facilities [26] [2]. Finally, it may be expected that for the comprehensive but sustainable development of this urban cum growth center,



there should be reflected the one and unique effort and role of all functional characters including common people, local administration, local representatives, politicians, plan makers, entrepreneurs, businessman and other institutional characters.

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