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Population dynamics and instability an assessment of socio-economic and ecological trait of existence: a comprehensive approach in semi arid climate of southeastern Maharashtra, India

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Abstract

In the prevailing, man induced ecological imbalance circumstances, to manage with population instability, it is essential to understand the population dynamics of southeastern Maharashtra in water-scarce and diverse climatic condition regions to invent sensible plans for the utilization of human resources. The current study, therefore, attempted to appraise the intensity and incidences of population dynamics and instability over the semi-arid climatic region of southeastern Maharashtra during the past census years (1981–2011).The study was carried out with the application of recorded data for the entire population of study area to examine the population growth and socio-economic aspects interrelating with ecology. The areas under constructive ecological circumstances having superior rate of population growth while rural population spread was observed in the admirable agro-ecological condition and urban habitat was spread in the industrially organized parts of study area. The study also highlights that an ecological balance plays a decisive role to decide the constructive dynamics of the population. The unbalanced condition of rainfall and temperature in the some parts of study area leads to massive out migration from the north and eastern province of study area. There is a possibility for human being and environmental resource management which conceivably generate the population balance in the future and also have to build up socio-economic accomplishment plan for well being of human population and sustainable environment.

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Key Words Maharashtra**,** Population dynamics, semiarid region, Socio-economic, Population ecology, sustainable environment, Demography

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Introduction

Study of human resources as population is very crucial in modern and advanced geography the activities of human beings are directly given stress on physical, cultural and ecological scenario of the any region. Man is a conveyer of socio-economic activities and distributional factors and he creates spatial effects on the nature for this understanding we need to focus on population studies. Population geographers have to give up their attention to social and cultural aspects of population rather than aggregate approach (White, P., & Jackson, P. 1995). A spatial contingency of population instability is directly related to socio-economic and ecological behavior (Bailey, A. J. 2009).

Analysis of the population dynamics tends to the ever changing space substance and association with region; the human migration has been measured susceptible key of altering mold of economic opportunity of the region (Renkow, M., & Hoover, D. 2000). Prospective contribution of population change is mainly due to inequalities in mortality and morbidity needed to monitor by population researcher (Boyle, P. 2004).Population dynamics and growth resulted inconsistent negative force on the environment (Ehrlich, P. R., & Holdren, J. P. 1971).In the study of Demography we have to an accepting of growth tendency of population is crucial for any consequential socio- economic development and planning of the region (Dumond, D. E. 1965). Literacy is a vital issue in demographic and socio-economic revolution (Krishan and Shyam 1977). The human populations demonstrate definite occupant attributes in terms of sex ratio (Joshi and Tiwari, 2011).The alteration or negative sex ratio affects largely on the primary socio-economic and cultural outline of the society and it has been huge burden on the administration, political personals and policy makers to control the damage. Population getting old is the historical conclusion of declining rates of fertility and mortality with fertility having

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the bigger consequence. While human being getting old has solitary taken the minds of policy makers ever since the 1980s (Peter McDonald 2016).The age structure affects the regions demographic characteristics as well as it is reflected in the ecological and social patterns of the region. (Hsieh, M. M., et al 2007)

Population replications and paleohistorical data recommend that population dynamics were certainly determined by foremost climate instability, even though climate has been significant determinant of human population dynamics.(Miikka Tallavaara et al 2015).The association connecting human population dynamics, crisis in food security, and climate change is a imperative modern distress that is in substantial necessitate of higher-resolution, chronologically longitudinal viewpoint (Bevan et al. April 2018). Digression from normal rainfall and moderate temperatures scientifically raise the risk of human population clash, often considerably (Solomon M. Hsiang et al September 2013). The amount of human population on the earth has changed significantly over time and was in several features linked to modify in the natural environment both in terms ecology and environment (Samir, K. C., & Lutz, W. 2017),(Pimentel, D., et al 1994), (Harte, J. 2007).and (Sherbinin, A. D., Carr, D., Cassels, S., & Jiang, L. 2007). Worlds ever increasing human population and notable raise in fossil fuel and manufacturing discharge, land use transformation, and agricultural actions have resulted in numerous unwanted changes in the Earth system, including in climate change, change in hydrological cycle etc.Human supremacy of environments has been pervasive over the last century, with nearly half of Earth's surface transformed by human actions (CristinaMilesi et al October 2004).

Hence the study area has been under scarcity zone of rainfall as well as it should need to utilize proper population resources in the study region for sustainable ecological environment. (Acharya, T. K. T., Sayanakar, S. B., & Kasar, D. V. 1977), (Patil, S. K., et al 2019) and (Das, Abhinandan 2010). Land use change occasionally product of interface of demographic, socio-economic practice because it is directly associated with the human needs for his survival in the nature his priorities altered according to the dependent population (Mayowa J Fasona et al June 2005). Climatic changes play the crucial role for the development of the region and may altered ecology and socio economic stability. A population problem becomes issue of long-term rational planning not quick short-term repair for betterment and well being of next generation and sustainable environment.

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Semiarid region of southeastern Maharashtra

Study area is situated in the southeast region of Maharashtra state (western India). This area located between 16º 45'12" to 17º 33'08" N. and 73º 42'23" to 74º 40'34"E. geographical co-ordinate. The district's region is about 8,572 sq. ft. the western side of the district is on the main line of Sahyadri mountain ranges. Sangli districts major rivers are Krishna and Warna. These basins are characterized by the semiarid climate that is Bsh type of climate (IMD 2020). Agriculturally and meteorologically these parts are falling in the rainfall scarcity zone (Kalamkar 2011). The district's average rainfall is 400-450 mm. The temperature of the district is between 14 degree centigrade and maximum of 42 ºc. (Government of Maharashtra 2020). The annual maximum temperature is (more than 40ºc) (IMD 2020).The district having ten administrative blocks at present i.e. Sirala, Valwa, Taasgwn, Khanapoor, Aatpodi, Kmankal, Meeraj, Paalus, Jath and Kadegwn.The study area has distinct physical, economic and social condition. Jath, Aatpodi, Kmankal are the enduring drought strike blocks (Government of Maharashtra 2020). The population of the region in 2011 is 28, 20,575. (Census hand book Sangli District 2011).NH 4 is passing through the district and connects India's two main cities Pune and Bangalore.Imporatant railway routes also passing through the district Meeraj is the main railway junction in the district it is connected almost all the main cities in the Maharashtra.

Hence the district in the low rainfall zone it has yellow red brown soil with low soil moisture and some parts of the river banks black soil was found agriculturally the area is backward with sustainable agricultural practices main Kharip (monsoon rainfed) crops are Bajara, Jawar, Groundnut, Sorghum etc. and Rabbi (under irrigation) crops are Sugarcane, Turmeric, Wheat, Maize, Rice etc. (Gaikwad, S. D. 2017).

Data and Methods

In the present study, surveyed and recorded secondary data from the government of Maharashtra of population growth, rural and urban population growth and distribution, male and female population growth, data regarding demographic transition, occupational structure in the study area, sex ratio data, population density data, literacy, population distribution and ecological data were considered. All the population data were collected from district census hand book for every census year i.e.1981, 1991, 2001 and 2011 and climatic data collected from the hydrological department of Maharashtra (Hydrological Data Users Group) .Physiographic, drainage and soil

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data obtained from the socio economic abstract of the district and Irrigation Department of Maharashtra State (IDMS).

In order to consider the location, physiography, drainage, soil pattern and thematic maps of population distribution in the study area for this GIS and remote sensing mapping is done by open source software i.e.QGIS version 3.6.3.Population growth, population density, literacy rate, occupational structure of population and rainfall data was analyzed by the fundamental statistical methods and techniques.

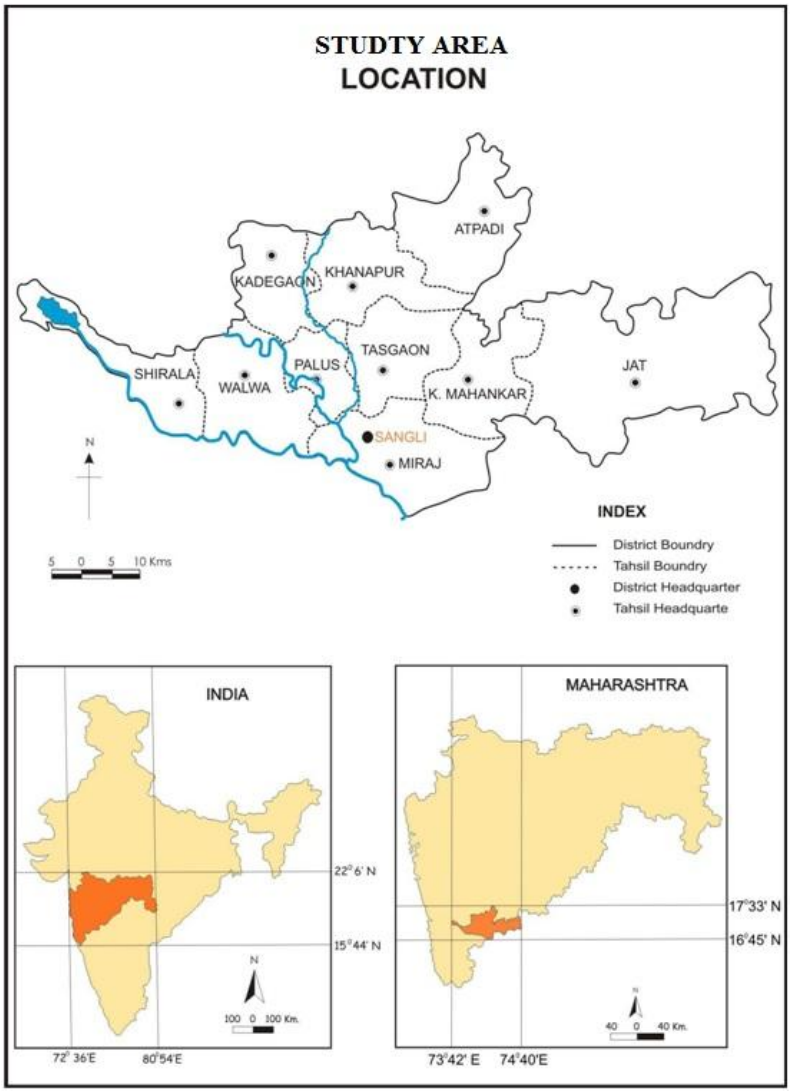

Fig.1 Location map of study area

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Results

1. Population dynamics and instability

Population dynamics contain transformation in population growth rates, age structures and distributions of peoples over the region (Population dynamics Thematic Think Piece UNDESA, UNFPA September 2011).The principle of population dynamics is extensively related with the exponential law of Malthus (Petersen, William 1979).In the last thirty years, population dynamics has been accompaniment by evolutionary game theory, developed first by John M Smith (Newton, Jonathan 2018).

Population growth

In the current analysis effort has been made to study the population growth rate in the study area at block level during the year 1981 to 2011.

Table 1 Details of population growth at block level of the study area during the year 1981-2011

Blocks	Year						
	Population				Growth Rate (%)		
	1981	1991	2001	2011	1981-91	1991-01	2001-11
Miraj	506320	634639	756048	854581	25.34	19.13	13.03
Tasgaon	300597	310318	429761	416310	3.23	38.49	-3.13
Khanapur	217958	221999	258231	313233	1.85	16.32	21.30
Atpadi	84016	111517	125263	148455	32.73	12.33	18.51
Jat	193096	240647	283950	328324	24.63	17.99	15.63
K.M'kal	97274	117901	144596	152327	21.21	22.64	5.35
Walwa	301302	293380	427377	456002	-2.63	45.67	6.70
Shirala	130649	147773	158298	162911	13.11	7.12	2.91
Study area Total	**1831212**	**2078174**	**2583524**	**2832143**	**13.49**	**24.32**	**9.62**

Source: 1.Census of India, District Census Handbook of Sangli, district, 1981-91.

2. Census of India2001 & 2011 Final Population Totals, Maharashtra, Series 28.

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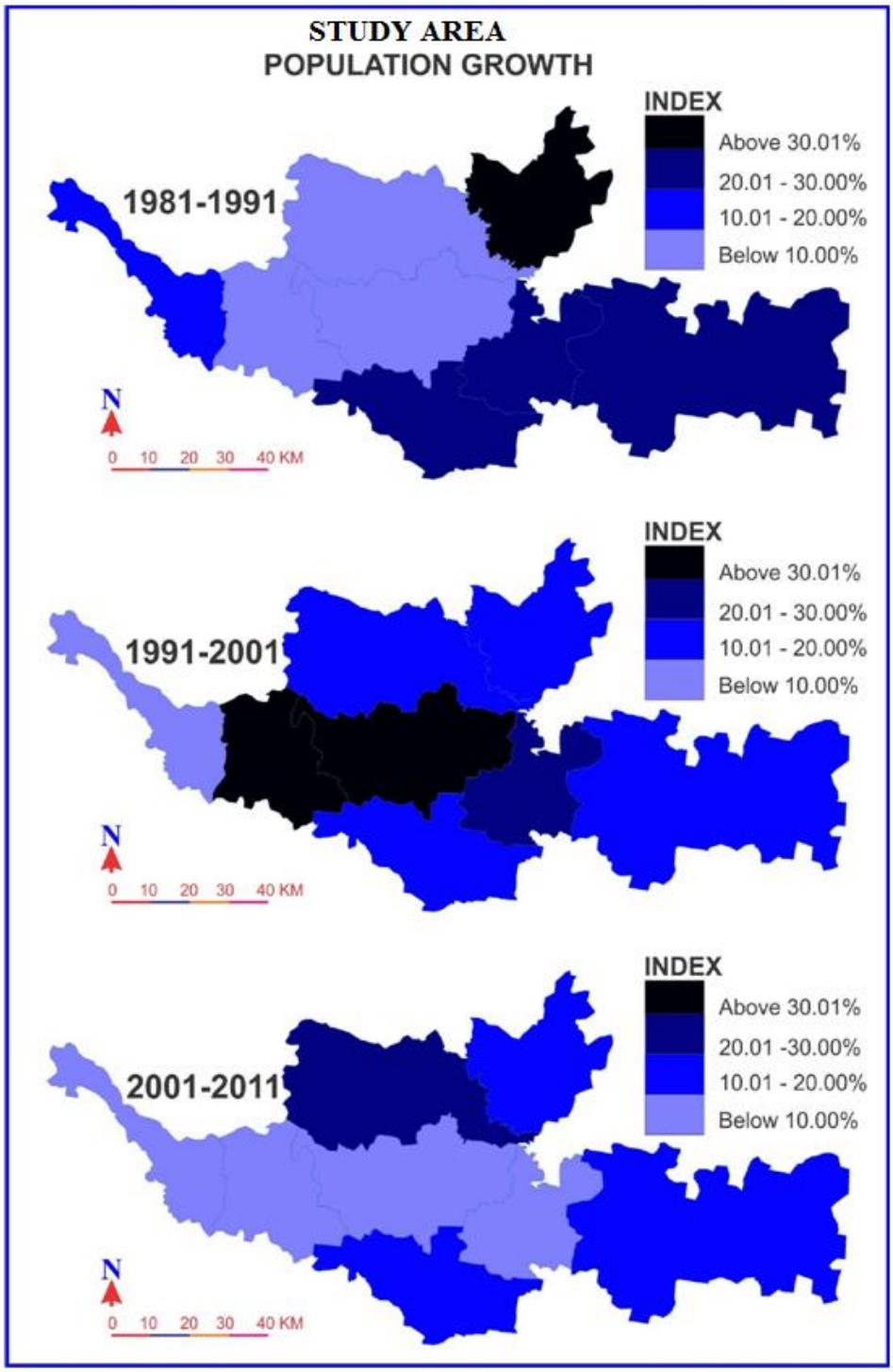

Fig.2 Figure shows population growth during year 1981-2011 percentage wise High population growth observed in the first two decades in east and middle parts of the study region.

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Population growth of the block level was computed for the census year 1981-2011 and it has been observed that the growth of the population is continuously having positive trend (ranging from 25.34 to 13.03%) while growth rate is declining decade wise but in the Walva and Tasgaon blocks having exception in this case because Walva region (45.67% growth in 1991) is the hotspot of ideal agricultural ecosystem and Tasgaon (38.49% growth rate in 1991) is the industrially organized part of study area. (Table 1) Population growth in the year 1981-1991 shows the above 20-30% growth has been seen in the Miraj, Shirala (High rainfall zone of the study area),Jath, Kavtemankal,and Atpadi, remaining parts in the western region Palus, Kadegaon and Khanapur having below 10% growth rate mainly because of the diverse climatic condition.(Fig.2) In the census year 1991-2001 above 30% growth rate of population has been seen in the Walva, Palus and Tasgaon region and remaining parts having below 30% growth rate of population. In the 2001-2011 population growth has been altered and it has been observed that the region having high growth rate previously they becomes shows declining trend mainly in the Shirala,Walva,Palus and Miraj blocks of the study area (Fig 2)

Rural and Urban population growth

Rural population was continuously increasing in every census year but the growth rate was showing declining trend highest population growth seen in the decade 2001-2011 in the Khanapur and it was 44.73% may be because of the irrigation efforts made by the government and lowest growth rate seen in the decade 1991-2001 for all over block it was 14.25%.(Table 2) The rate of rural population growth is high in the 1981-1991 it was more than 60% area covered by the above 30% growth of rural population in the study area while other two decades 1991-2001 and 2001-2011 had low growth comparatively .(Fig 3) Urban population in the study area showing constantly high growth but it was limited to the central part of the study area mainly in the Sangli-Kupwad and Miraj (84.77%) industrial area and also in the Vita,Palus,Tasgaon and Walva blocks are also had the urban population it was mainly because of agrarian economy changed into industrial one but at some extent.(Table 3).

Male and Female population growth

Male and Female population growth had contrast behavior total block level Male population growth rate is increasing it was 13.91% in 1981-91 and changed in to 24.45% in the 2001-2011 census year. Female population growth rate decreasing it was 20.24% in 1991-2001 and it was

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resulted in 13.32% in the census decade 2001-2011(Table 4).While we seen block wise Male population growth in the study area had falling trend seen in the Miraj,Atpadi,Jath,and Shirala blocks it was ranging between 18% to 8.56%. While growing trend seen in Tasgaon, Khanapur, Kavtemahankal and Walva it was ranging between 18.75% to 46.11% .Female population growth in the study area falling in Tasgaon, Atpadi and Kavtemankal,and increasing trend in the Khanapur and Walva (Table 4).The fig 5 shows block wise growth rate in graphical form.

Table 2 Details of rural population growth at block level of the study area during the year 1981-2011

Blocks	Year						
	Population				Growth Rate (%)		
	1981	1991	2001	2011	1981-91	1991-01	2001-11
Miraj	237332	270888	293546	325954	14.14	8.36	11.04
Tasgaon	253926	310318	396304	378365	22.21	27.71	-4.53
Khanapur	193877	221999	216427	313233	14.51	-2.51	44.73
Atpadi	84016	111557	125263	138455	32.78	12.29	10.53
Jat	193096	240647	283950	328324	24.63	17.99	15.63
K.M'kal	97274	117901	144596	152327	21.21	22.64	5.35
Walwa	246953	293380	335844	456002	18.80	14.47	35.78
Shirala	130649	140351	154376	162911	7.43	9.99	5.53
Study area Total	**1437123**	**1707041**	**1950306**	**2255571**	**18.78**	**14.25**	**15.65**

Source: 1.District Census Handbook of Sangli, districts, 1981-91.

2. Census of India2001, Final Population Totals, Maharashtra, Series 28

Demographic Transitional Model

Demographical transitional model for the study area shows constantly increase in population ranging from 19.63% in the census year 1981 to 30.37% in the census year 2011 and birth rate is higher for two stages later on it was decreasing and death rate increasing in first decade and later on falling slowly for the remaining census years (Table 5)

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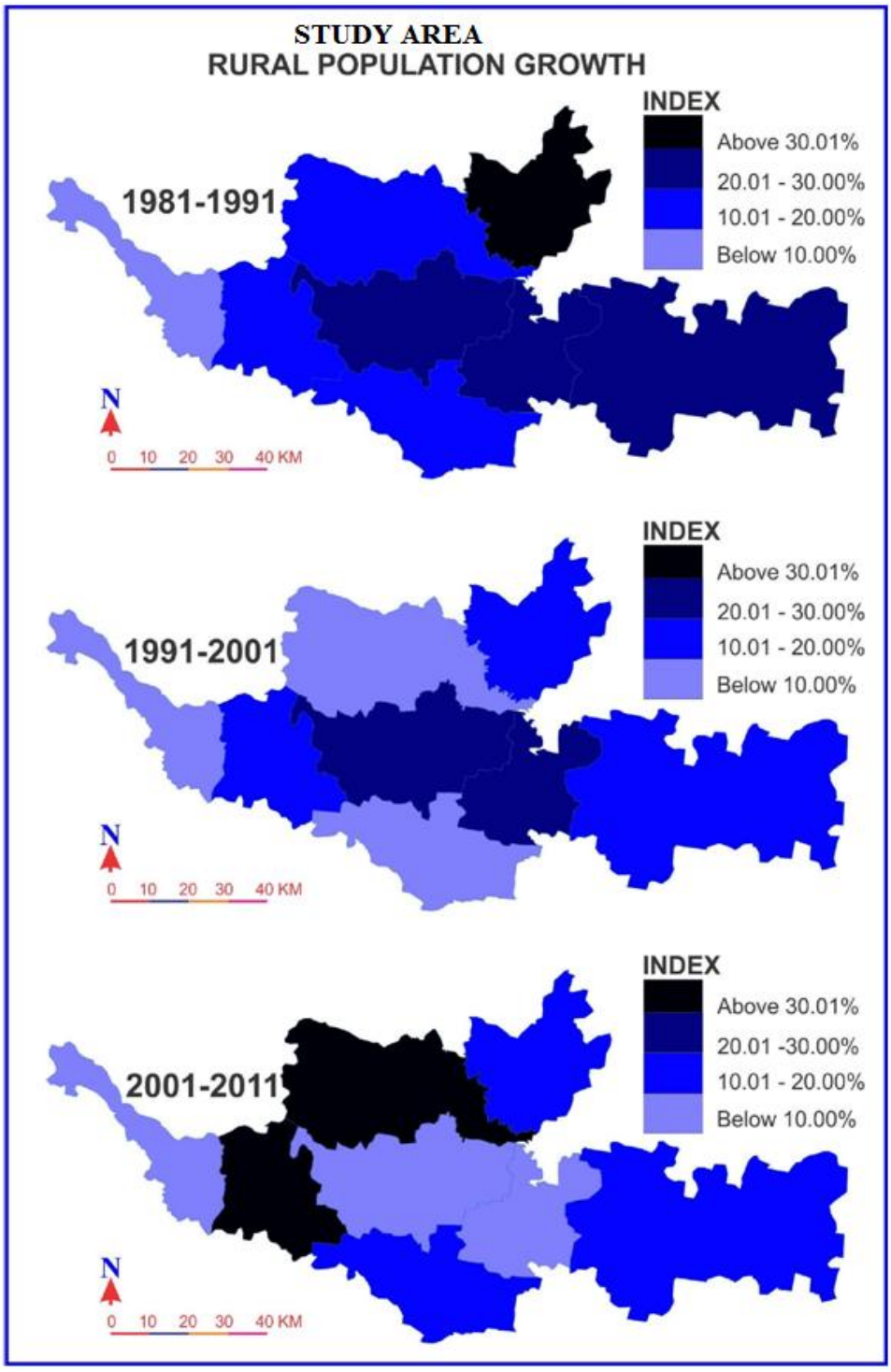

Fig.3 Figure shows rural population growth during year 1981-2011 percentage wise High population growth observed in the first decade in the overall region except western parts of study area

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Table 3 Details of rural population growth at block level of the study area during the year 1981-2011

Blocks	Year						
	Population				Growth Rate (%)		
	1981	1991	2001	2011	1981-91	1991-01	2001-11
Miraj	268988	363751	462502	854581	35.23	27.15	84.77
Tasgaon	46671	29392	33457	37945	-37.02	13.83	13.41
Khanapur	24081	32018	41804	48289	32.96	30.56	15.51
Atpadi	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Jat	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
K.M'kal	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Walwa	54349	69864	91533	104496	28.55	31.02	14.16
Shirala	N.A.	7422	3922	N.A.	N.A.	-47.16	-100.00
Study area Total	**394089**	**502447**	**633218**	**1045311**	**27.50**	**26.03**	**65.08**

Source: 1.District Census Handbook of Sangli, districts, 1981-91.

2. Census of India2001, Final Population Totals, Maharashtra, Series 28

2. Socio-economic aspects of population

Representation from close into the inconsistency of multifaceted biologic arrangement of population we propose that the well being of human populations reflects in to the interrelationship between fundamental vulnerabilities resolute by population level socio-economic aspects and capacities. Monitor this change at the population point of view can be increasing every year while birth rate first two decades high then it is falling and death rate first decade high then continuously falling. Consummate by investigating not only rates of infirmity and death, but *inconsistency* in age composition, density of population, sex ratio, occupational structure etc. whichever involving populations over time.

Occupational structure

The socio-economic growth of any area depends on the number of people who are efficiently active in the economic sharing in the society and the excellence and promptness of their work. Workers engaged in the primary sector had constantly decreasing tendency while population

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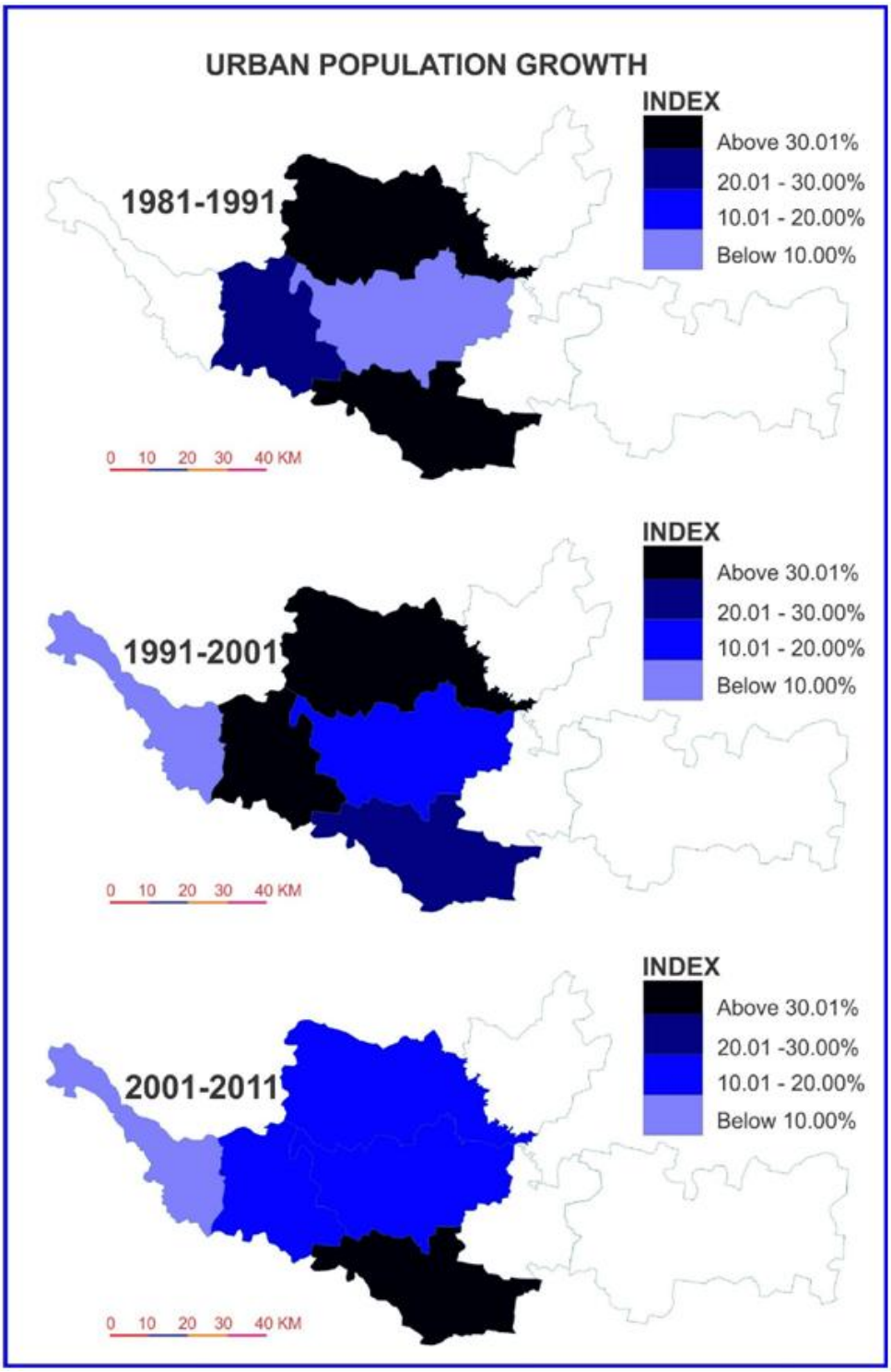

Fig.4 Figure shows urban population growth during year 1981-2011 percentage wise continues population growth observed in the all decade in the overall parts of study area.

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engaged in secondary activities are highest in proportion in the census year 1991 and population engaged in the tertiary activities had lowest proportion in the census year 1991 after that it was showed increasing tendency. Population engaged in the marginal activities had constant in every census year and positively proportion of non working population had falling every census decade. (Table 6)

Table 4 Details of Male and female population growth at block level of the study area during the year 1981-2011.

Blocks	Year					
	Male Population Growth Rate (%)			Female Population Growth Rate (%)		
	1981-91	1991-91	2001-11	1981-91	1991-2001	2001-11
Miraj	24.84	24.84	18.30	25.89	20.02	14.46
Tasgaon	3.17	3.17	39.02	3.30	37.94	-3.12
Khanapur	2.06	2.06	18.75	1.66	13.99	21.47
Atpadi	36.17	36.17	10.34	29.40	14.33	11.01
Jat	26.45	26.45	17.14	22.73	18.91	15.85
K.M'kal	22.11	22.11	23.24	20.28	22.02	5.40
Walwa	-2.55	-2.55	46.11	-2.71	45.21	6.77
Shirala	14.14	14.14	8.56	12.14	-47.16	105.48
Study area Total	**13.91**	**13.91**	**24.45**	**13.05**	**20.24**	**13.32**

Source: 1.District Census Handbook of Sangli, districts, 1981-91.

2. Census of India2001, Final Population Totals, Maharashtra, Series 28

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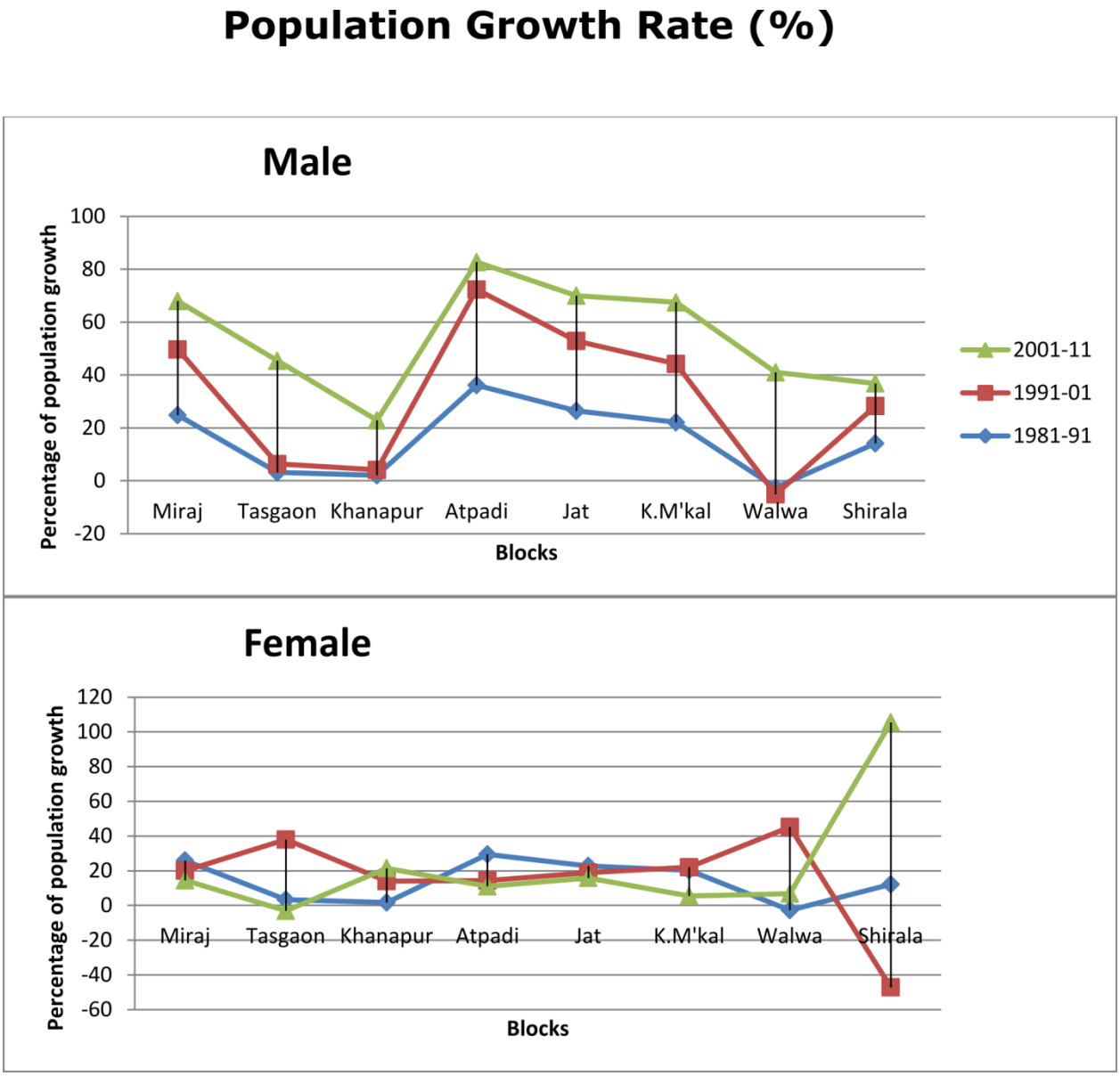

Fig.5 Figure shows Male and Female population growth during year 1981-2011 percentage wise continues population growth observed in all parts of study area except in the year 1991-01.

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Table 5 Demographic transition model for the study area during the year 1981-2011.

Year	Population (%)	Birth rate per 1000 people	Death rate per 1000 people
1981	19.63	33	30
1991	22.28	35	21
2001	27.7	26	18
2011	30.37	25	15

Source: 1.District Census Handbook of Sangli, districts

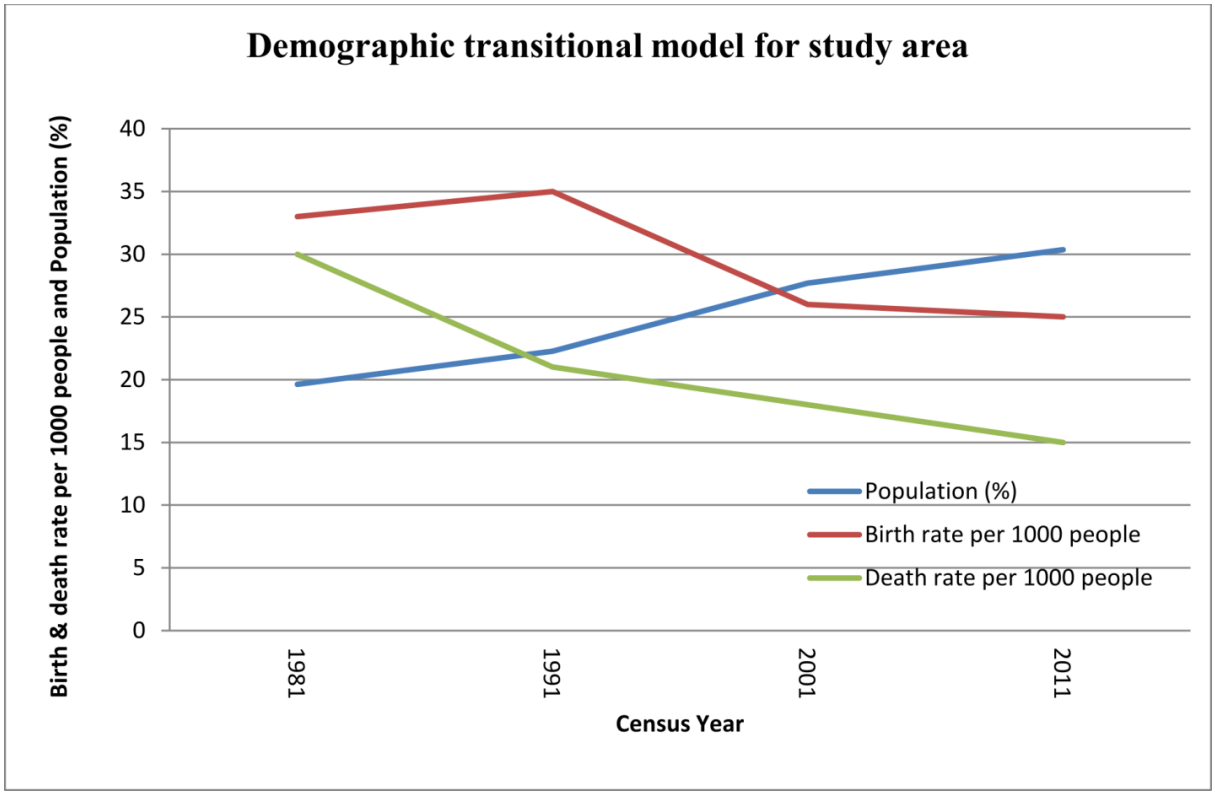

Fig. 6 Figure shows Demographic transitional model for the study area with population

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Table 6 Shows the occupational structure of the population for the census year 1991, 2001 and 2011.

Blocks	1991					2001					2011				
	Primary	Secondary	Tertiary	Marginal Workers	Non Workers	Primary	Secondary	Tertiary	Marginal Workers	Non Workers	Primary	Secondary	Tertiary	Marginal Workers	Non Workers
Miraj	13.64	37.58	25.46	10.50	20.83	10.94	29.60	44.77	14.80	37.00	15.46	33.80	51.82	22.81	35.91
Tasgaon	17.63	11.00	17.65	16.66	17.83	20.24	15.18	11.09	21.98	14.49	17.83	15.27	11.63	16.61	15.64
Khanapur	18.50	11.34	13.30	12.88	11.26	17.01	7.26	9.22	13.84	7.41	7.32	2.53	3.23	7.44	4.93
Atpadi	5.84	3.81	3.80	7.37	6.22	6.06	2.84	2.81	6.02	4.46	6.20	4.78	3.32	5.96	3.04
Jat	14.77	12.48	10.45	15.42	12.48	15.70	10.47	5.57	11.96	9.58	16.88	10.70	6.60	14.51	11.58
K. M'Kal	5.90	4.41	7.79	9.07	6.35	7.10	3.57	3.52	6.95	4.98	6.79	4.27	3.41	5.67	5.86
Walwa	15.73	12.31	15.71	16.94	16.63	15.98	23.46	16.03	16.08	16.48	17.65	20.42	15.62	15.33	17.46
Shirala	8.00	7.08	5.85	11.16	8.40	6.97	7.62	6.98	8.36	5.59	11.86	8.23	4.37	11.67	5.57

Source: Census of India, District Census Handbook of Sangli District

Sex ratio

Sex ratio is an important character of population. It can replicate all individuality like social, economic and migration. Disparity in the sex ratio consequences in lower fertility and slower population growth. Sex ratio in the study area in the census year 1991 decreasing again in the next census year in 2001 it was inclining after that in the 2011 sex ratio drastically decreasing for the overall study area (Fig 8) Block wise sex ratio condition is better and ever increasing in the Miraj, Khanapur while other blocks unfortunately showing falling proportion of the sex ratio in the study area.

Population Density

Population density in industrially developed area had high i.e.in Miraj (1016 per sq/km), followed by Walva (695 per sq/km) in the census year 2011 and otherwise it was constant in all the remaining blocks but the concentration of the population was seen in the western parts of the study area it is the area covered by Krishna and Warna river banks. (Fig 9)

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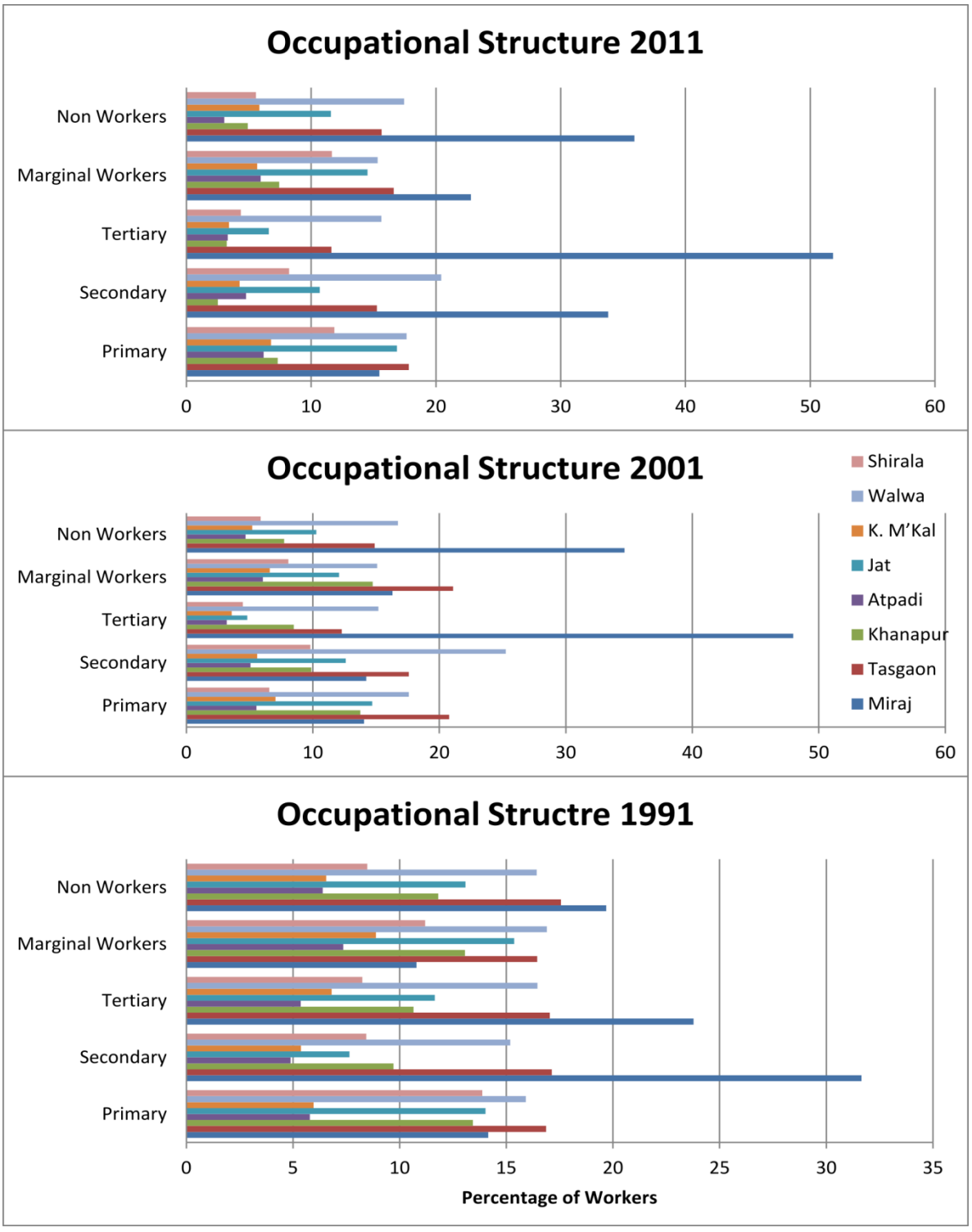

Fig. 7 Figure shows occupational structure for the study area for the three decades from 1991-2011

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Table 7 Shows the sex ratio for the census year 1981, 1991, 2001 and 2011.

Blocks	Decade				Change		
	1981	1991	2001	2011	1981-91	1991-01	2001-11
Miraj	922	929	943	966	7	14	23
Tasgaon	956	958	950	950	2	-8	0
Khanapur	1046	1042	1000	1003	-4	-42	3
Atpadi	1002	952	986	995	-50	34	-31
Jat	962	934	948	951	-28	14	3
K. M'Kal	986	971	962	963	-15	-9	1
Walwa	945	944	1031	939	-1	87	-92
Shirala	1066	1047	1020	1015	-19	-27	-5
Total	967	959	972	966	-4	9	-6

Source: Census of India, District Census Handbook of Sangli District

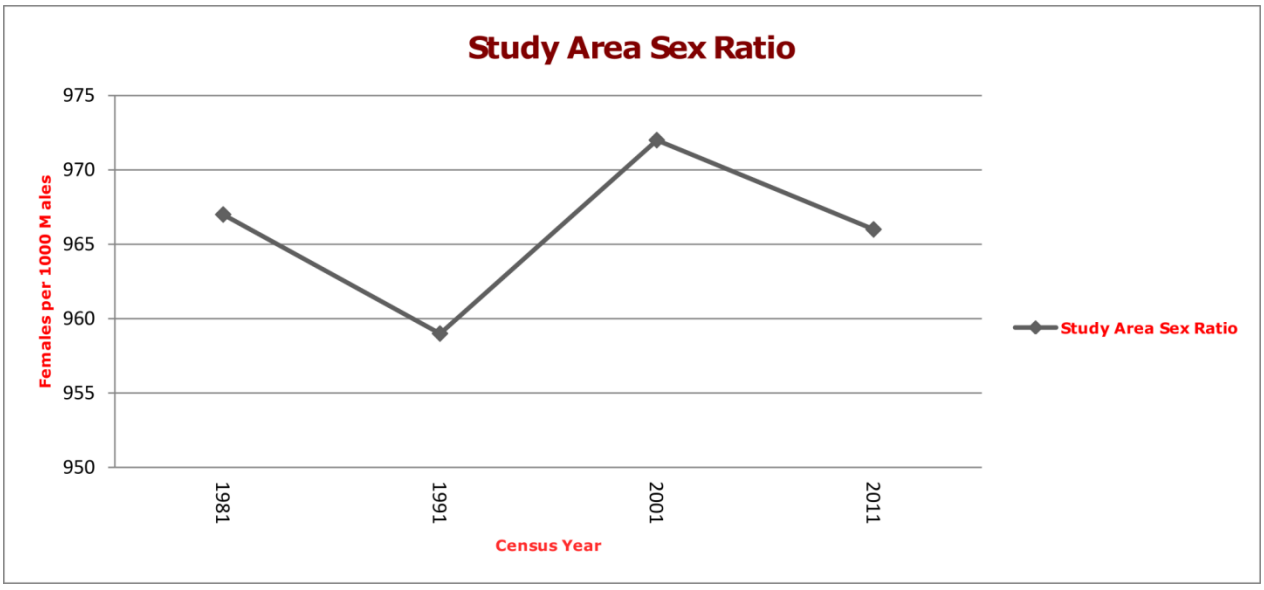

Fig.8 Shows the sex ratio for the census year 1991, 2001 and 2011.

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Table 8 Shows the population density for the census year 1981, 1991, 2001 and 2011.

Blocks	Population Density (per sq/km)			
	1981	**1991**	**2001**	**2011**
Miraj	547	755	899	1016
Tasgaon	270	260	361	349
Khanapur	164	175	204	247
Atpadi	96	134	151	167
Jat	86	110	129	150
K. M'kal	138	161	197	208
Walawa	383	447	652	695
Shirala	206	231	248	255
Total	213	249	309	338

Source: Census of India, District Census Handbook of Sangli District

Population literacy

Population literacy in the study area has been showing positive tendency it was changed from 46.87% to 66.32% in over all block while high percentage of literacy is seen in the Miraj (76.66%) and Walva(76.56%) lowest percentage of literacy seen in the Tasgaon (30.65%) in the census year 2011.(Table 9)

3. Population ecology

Population ecology is the environmental study of how biotic and abiotic issues manipulate the density, diffusion, and size of a population .Human population growth serves as an important model for population geographers, and is one of the most significant environmental concerns of the modern century. The study of Human population ecology includes considerations, explanation, and prediction of population distributions. Why do people inhabit particular areas, and how are they prevented from establishing beyond their range limits? And how they put their

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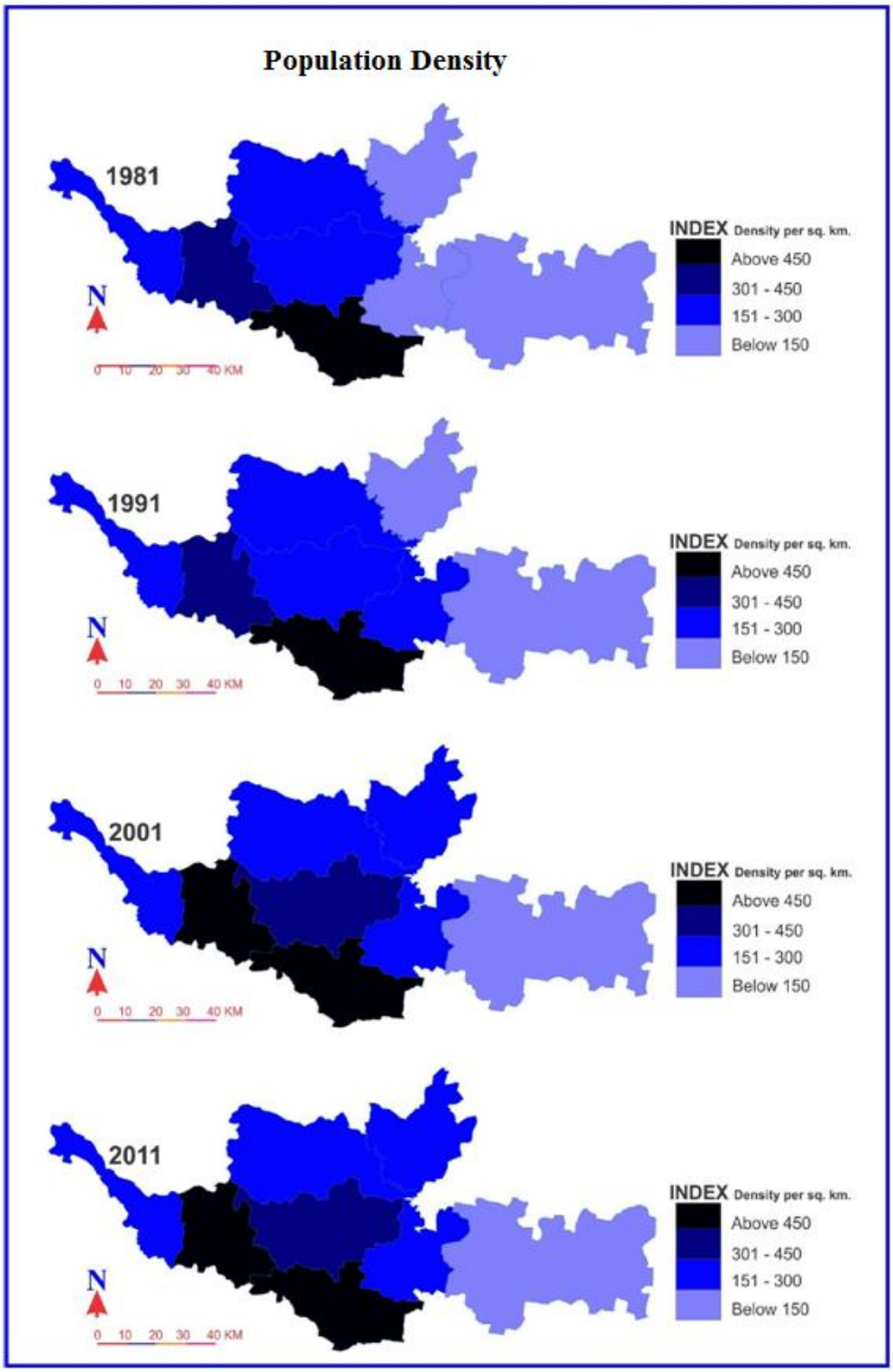

Fig 9 Shows the population density for the census year 1981, 1991, 2001 and 2011.

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footprints over nature .Such range questions have become popular in the last decade or so in response to concerns about climate change.

Table 9 Shows the literacy rate in (%) for the census year 1981, 1991, 2001 and 2011.

Blocks	Decades			
	1981	1991	2001	2011
Miraj	55.82	54.74	71.95	76.66
Tasgaon	49.79	56.25	68.39	30.65
Khanapur	45.86	52.27	65.92	73.04
Atpadi	35.31	42.25	56.65	64.21
Jat	27.91	34.53	53.19	61.17
K. M'Kal	42.03	47.46	62.48	69.67
Walwa	50.96	54.29	69.35	76.56
Shirala	36.86	47.84	63.83	70.66
Total	46.87	50.01	66.50	66.32

Source: 1. District Census Handbook of district 1981-91.

2. Census of India2001& 2011 Final Population Totals, Maharashtra, Series 28.

Distribution of population and ecology

Distribution of population in the study area is closely related with the natural environment and agricultural and commercial development the concentration of population was seen in the main river banks mainly of Krishna and Warna rivers. The distribution of population is very dense in the Shirala, Walva, Miraj and Palus because these areas had above average rainfall condition as well as the areas are characterized by modest climatic condition with favorable ecological condition compare to the eastern parts of the study area had the dry climate with diverse condition of climate and natural ecological condition. (Fig 11) Population distribution and ecology having very close relation in the study area the natural drainage condition in the South west region of the block is favorable for agrarian economy while this area is also having low slope and characterized with the fertile Plaines with deep black soil.

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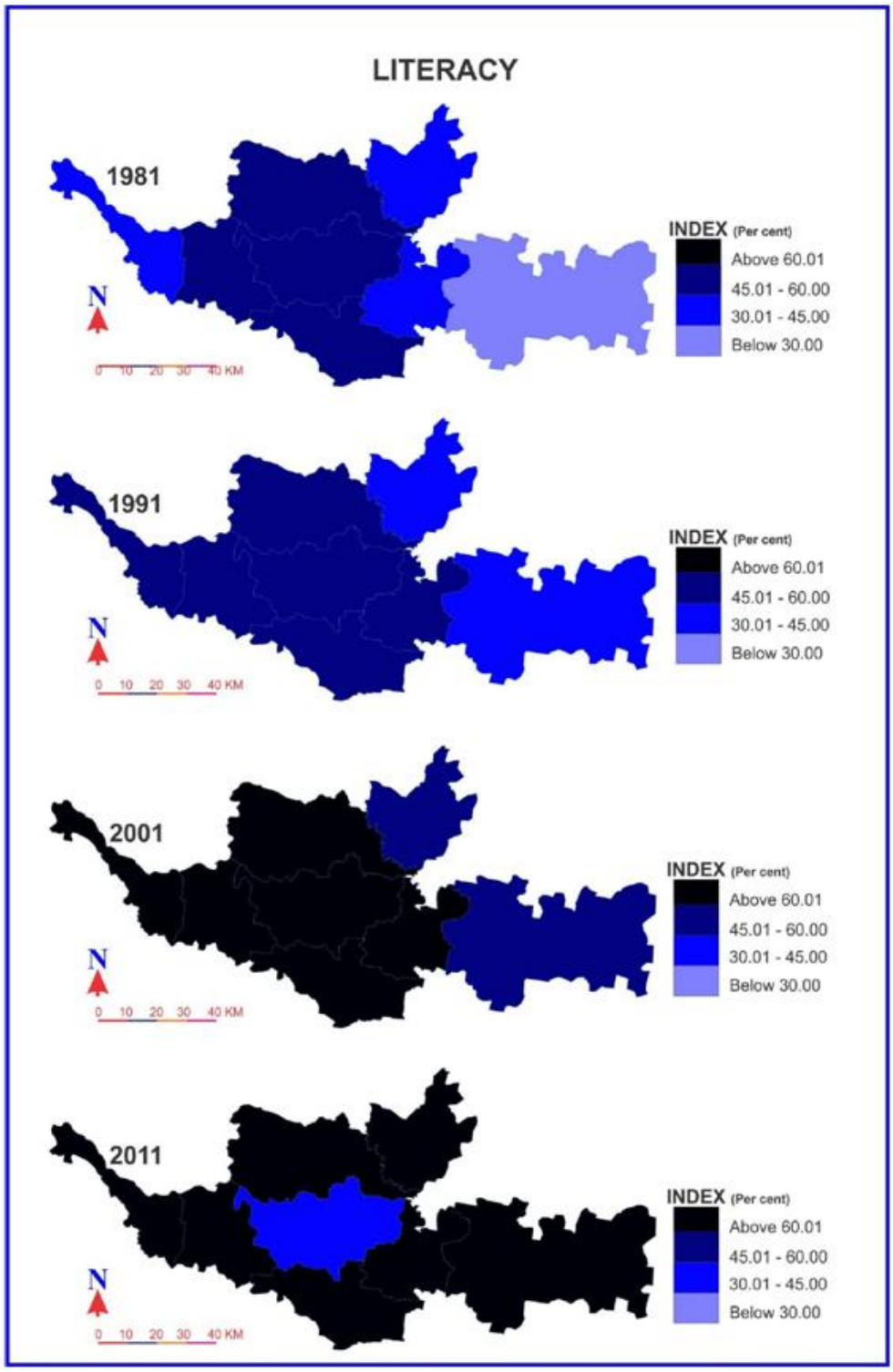

Fig 10 Shows the literacy rate in (%) for the census year 1981, 1991, 2001 and 2011.

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Table 10 Details of distribution of population at block level of the study area during the year 1981-2011.

Block	Year			
	Population			
	1981	**1991**	**2001**	**2011**
Miraj	506320	634639	756048	854581
Tasgaon	300597	310318	429761	716310
Khanapur	217958	221999	258231	313233
Atpadi	84016	111557	125263	138455
Jat	193096	240647	283950	328324
K. M'kal	97274	117901	144596	152327
Walawa	301302	293380	427377	456002
Shirala	130649	147773	158298	162911
Study Area total	1831212	2078214	2583524	2822143

Source: Census of India, Sangli district 1981, 1991, 2001 & 2011.

these area had dense population mainly in the Shirala, Walva, Palus,Tasgaon and Miraj .Other hand the eastern and northern parts of the study area had diverse condition with the dry climate and scarcity of water resulted in the low density of population mainly in Kadegaon,Atpadi,Khanapur,Kavtemahankal and Jath.(Fig 12)

Discussion

As of the end results given in the previous section, it is clear that the population dynamics and socio economic status in the southeastern Maharashtra heavily depend on the semi arid climate and environmental variability. The population growth within the region is highly inclined it has been ranges between above 30% to below 0% growth rate .The areas under favorable ecological condition having the high rate of population growth mainly in the south and southwest parts of the study area. Rural population growth has been notably observed in the southwest and northwest region of the study area these are the parts of Krishna and Warna river basins also having the deep black soil which is favorable for the agricultural practices.

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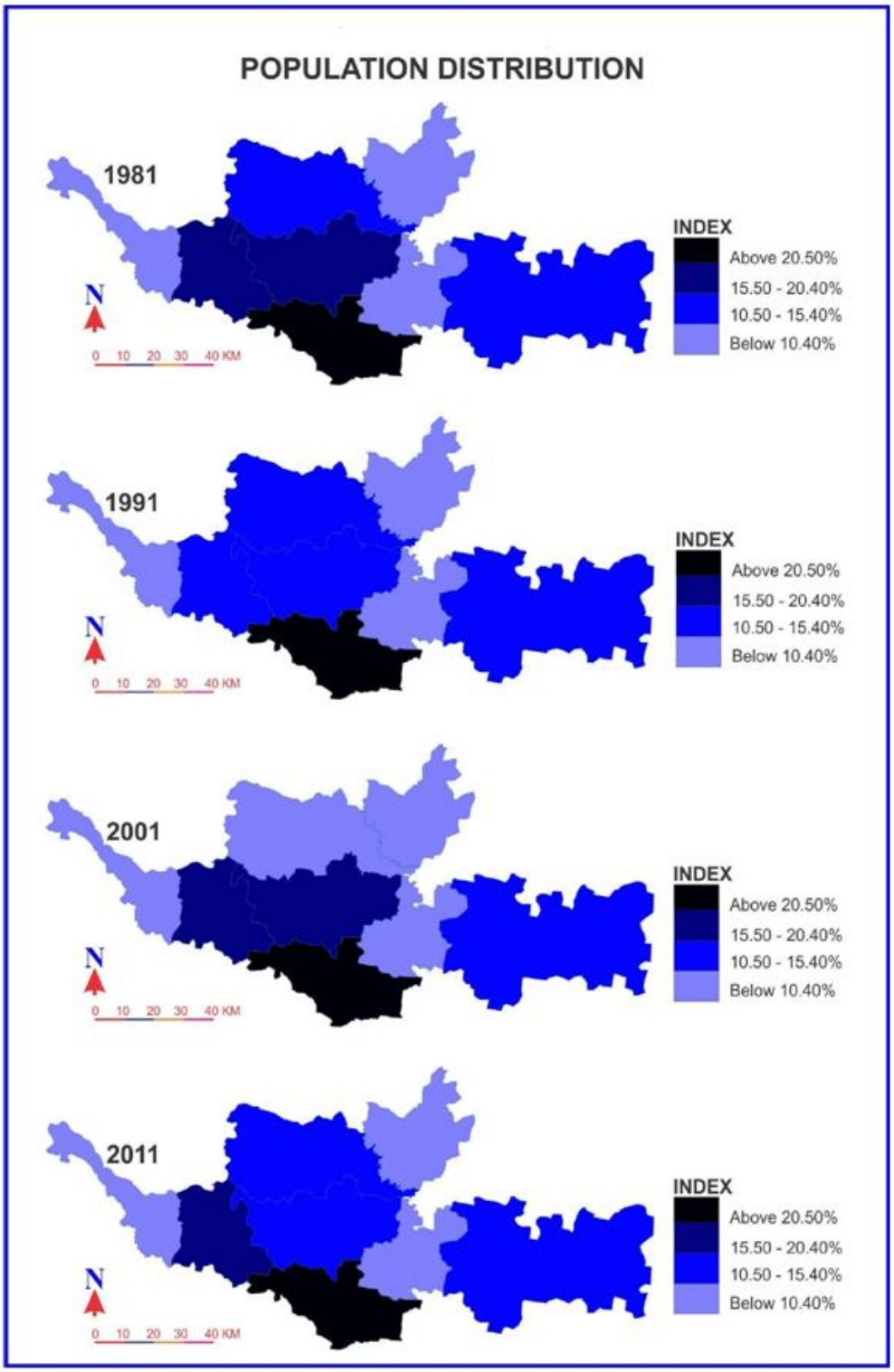

Fig. 11 Figure shows distribution of population during year 1981-2011 percentage wise continues dense population distribution observed in southern parts of study area

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Population Ecology

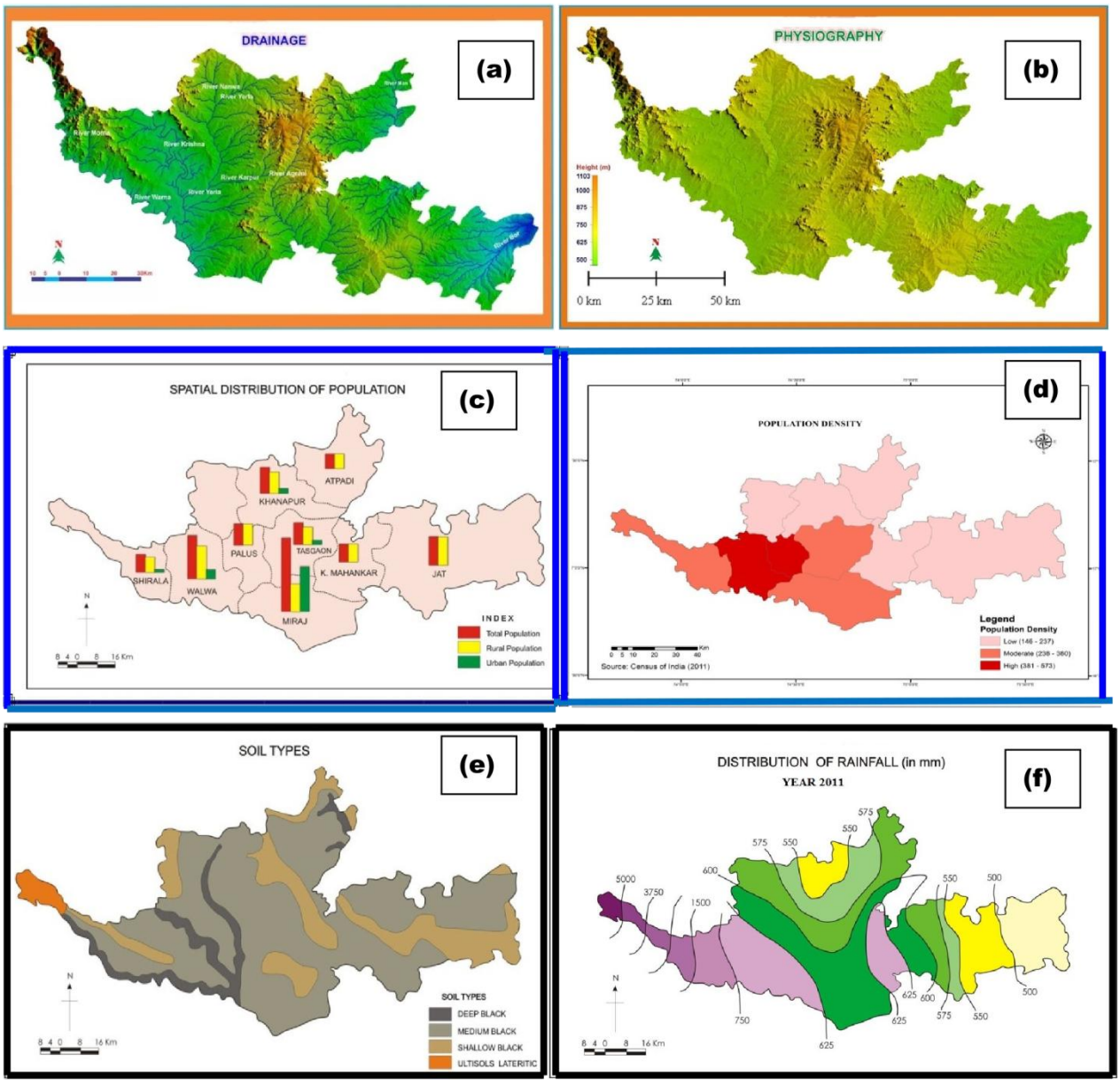

Fig. 12 Figure (a) shows drainage pattern of the study area figure (b) shows DEM of the study area figure (c) shows the spatial distribution of the population and figure (d) shows concentration of the population figure (e) shows soil types according to the space and figure (f) shows the distribution of the average rainfall for the year 2011 and all the figures are showing relationship of population distribution and ecological features of study area.

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Vice versa the urban population growth is high in the industrially organized areas of the blocks in the south and northwestern parts of the study area. The semi arid climate and unfavorable environment in the eastern and northeastern parts of study area under such circumstances, appropriate ecology plays a crucial role to determine the stability or instability of the population. The current study makes it clear that the prominent consistency in population dynamics and instability over the southeastern Maharashtra, amongst the selected stations, Walwa reveals a significant increase in population in the census year 2001.

The previous studies (Karande, S. V., & Khadke, P. A. 2013) Maharashtra population growth is second largest and occupied 9.29 % population of India in the Census year 2011 but it has been mainly recorded low growth in the parts of unsustainable ecology in the state, There is a socio economic constraints behind the male and female population growth rate in the study area it has been observed that constantly increasing trend of male population instead of female population. About 60% of the study area as well as the eastern domain of the Sangli districts are observed with a notable very low population density (Table no 8). However, there is strong possibility that due to the averaging diverse effect of climate or shorter monsoon duration (Ratna, S. B. 2012). The average monsoon rainfall over the study region does not show a significant increase in the northern and eastern parts of study area (Fig. 12). It signifies no considerable efforts have been made by the administration or by the policy makers for the betterment of dry or drought prone habitat during the last three decades (1981–2011).

Moreover, Fig 6 shows an increasing trend in the population while the birth and death rate are notably decreasing at certain level that is first two decades having high trend apart from last decade. The occupational structure of the study area having significant variation in each decade nonworking population has been increased and proportion of primary sector workers has been decreased in the census year 2011 (Table 6).Sex ratio in the study area is having the negative significance (Fig. 8).Literacy in the region having positive reflectance under the diverse socio economic burden. Optimistic standing of the literacy will be leads to change in superior socio-cultural revolution in the study area in upcoming years.

It is relatable to point out population instability in the study area is due to under the pressure of ecological and socio economic role in the southeastern Maharashtra. This may primarily depend on the monsoon rainfall and agricultural ecosystem, which is pressurize by increasing demand of

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water resource managing in the future for rural based population. In view of upcoming water resource management, it should be noted that the below average rainfall estimation leads to huge out migration from the study area. In addition, the upcoming temperature rises over the southeastern Maharashtra (Dhorde, A. G., Korade, M. S., & Dhorde, A. A. 2017) very probable to intensify the rate of yearly Potential Evapotranspiration, which will lead to rise in crop water necessity and harshness of droughts too lead to further instability of population in the study area. However, in the north and eastern domain of the Sangli district, there is scope for human and natural resource management, which perhaps creates the stability in the population distribution in the future.

Conclusion

The current exploration has given insight into changes in population growth, rural –urban population proportion, male-female population distribution and growth, density, occupational structure, literacy, population ecology in the southeastern parts of the Maharashtra state. Although the population dynamics and instability in any region is responsible for the stress on the physical, socio-cultural and ecological situation (Lioubimtseva, E., & Henebry, G. M. 2009). The growth in population is the natural process but its intensity is limited to the certain parts of the region according to the limitations of socio-physical conditions of the study area. Male female population status in the area showing the diversity in the sex ratio as well as it is according to the economic development of the region. The notable increase in urban population structures in industrial regions during the recent years (census decade 2001-2011) explains the decline in the primary occupational structure over the study area and consequently the significant increase in tertiary and secondary occupational proportion (Table no 6) is reflected. Without a considerable increase in rainfall and moderate temperature or manmade water management (constructive ecology) over the Sangli district, the population instability is not recovering. Obviously, it leads to augment the socio-economic and environmental hammering.

On the other hand, a significant increase in pressure on the natural resources can adversely affect the migration, sex-ratio and population distribution in the region amplifies the ecological balance. The human activities (modify in the agriculture practices) adding pressure on available human and natural resources and the future climatic calamities are likely to promote already intricate population instability challenge. Necessary to say, it is to effectively manage the available human

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and natural ecosystem assets in the study area under the climate change circumstances for the regionally balanced trait of existence of population. For this, the government and every individual should induce and profoundly promote to keep the natural environment sustainable. Apart from this, the agricultural scientist, population researchers, geographers, climatologist can play a vital role in such population ecological challenge by introducing scientific and socio-economic action plan for each and every human habitat in the study area.

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