Altitudinal Disparities and Service Efficiency of Tribal Health Facilities: A Composite Weightage Approach from Nashik District

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Abstract:- This research examines the distribution and efficiency of tribal health service centers in the Nashik district of Maharashtra, focusing on Rural Hospitals (RHs), Community Health Centers (CHCs), and Primary Health Centers (PHCs). These centers are vital for providing medical care in remote tribal zones where hilly terrain and limited connectivity restrict access to health services. The key objectives are to understand how health facilities are distributed across altitudinal belts, to study their population and village coverage, and to evaluate their performance using a composite weightage system.

The study area covers the tribal tehsils of Peint, Surgana, Dindori, Trimbakeshwar, and Kalwan, which lie between 300 and over 700 meters above sea level. Quantitative and spatial analyses were carried out using Census 2011 data along with field observations from 2020–21. Each PHC was assessed for medical infrastructure, staffing, patient load, population served, and coverage area. The resulting composite scores helped classify the centers as poorly, moderately, or well served.

Findings reveal nine community health centers and forty primary health centers functioning in the tribal belt. About 55.81% of these are poorly served, 32.55% are moderately served, and only 11.63% fall in the well-served category. Most PHCs are situated in the 600–700-meter altitude zone, indicating accessibility challenges in elevated areas. A few centers—Mohadi, Khedgaon, Kanashi, Anjaneri, and Kochargaon—recorded higher scores due to better infrastructure and staffing. Despite the low population density, the uneven terrain continues to limit equal access to healthcare. The study underscores the need to strengthen PHCs for effective and inclusive tribal health service delivery in Nashik district.

Keywords: Tribal Health Services, Primary Health Centers, Spatial Distribution, Composite Weightage, Nashik District.

I. INTRODUCTION

A central place theoretically enjoys a central location, as its name indicates in a given area of a region and provides variety of functions or services not only to its own population but also to that of its own immediate contiguous surrounding area" (Singh S. B, 1977). According to Jefferson, (1931) "Central place can-not be a place of manifold activities for surrounding countryside". Walter Christier, (1933) designated the functions of services performed for the surrounding countryside as central functions and the places wherein such services are performed as central places". "The centrality of a services is importance in the provision of goods and services to the surrounding hinterland population is indicated by the number of services it provides and by the proportion of these services supported solely by the tributary population" (Johnston, 1966). Agro-service centers, educational service centers, health service centers, and other types of service centers may be categorized based on the tasks they serve. A tribal health care center is a location that provides health services to the tribal hinterland around it. In this research, tribal health service centers are defined as rural hospitals and primary health centers that offer health services to the surrounding countryside. The tribal communities that are served by these medical facilities are referred to as tribal health service centers.

II. REVIEW OF LITERATURE

The impoverished tribal communities of India have much poorer indices of health than the general population. Many tribal people live in isolated rural hamlets in hilly, forested or deserted areas where they are more vulnerable to disease by illiteracy, physical conditions, malnutrition, poor access to

drinking water and lack of personal hygiene and sanitation. In order to improve the intensity of the research, several researchers have published books and articles dealing with numerous review reports on health problems in tribal areas relevant to newspapers, magazines, theses, and books for review. A literature review is an integral aspect of the area of study. The reasoning is that it enables the researcher to consider the pattern in a specific sample and instruct him in his studies about how to continue in his fields of research. This investigator made an attempt to study the literature.

Medical Geography is another name for Geography of health. Medical geography is a subdiscipline of human geography that explores the relationship between the environment and health, as well as the relationship between lifestyle and health and the geographical variation in health status and health treatment (Misra, 2007). In Western countries, the subject is well-developed. Due to a lack of reference material, virtually little study has been done in poor countries. The subdiscipline was founded by Jacques May, the pioneer of medical geography in the United States, who wrote 'The Ecology of Diseases' (1985). Medical geography emerged in the late nineteenth and early twentieth centuries (Cubitt. S, 2002). Earlier research was primarily descriptive in nature, focusing on disorders. Although medical researchers have studied the disorders extensively, little is known about their regional distribution.

The study of 'aerial' or spatial patterns of disease is a simple definition of Medical Geography. Medical geography, according to Armstrong, is concerned with the distribution and comparability of various illness indicators in the human population, as well as the interrelationship with other elements of space's physical, biological, and cultural environment. McGlashan stated that a medical geographer's responsibilities include the preparation and collection of data, as well as mapping them to show where a specific disease is present and applying objective statistical tests to the distribution to determine whether the pattern is likely to have occurred by chance; measuring the degree of correspondence between diseases and then applying tests to determine whether any spatial associations could be causative; and measuring the degree of correspondence between disease and then applying tests to determine whether any special associations could be causative.

The World Atlas of Diseases and volumes on Disease Ecology were pioneering investigations carried out by Jacques May in the United States, while the wonderful World Atlas of Diseases was the result of many years of research by Rodenwald, Jusatz, and others. Armstrong's work in Chicago on cancer and stroke, as well as Fonaroff's work on malaria, are both watershed moments in the systematic development of medical geography. Arthur Brownela and Nell McGlashan are making significant contributions to medical geography in Australia. Pavlovskly, Ignatyev, and Shosin are excellent researchers in Russia, and Shkurlator and Markovin have authored noteworthy syntheses. Melinda Meade, who was investigating the key elements of Medical Geography at the time, recently pointed out that disease is the result of maladaptive interactions between population, environment, and culture.

D.S. Suryawanshi and Nitin Borse- (2017) He analysed the current level of healthcare services in the study area in their work on the comparison of development of government healthcare facilities in tribal and non-tribal regions of Nasik district (Maharashtra) India. He discovered that government healthcare services are not properly spread in Nasik district's tribal regions. Kisan Algur, Ajay Gawari and Kishor Mohan (2017) The analysis for this research was carried out with the use of descriptive data based on the Indian census (2001 and 2011). The research found that tribal people lead in terms of general sex ratio and child sex ratio when compared to non-tribal people, while non-tribal people lead in terms of literacy when compared to tribal people in all Nasik district sub-districts. When compared to non-tribal's, tribal's have a higher percentage of work involvement.

III. STUDY AREA

The study area is located in the north-western and south west region of the Nashik District. It extends from $19^0 44' 57''$ to $20^0 43' 55''$ north latitudes and $73^0 14' 05''$ to $73^0 06' 57''$ east longitudes. Study area covers an area of 4581.98 sq. km., which is 29.40 % of the geographical area of the district. It is surrounded by Deola and Chandwad tehsil in the east and the north-east, Gujrat state in the north, Palghar districts of Maharashtra State to the south-west, Igatpuri tehsil to the south. It consists of 05 tehsils, namely Peint, Dindori, Surgana, Kalwan and Trimabkeshwar. The population of the region is 976092. It includes 760 villages and 40 PHC.
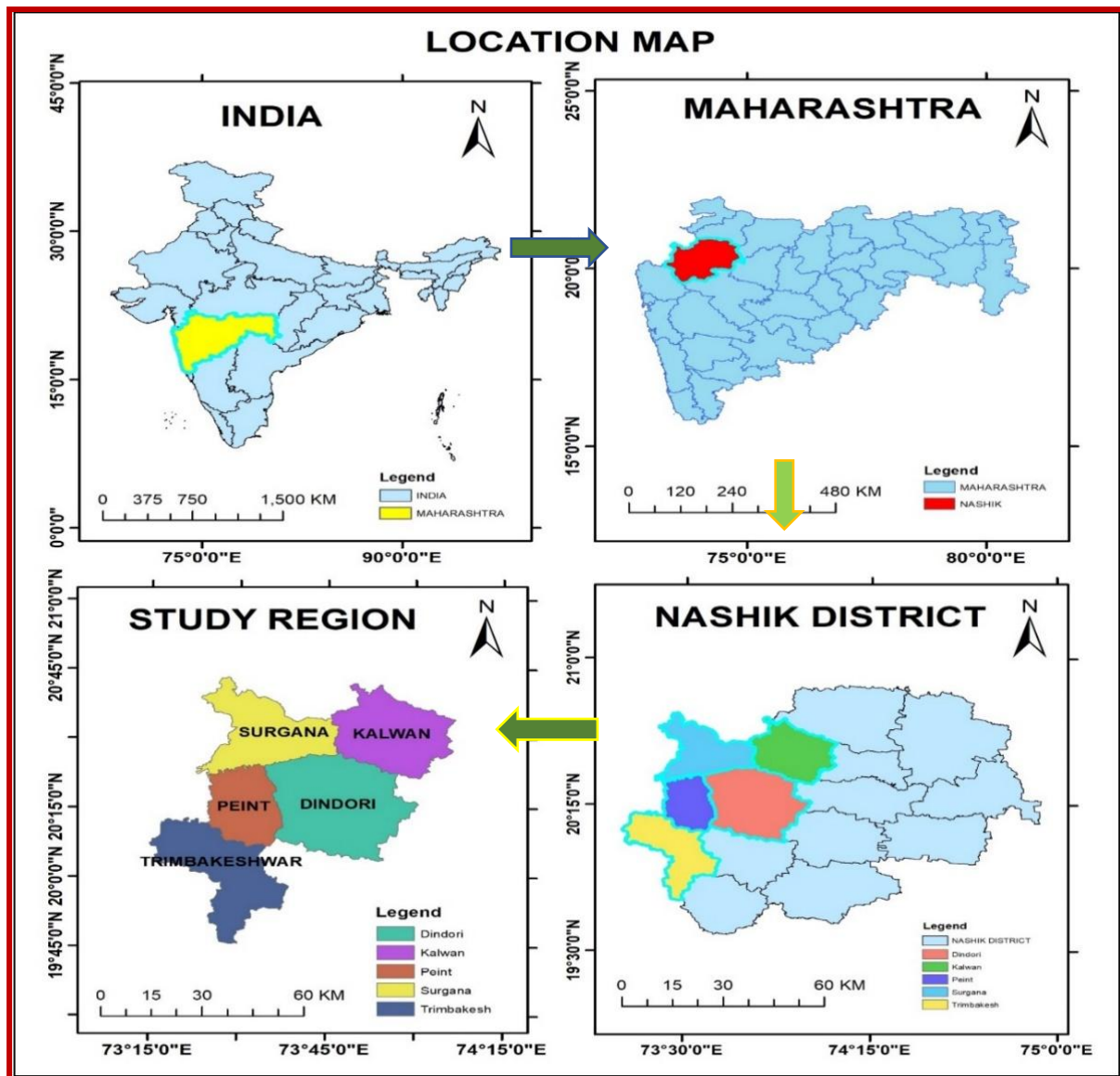
Fig. No. 01

IV. OBJECTIVE

1. To study the spatial distribution of tribal health service centers in Nashik district.
2. To assess the population and village coverage of primary health centers.
3. To evaluate the efficiency of primary health centers using the composite weightage method.

V. METHODOLOGY

A thorough field investigation has been carried out in order to obtain this material. Information on household, village, and primary health center conditions has been compiled using three separate forms of questionnaires. A total of 38 Primary Health Centers, 5 Rural Hospital were assessed, and data on the number of patients treated has been compiled. Primary health care centers in the research area are directly inspected, and data on infectious patients with different diseases was obtained from primary health center and Rural hospital. The study applied a composite weightage method to evaluate the efficiency of tribal health service centers. Specific weightages were assigned to medical facilities, staff availability, patient investigation rate, population served, and area covered by each PHC. The total composite score for each center was computed by summing all assigned weightages. Based on these composite values, centers were classified as poorly served (<30), moderately served (30–60), and well served (>60). Altitudinal belt-wise classification was performed to analyze spatial variations. This weightage approach enabled quantitative assessment of healthcare service quality across tribal regions.

VI. RESULT AND DISCUSSION

Tribal Health Service Centers:
In the lives of the villages, rural service centers play an essential role. A services center's primary function is to provide service to the surrounding region. A service center may also serve as a collecting and distribution point. In this research, tribal health service centers are defined as rural hospitals and primary health centers that offer health services to the surrounding countryside. The tribal communities that are served by these medical facilities are referred to as tribal health service centers.

Rural Hospital / Community Health Centers:
A rural hospital or community health center has a larger field of impact than a primary health center. As a result, tribal health service centers with remote hospitals are classified as higher-level tribal health service centers. There are 09 community health facilities in the study area, including Peint, Dindori, Surgana, Kalwan, and Trimbakeshwar. Rural hospital facilities are situated in mountainous areas such as Barhe, Surgana, and Peint, among others. The remaining rural medical facilities are located between 600 and 700 meters above sea level in tribal regions. Hilly regional community health centers are more difficult to reach and are usually located outside of metropolitan areas. A rural hospital center provides higher-order health services to the basic health clinics in the area.

Primary Health Center:
Health care is a public right, and it is the government's duty to ensure that everyone has access to it. The Maharashtra government has built primary health clinics in tribal regions to provide health services to the neighboring communities, based on this concept. Every primary health center has been designated as a tribal health services facility in this manner. In the study area, there are 40 primary health care facilities.
The research area has a very homogeneous distribution of primary health facilities. Relief and accessibility seem to have had an impact on the distribution of primary health care in the research area. The majority of basic health clinics are located near rivers and highways in hilly and plain regions. The percentage of primary health care facilities, on the other hand, is low in plain region. Due to inaccessibility, the research area's Peint and Surgana tehsil, as well as the inner portion of the mountainous region, were excluded. According to the 2011 census, primary health center services were given to an average of 24402 people per primary health center. This factor has influenced the delineation of a primary health center's service regions.

Table No. 1 Tribal Tehsil of Nashik District: Altitudinal Belt Wise Proportion of Centers According to Population Served by them.

Population	300 to 400 m.		400 to 500 m		500 to 600 m.		600 to 700 m.		Above 700		Region	
	No. of PHC	%	No. of PHC	%	No. of PHC	%	No. of PHC	%	No. of PHC	%	No. of PHC	%
Less than 20,000	-	-	5	71.42	-	-	3	16.66	3	30	11	25.58
20,000 to 30,000	1	25	2	28.57	2	50	7	38.88	3	30	15	34.88
More than 30,000	3	75	-	-	2	50	8	44.44	4	40	17	39.53
Total	04	100	07	100	04	100	18	100	10	100	43	100

Source: Census handbook of Nashik District, 2011.

According to the National Health Plan, each tribal region should have one primary health center for every 20,000 people. In the tribal territory as a whole, 34.88 % of primary health centers are in ideal locations. Each of the remaining primary health care centers that serves more over 20,000 people may be regarded an undesirable number. In the entire region, the share of primary health centers rise as altitude rises. In all five altitudinal belts, the number of people serviced by each primary health center grows, but their share decreases in the study region. Figure no. 2 shows that each primary health facility in the tribal tehsils serves fewer than 15000 people. This demonstrates that the area has a lower population density, and that, as a result of its inaccessibility, Maharashtra's governments have built more primary health facilities than are required. Except in a Dindori, and Kalwan Tehsils, other primary health center has a population of less than

20,000 people such as Peint, Surgana and Trimbakeshwar. It is required to suggest some additional primary health centers in these respective primary health centers in order to meet the desired health needs of a local community. In the research region, the average number of dependent villages covered by each primary health facility increases to roughly 12 in 2020-21.
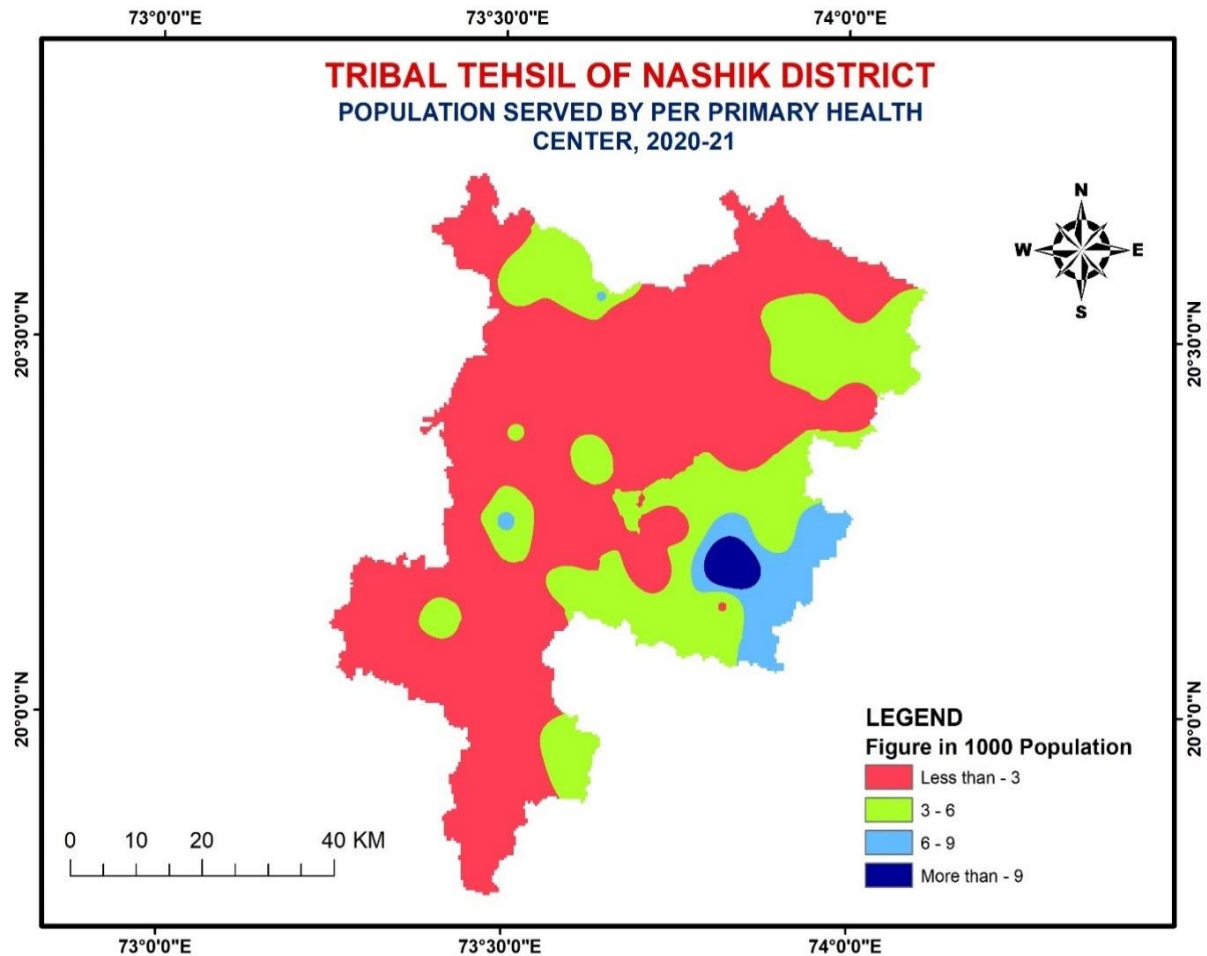

Fig. No. 2

Table No. 2 Tribal Tehsil of Nashik District: Altitudinal Belt Wise Proportion of Primary Health Centers According to the Number of Villages Serve by them.

Sr. No. of Villages	300 to 400 m.		400 to 500 m		500 to 600 m.		600 to 700 m.		Above 700		Region	
	No. of PHC	%	No. of PHC	%	No. of PHC	%	No. of PHC	%	No. of PHC	%	No. of PHC	%
Less than 15	-		1	14.28	1	25	7	38.89	2	20	11	25.58
15 to 25	2	50	5	71.42	-	-	6	33.33	3	30	16	37.20
More than 25	2	50	1	14.28	3	75	5	27.78	5	50	16	37.20
Total	04	100	07	100	04	100	18	100	10	100	43	100

Source- Computed by Researcher, 2020-21

The above table no.2 shows that less than 15 villages are included in the service area of each 25.58 % primary health center. These communities are mostly found in the lower altitudinal belt, where population density is higher and major settlements are more common. About 15 to 25 communities in a primary health center's service area receive services from about 37.20 % of primary health centers. Most of the primary health centers located in the 600 meters to more than 700-meter altitude hilly areas serve more than 15 villages, and they are distributed in a dispersed fashion. In the research region, the proportion of such primary health centers is estimated to be 37.20 %.
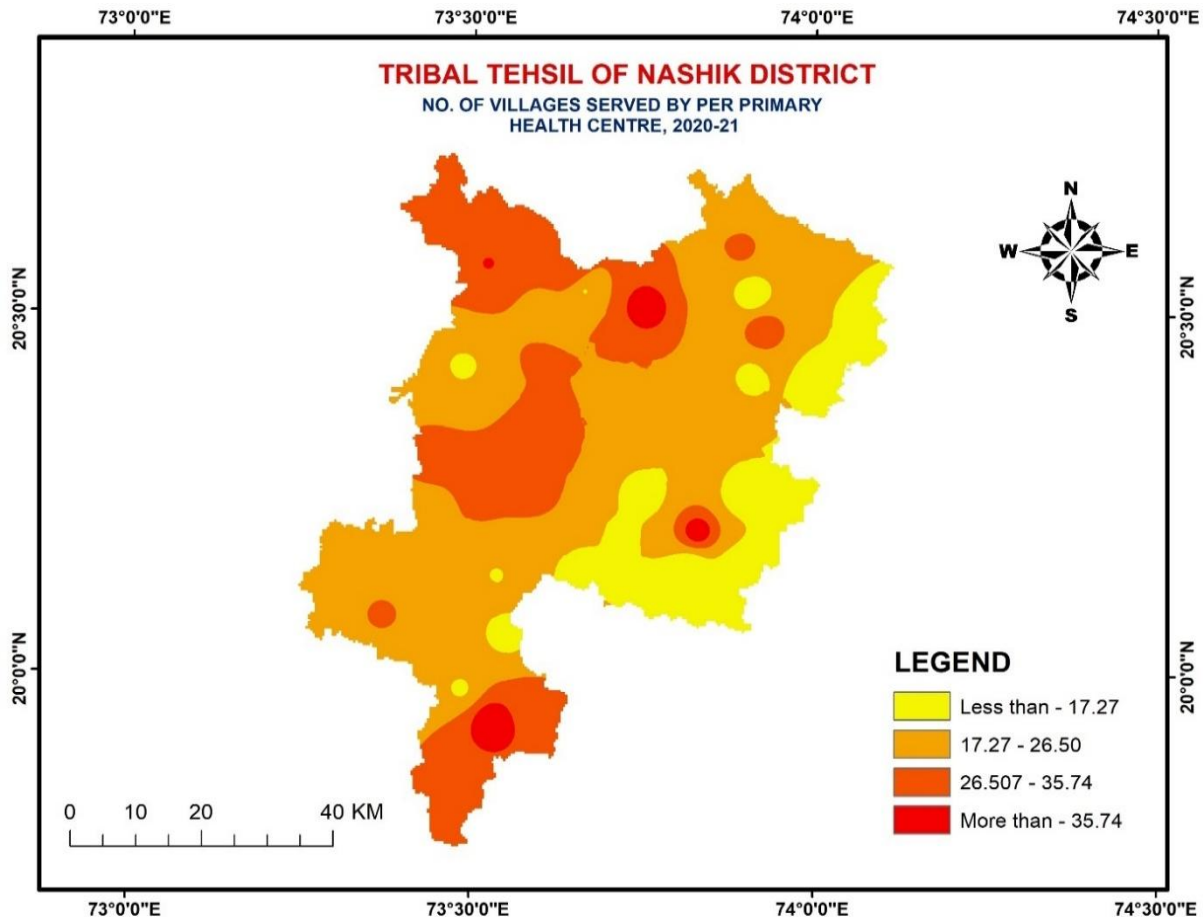
Fig. No. 3

Tribal Health Service Centers According to Weightages:

Certain weightages were assigned to the different criteria in order to establish the spatial pattern and degree of health services provided by the primary health center. The weightage values were assigned based on the importance and quantity of the variables. The factors that were considered are listed in the table below, along with their respective weightages. The composite weightage for each primary health center is calculated by adding the given weightages for each main health facility. The regional average of the composite weightages is calculated by adding all of the composite weightages together (29.07). Poorly served primary health facilities are those with a composite weightage of less than 30 % of the national norm. Centers with a composite value of 30 to 60, on the other hand, are categorized as moderately served primary health centers, while those with a composite value of more than 60 are classed as served primary health centers.

Table No. 4 Weightages Given to Various Facilities Available at a Tribal Health Service Center.

	Weightages
A) Medical Facilities Availability at the PHCs.	
1) Outdoor Patients Departments	01
2) Operation Theatre	03
3) X-ray Unit	04
4) Pathological Lab	02
5) Ward	02
6) No. of beds (Per 6 Beds)	01
B) Medical Staff (1 Staff Member)	01
C) Per 20 Patients investigated per day	01
D) Per 500 average population per villages served by a PHC	01
E) Area of 5 sq.km. per village served by a PHC	01

Table No. 5 Tribal Tehsil of Nashik District: Primary Health Center-Wise Total No. of Weightages Given according to Various Medical Facilities, 2020-21

Primary Health Centre	Medical Facilities	Total Workers	Per 20 Patients investigated per day	Per 500 average population per PHC	Area of 5 sq.km.	Composite Weightages
	1	2	3	4	5	6
Kulwandi	10	11	1.25	3.60	1.97	27.82
Jogmodi	9.66	09	2	1.87	0.38	22.91
Kumbhale	09	12	2.15	3.90	1.82	28.87
Ambe	09	13	1.2	6.35	0.28	29.83
Karanjali	10.5	12	1.65	4.45	1.06	29.66
Bhuawan	9.66	08	2.4	2.23	1.19	23.48
Kohar	10	11	2.45	7.18	2.52	33.15
Peint (RH)	17	28	7.5	13.71	2.57	68.78
Talegaon	09	12	1.85	5.22	2.62	30.69
Ware	1.66	13	2.15	3.11	1.22	21.14
Varkhede	9.66	12	2.05	8.3	2.09	34.1
Umrale	9.66	09	4.4	2.88	1.4	27.34
Nanashi	5.66	08	2.25	8.67	3.90	28.48
Nigdol	6.66	11	1.55	4.50	1.77	25.48
Mohadi	9.33	12	3.7	16.06	6.72	47.81
Pandhane	9.66	10	3.15	3.55	0.79	27.15
Khedgaon	10	13	2.65	15.53	3.08	44.26
Kochargaon	10	09	2.35	10.08	4.08	35.51
Dindori (RH)	17	37	6.9	35.46	5.19	101.55
Borgaon	9.66	11	3.05	4.58	2.16	30.45
Umbarthan	7.66	12	3.25	6.30	1.70	30.91
Barhe	3.33	13	2.05	1.73	0.72	20.83
Mani	6.66	09	2.6	2.93	0.74	21.93
Mankhed	9.16	11	2.8	4.76	1.10	28.82
Bubali	9.16	13	1.9	2.71	0.75	27.52
Surgana (RH)	17	41	10.75	12.52	0.70	81.97
Jaidar	10	10	4	2.33	0.40	26.73
Dalwat	11.33	11	4.6	4.52	0.71	32.16
Tirhol	7.66	09	2.15	1.53	0.46	20.8
Kanashi	10.33	11	4.75	9.71	3.03	38.82
Nandori	11.33	13	4.1	3.18	1.33	32.94
Umbargavhan	9.5	06	1.1	2.5	1.50	20.6
Otur	7.66	11	4.55	5.48	2.15	30.84
Mokhbhangi	9.66	09	3.65	5.47	1.05	28.83
Navi Bej	10.66	08	1.6	6.70	1.68	28.64
Abhona (RH)	17	27	7.55	11.72	0.58	63.85
Amboli	10	12	1.75	3.37	2.10	29.22
Chinchohal	8.66	13	2.6	2.15	0.97	27.38
Shirasgaon	09	11	1.9	3.59	1.58	27.07
Thanapada	09	10	2.1	8.28	3.65	33.03
Rohile	9.33	09	1.75	3.54	1.60	25.22
Anjanneri	8.66	12	2.05	9.86	6.02	38.59
Trimbak (SDH)	20.33	28	12.05	2.27	2.35	65

Source- Computed by Researcher, 2020-21

Table No. 6 Tribal Tehsil of Nashik District: Altitudinal Belt-Wise Classification of Tribal Health Service Centers According to their Composite Weightages.

| Composite Weightage	300 t0 400 M.		400 to 500 M.		500 to 600 M.		600 to 700 M.		Above 700 M.		Region	
	No. of PHC	%	No. of PHC	%	No. of PHC	%	No. of PHC	%	No. of PHC	%	No. of PHC	%
Less than 30 (Poorly Served)	02	50	06	85.71	03	75	08	44.44	05	50	24	55.81
30 to 60 Moderately Served)	02	50	01	14.29	-	-	07	38.89	04	40	14	32.55
More than 60 (Better Served)	-	-	-	-	01	25	03	16.67	01	10	05	11.63
Total	04	100	07	100	04	100	18	100	10	100	43	100

Source- Computed by Researcher, 2020-21
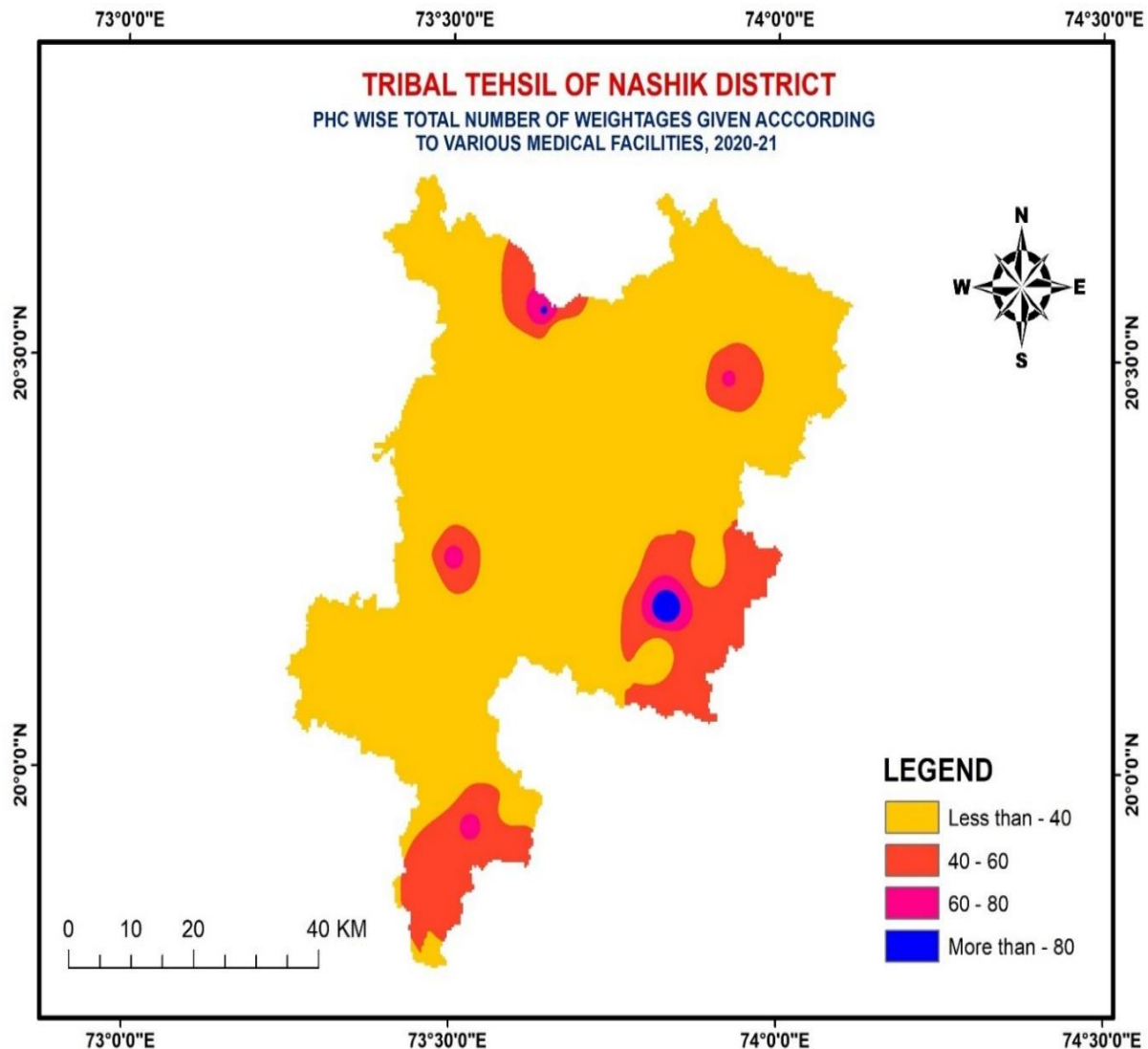
Fig. No. 4

This table no. 6 shows that around 55.81% of indigenous health service centers are poorly served. It means that, although having the status of health service centers, these service centers are not adequately offering health services to the surrounding hinterland. According to the altitude classification, nearly 34.88% of tribal health service centers are located between 300 and 600 meters above sea level. The remaining two altitudinal belts, on the other hand, should be treated as a single unit. It indicates that roughly 65.11% of health service locations are located in more difficult-to-reach places. As a result, their capacity to provide services is limited, and they are designated as underserved tribal health service centers. Only 32.55 % of health service locations have a composite weightage of 30 to 60, and less than 35 % service center are lying within the belt of 300 to 600 meters.

The remaining above 60% can be found in the upper elevations. All of these health care facilities are classified as moderately serviced tribal health care facilities. In the entire research region, there are only 05 primary health centers with more than 35 composite weightages. Mohadi, Khedgaon, Kanashi, Anjaneri and Kochargaon are the 05 best-served primary health centers except Rural Hospitals. Better infrastructure and medical facilities are available at all of these service centers. They may also enjoy the status of better-served primary health centers in the region since they are more accessible.
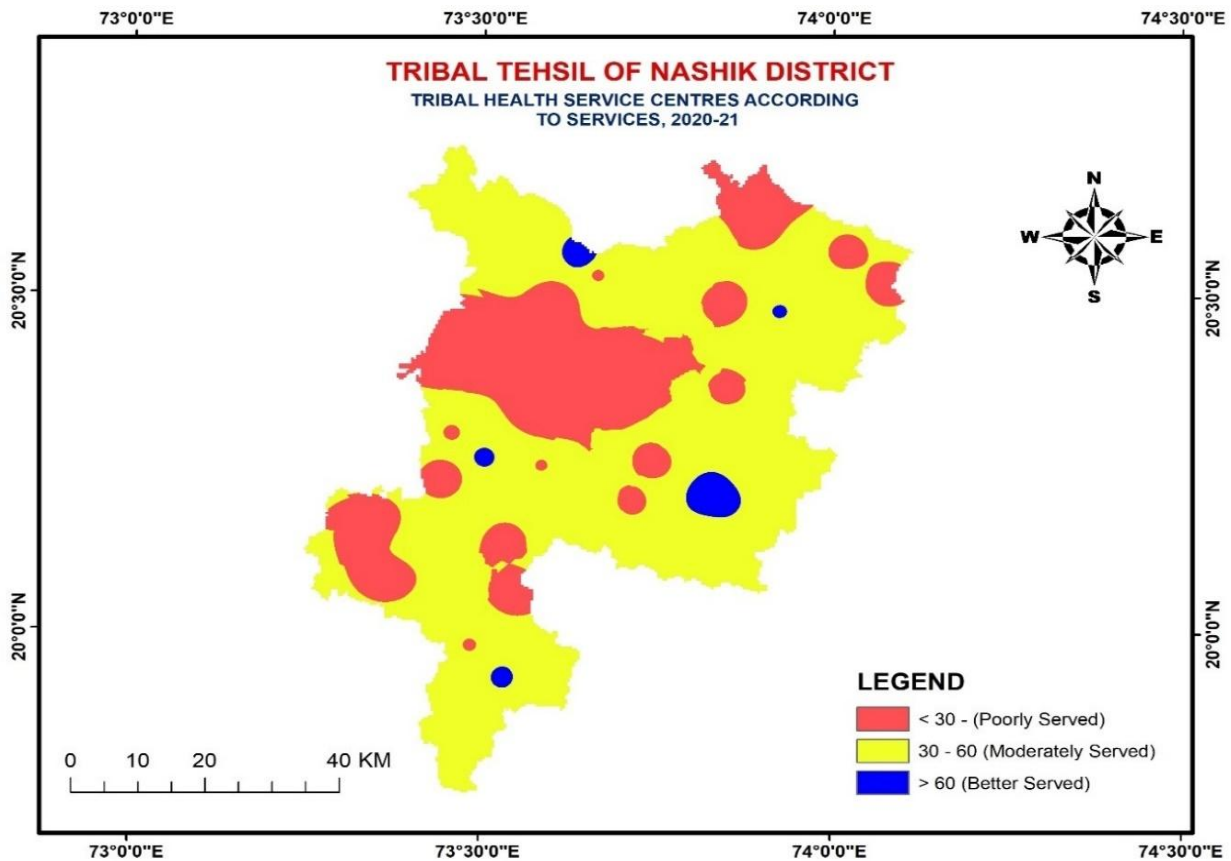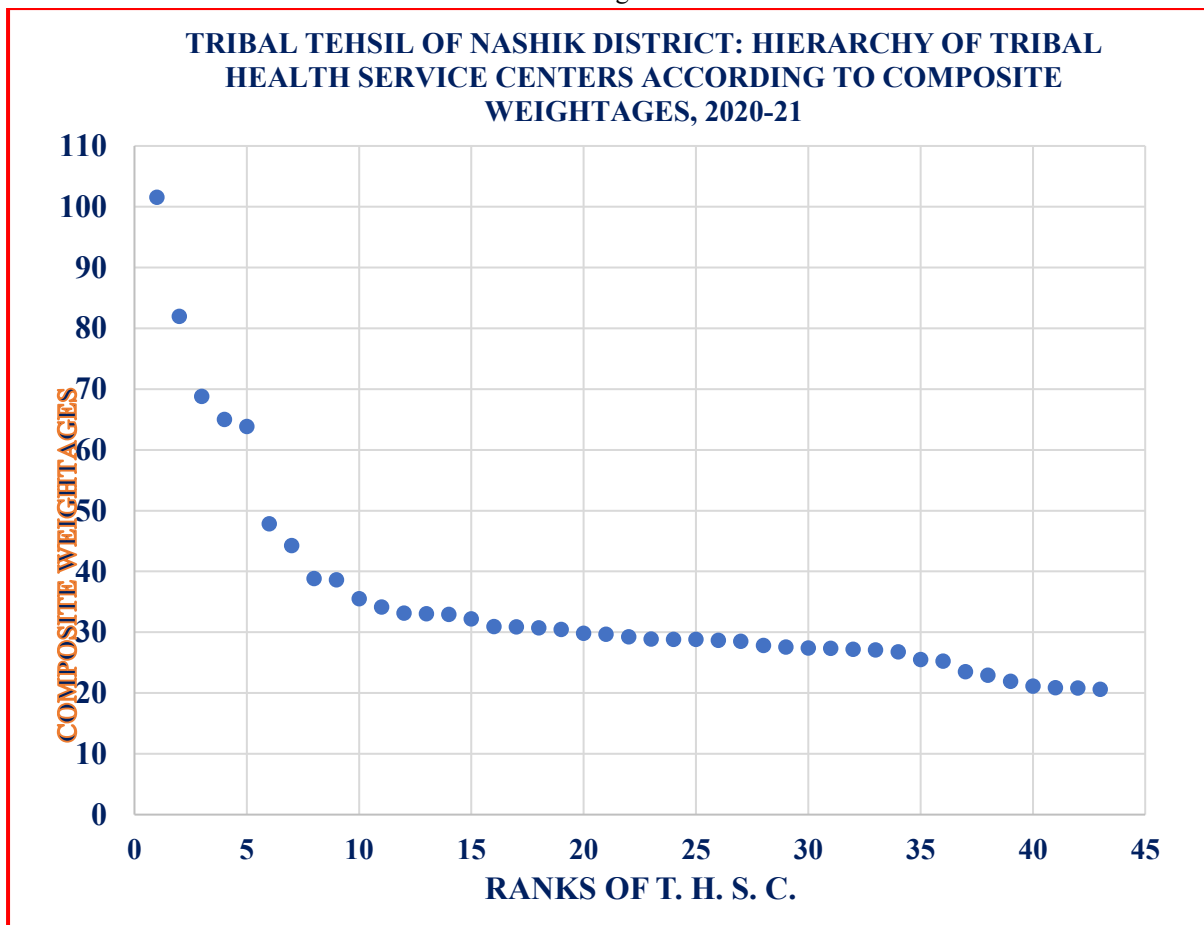
Fig. No. 5

Fig. No. 6

VII. CONCLUSIONS

The present study highlights the spatial hierarchy and functional efficiency of tribal health service centers in the Nashik district, focusing on rural hospitals, community health centers, and primary health centers. The findings reveal that while rural hospitals and community health centers provide higher-order medical services, their accessibility is often limited due to difficult hilly terrain and sparse population distribution. Primary health centers, being the most widespread, serve as the backbone of healthcare delivery in tribal areas. However, despite their uniform distribution, many PHCs are located in regions where geographical barriers and low population density restrict effective healthcare coverage.

The composite weightage analysis clearly indicates disparities in the level of services among different centers. Nearly 55.81% of tribal health service centers are categorized as poorly served, primarily located in remote and elevated regions. These centers lack adequate medical infrastructure, staff, and diagnostic facilities. Around 32.55% of the centers fall under the moderately served category, showing partial fulfillment of health service norms. Only a small proportion (11.63%) of centers, such as Mohadi, Khedgaon, Kanashi, Anjaneri, and Kochargaon, qualify as well-served due to better infrastructure and accessibility. The altitudinal analysis further shows that accessibility decreases with elevation, directly affecting service quality and coverage area.

VIII. ACKNOWLEDGMENT

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