iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** VIII **Month of publication:** August 2025

DOI: https://doi.org/10.22214/ijraset.2025.73771

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VIII Aug 2025- Available at www.ijraset.com

Sectoral - Spatial Hierarchy of Health Services in Taiz Governorate, Yemen

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Abstract: ***The study offered a detailed overview of the hierarchical structure of healthcare services in Taiz Governorate, focusing on eighteen components within public and private sectors. It employed quantitative methods and Scale Drawing Analysis (Scalogram Analysis) alongside Geographic Information Systems (GIS) for spatial analysis. The results revealed that, in the public sector, nursing personnel, physicians, and medical units dominated the first level, while in the private sector, pharmacies and drug stores led, with hospitals, optometry centers, and radiology centers at the lowest tier. Spatially, Al-Shamayatayn district ranked highest in the public sector, while Al-Ta'ziyah, Jabal Habashe, Al-Wazi'yah, and Mawzaa were at the bottom. In the private sector, Al-Qahirah, Salh, and Al-Mudaffar districts excelled due to comprehensive service coverage, whereas Al-Silw, Sama'a, and Bab Al-Mandab lagged, with services limited to pharmacies. This highlights the centralization and inadequacies in healthcare policy and planning within Taiz Governorate.***

Keywords: ***Hierarchy; Health services; Public sector; Private sector; Geographic analysis; Scalogram analysis; GIS***

I. INTRODUCTION

Healthcare services are fundamental to the internal structure of urban centers and serve essential functions within them [1]. They are significant indicators of a country's progress in quality of life and a measure of effective government management [2]. The relationship between healthcare providers and consumers is mutual, forming an integrated system characterized by comfort, care quality, and the environmental conditions under which these services are delivered [3]. Hierarchical analysis, a method used for classification and geographic assessment, plays a crucial role in revealing the hierarchy of administrative units within a city based on service availability and population distribution [4].

An increase in the size of certain hierarchical levels indicates a growing demand for services, while a decrease suggests a declining demand. This hierarchy also highlights the importance and quality of services offered in various sectors, as well as the centrality of administrative units spatially within the studied area [5]. It shows variations in the distribution of services and their functional roles, contributing to the overall development process [3]. The Scalogram analysis technique has been successfully applied in several countries, including India, Indonesia, Bolivia, the Philippines, Thailand, and Sri Lanka [6], as well as in academic studies in Jordan, Egypt, and Yemen [7]. Health services are paramount among these services, acting as a cornerstone for human activity and playing a crucial role in human development and well-being [8].

This sector is also one of the fastest-growing areas within the service economy [9]. The study focuses on the health services available to the population in Taiz Governorate, examining eighteen components provided by both public and private sectors. The public sector includes seven components: urban hospitals, rural hospitals, healthcare centers, primary health care units, doctors, nursing staff, and the number of beds. The private sector encompasses eleven components, which include hospitals, clinics, medical centers, beds, medical clinics, ambulance services, dental laboratories, testing laboratories, radiology services, optical shops, pharmacies, and drugstores, distributed across 23 districts. Trained healthcare professionals and their assistants deliver these services. The study applies the scalogram analysis method to each sector separately, allowing for comparisons between centers or population clusters in terms of their significance and the level of service provided to residents. This analysis reveals the superiority of one center over another and highlights the volume of services and functional gaps through the hierarchical ranking of each center. Ultimately, it distinguishes the spatial-sectoral hierarchy of health services within Taiz Governorate for both public and private sectors.

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II. STUDY AREA

Taiz Governorate is one of the governorates of the Republic of Yemen. It is located in southwestern Yemen, at a longitude of (43^{O} - 45^{O} E), and a latitude of (12^{O} -14^{O} N). It covers an area of approximately (9,587.6 Km^2), 1.8% of the area of the Republic of Yemen. The study area includes (23) districts. As of 2014, it had a population of (2,927,299). Taiz is considered the cultural capital of the Republic of Yemen and serves as a connecting link between different parts of the country, where transportation routes between governorates intersect [10].

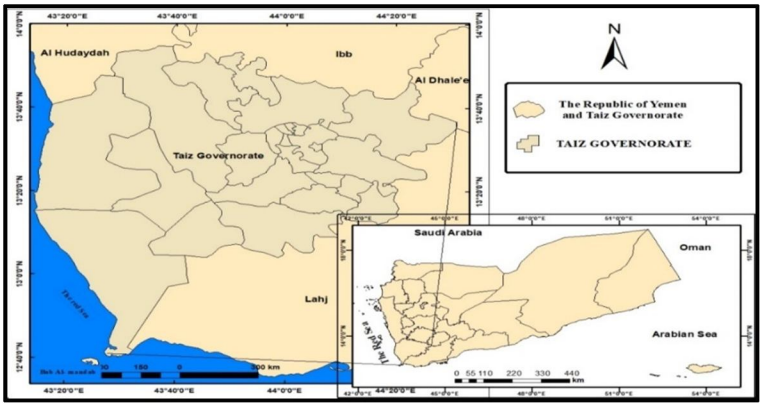


Fig. 1 Location map of study

III. DATABASE AND METHODOLOGY

The study followed an objective approach, employing quantitative methods to analyze data gathered from various sources, including published data from the Public Health Office and the Statistics Office, as well as unpublished reports issued by the Information Unit affiliated with hospitals, health centers, and units in the districts for the year 2014 in Taiz Governorate. To illustrate the sequence of health service components, the study adopted the standardized drawing technique "scalogram," drawing on several studies such as (Amin Hassan 2003); (Dennis Rondinelli 1985); (Khalif Gharaibeh 1995) [4], [6-7]. Additionally, it utilized Geographic Information System (GIS) and fieldwork, such as visiting public health service institutions and conducting personal interviews with officials to ensure data accuracy.

- Steps to apply the scalogram analysis technique in the study:

1. Create a matrix where columns represent health service components, and rows represent districts of the governorate, arranged in descending order based on population size. Table 1.
2. Fill the number of services in the cells of the matrix, if available. If a specific district does not have a particular service, record the number (0) in the corresponding cell.
3. Determine the number of available services, excluding empty cells, vertically for services and horizontally for districts.
4. Calculate the total services, both vertically and horizontally.
5. Rank services vertically and districts horizontally based on the results from steps 3, 4.
6. Redraw the table, the final table for Scalogram analysis, based on the outcomes from step 5. Then, create a linear ordering that illustrates the spatial and sectoral hierarchy for both districts and the available health services. Table No 1.

The study separately applied the standard graphic analysis scale to the components of health services in the public and private sectors. Then, it combined them into one Table to make a comparison between the two sectors and reveal their general spatial and sectoral hierarchy as follows:

IV. SECTORAL AND SPATIAL HIERARCHY OF PUBLIC HEALTH SERVICES

A. Sectoral And Spatial Hierarchy Of Public Health Services

The results of the scalogram analysis clearly show the hierarchical form of sectoral and spatial public health services, based on seven of its components as classified according to government statistical reports issued during the same study period [11]-[14] presented in tables (I, II) and fig. 2 as follows:

TABLE.I
SPATIAL DISTRIBUTION OF PUBLIC HEALTH SERVICES IN A SCALOGRAM ANALYSIS IN THE DISTRICTS OF TAIZ GOVERNORATE FOR THE YEAR 2014

Districts	Population	Urban Hospital	Rural Hospital	Medical Centers	Sanitary Units	Doctors	Nursing Staff	Number Of Beds		Total Type	Total Unit	District Rank
Al-Ta’ziyah	242.185	0	0	12	17	14	64	0		4	107	18
Maqbanah	227.483	0	3	18	25	29	70	93		6	238	5
Al-Mudaffar	214.252	3	0	4	1	50	82	240		6	380	4
Al-Shamayatayn	185.278	1	1	19	18	45	148	170		7	402	1
Salh	182.852	2	0	5	2	149	294	620		6	1072	3
Sharab Rawnah	179.969	0	2	7	13	10	47	44		6	123	11
Al-Qahirah	178.929	3	0	5	1	185	274	688		6	1156	2
Mawiyah	160.484	0	1	4	20	9	33	21		6	88	15
Jabal Habashe	145.259	0	0	4	20	6	58	0		4	88	19
Al-Mawasit	140.922	0	2	11	10	18	58	33		6	132	6
Dimnat Khadir	138.346	0	1	3	3	25	36	61		6	129	9
Al-Ma’afer	135.359	0	1	7	4	18	31	29		6	90	14
Sharab Salam	133.696	0	2	7	11	14	53	42		6	129	8
Saber Al Muadem	133.037	0	1	7	14	7	59	28		6	116	12
Al-Misrakh	122.186	0	1	7	11	13	65	28		6	125	10
Hifaan	91.973	0	2	12	9	21	59	28		6	131	7
Al-mukah	76.526	0	1	2	10	7	43	36		6	99	13
Al-Silw	60.382	0	1	6	9	9	35	17		6	77	16
Sama'a	50.743	0	0	3	7	2	19	0		4	31	23
Mawzaa	42.418	0	0	3	5	3	26	0		4	37	21
Al-Wazi’yah	32.647	0	0	4	9	4	23	0		4	40	20
Mashrah and Hadnan	30.103	0	0	2	4	3	23	0		4	32	22
Bab Almandab	22.27	0	1	1	5	4	22	25		6	58	17

Total Type	4	14	23	23	23	23	17
Total Unit	9	20	153	228	645	1622	2203
District Rank	7	6	4	3	2	1	5

* The count included Al-Arous Rural Hospital in Saber Al-Mauadem and Al-Thawra Rural Hospital in Al-Silw among the rural hospitals. The results of the research and field study have proven that they have all the elements to be considered rural hospitals, as they contain an operating and surgery room and provide their complete services to the population, as well as the governorate's health office is making Efforts to accredit them as two rural hospitals in the future.

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TABLE.II
HIERARCHY OF COMPONENTS OF PUBLIC HEALTH SERVICES IN A (SCALOGRAM) ANALYSIS OF THE DISTRICTS OF TAIZ GOVERNORATE FOR THE YEAR 2014

Districts	Population	Nursing staff	Doctors	Sanitary Units	Medical centers	Number of beds	Rural Hospital	Urban Hospital		Total Type	Total Unit	District Rank
Al-Shamayatayn	185.278	!	!	!	!	!	!	!		7	402	1
Salh	182.852	!	!	!	!	!	(	!		6	1072	3
Al-Mudaffar	214.252	!	!	!	!	!	(	!		6	380	4
Maqbanah	227.483	!	!	!	!	!	(	(		6	238	5
Al-Mawasit	140.922	!	!	!	!	!	!	(		6	132	6
Hifaan	91.973	!	!	!	!	!	!	(		6	131	7
Sharab Salam	133.696	!	!	!	!	!	!	(		6	129	8
Dimnat Khadir	138.346	!	!	!	!	!	!	(		6	129	9
Al-Misrakh	122.186	!	!	!	!	!	!	(		6	125	10
Sharab Rawnah	179.969	!	!	!	!	!	!	(		6	123	11
Saber Al- Muadem	133.037	!	!	!	!	!	!	(		6	116	12
Al-mukah	76.526	!	!	!	!	!	!	(		6	99	13
Al-Ma’afer	135.359	!	!	!	!	!	!	(		6	90	14
Mawiyah	160.484	!	!	!	!	!	!	(		6	88	15
Al-Silw	60.382	!	!	!	!	!	!	(		6	77	16
Bab Al-Mandab	22.270	!	!	!	!	!	!	(		6	58	17
Al-Ta’ziyah	242.185	!	!	!	!	(	(	(		4	107	18
Jabal Habashe	145.259	!	!	!	!	(	(	(		4	88	19
Al-Wazi’yah	32.647	!	!	!	!	(	(	(		4	40	20
Mawzaa	42.418	!	!	!	!	(	(	(		4	37	21
Mashrah and Hadnan	30.103	!	!	!	!	(	(	(		4	32	22
Sama'a	50.743	!	!	!	!	(	(	(		4	31	23

Total Type	23	23	23	23	17	14	4
Total Unit	1622	645	228	153	2203	20	9
District Rank	1	2	3	4	5	6	7

Based on Table I, II we can conclude that the hierarchical classification of the components of public health services used in the analysis adopts four levels (ranks), ranked from the highest rank to the lowest, as shown in the following tables III, IV.

TABLE. III
SECTORAL HIERARCHY LEVELS OF PUBLIC HEALTH SERVICES

Hierarchy level	Health Service Sector	Distribution
First	Nursing Staff, Doctors, Sanitary Units, Medical center	Present in all districts
Second	Beds	Present in 17 districts
Third	Rural Hospital	Present in14 districts
Fourth	Urban Hospital	Present in 4 districts

TABLE.IV
SPATIAL HIERARCHY LEVELS OF PUBLIC HEALTH SERVICES

Hierarchy level	Hierarchy Spatial	Distribution
First	Al-Shamayatayn	Includes all seven components of the government health service
Second	Salh, Al-Qahirah, AL-Mudaffar, Maqbanah, Al-Mawasit, Hifaan, Sharab Salam, Dimnat Khadir, Al-Misrakh, Sharab Rawnah, Saber Al Muadem, Al-Mukah, Al-Ma'afer, Mawiyah, Al-Silw, Bab Al-Mandab	Each district includes six health service components.
Third	Al- Ta'ziyah, Jabal Habashe, Al-Wazi'ya, Mawza'a, Mashrah and Hadnan, Sama'a	These districts include only four components of government health services.

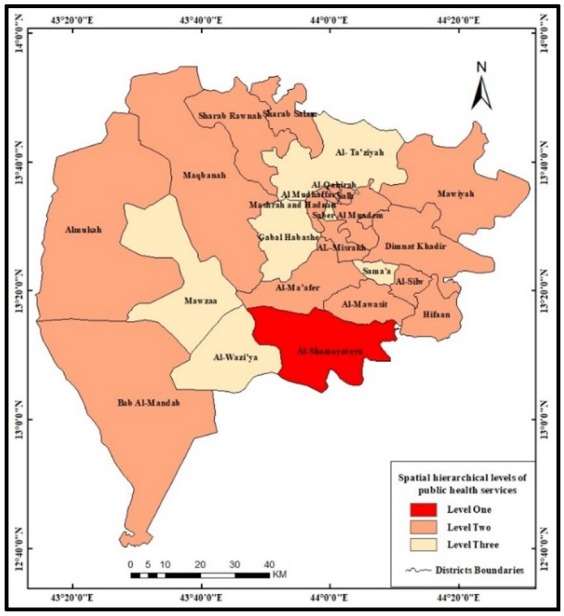


Fig.2 Spatial hierarchy of components of Public health services in Taiz Governorate according to the scalogram technique for the year 2014, based on Table IV

B. Sectoral And Spatial Hierarchy Of Privet Health Services In Taiz Governorate

Scalogram analysis reveals the hierarchical structure of private health services, sectoral and spatial, based on eleven private sector components as classified according to government statistical reports issued during the same study period [15]-[18], tables V, VI show these components as follows:

TABLE. V
SPATIAL DISTRIBUTION OF PRIVATE HEALTH SERVICES IN A SCALOGRAM ANALYSIS IN THE DISTRICTS OF TAIZ GOVERNORATE 201

Districts	Population	Hospital *	Dispensary	Medical Centers	Beds	Clinics**	Emergency clinics	Dental labs	Medical lab	Rays	optics	Pharmacies and Medicine Stores		Total Type	Total Unit	District Rank
Al-Ta'ziyah	242.185	0	6	2	90	3	5	2	1	0	0	86		8	195	4
Maqbanah	227.483	0	5	2	75	4	7	2	3	0	0	69		8	167	5
Al-Mudaffar	214.252	9	4	7	564	97	30	9	16	4	3	171		11	914	3
Al-Shamayatayn	185.278	0	2	2	30	5	7	1	8	0	0	93		8	148	7
Salh	182.852	13	4	5	710	84	22	9	31	2	4	125		11	1009	2
Sharab Rawnah	179.969	0	3	0	35	0	7	0	1	0	0	14		5	60	10
Al-Qahirah	178.929	9	12	3	615	158	35	3	32	7	10	198		11	1082	1
Mawiyah	160.484	0	2	3	28	1	9	0	1	0	0	42		7	86	8
Jabal Habashe	145.259	0	0	0	0	0	6	0	2	0	0	12		3	20	17
Al-Mawasit	140.922	0	1	1	15	0	11	0	0	0	0	25		5	53	11
Dimnat Khadir	138.346	0	3	5	45	4	13	3	3	0	0	82		8	158	6
Al-Ma'afer	135.359	0	2	3	20	6	1	0	1	0	0	31		7	64	9
Sharab Salam	133.696	0	1	2	17	0	2	0	0	0	0	11		5	33	12
Saber Al Muadem	133.037	0	0	0	0	0	4	0	0	0	0	18		2	22	19
Al-Misrakh	122.186	0	0	0	0	1	5	0	2	0	0	33		4	41	15
Hifaan	91.973	0	0	1	10	0	3	1	0	0	0	11		5	26	13
Al-Mukah	76.526	0	0	1	2	0	7	0	1	0	0	14		5	25	14
Al-Silw	60.382	0	0	0	0	0	0	0	0	0	0	2		1	2	21
Sama'a	50.743	0	0	0	0	0	0	0	0	0	0	1		1	1	22
Mawza'a	42.418	0	0	0	0	1	3	0	1	0	0	7		4	12	16
Al-Wazi'ya	32.647	0	0	0	0	1	1	0	0	0	0	3		3	5	18
Mashrah and Hadnan	30.103	0	0	0	0	0	2	0	0	0	0	5		2	7	20
Bab Al-Mandab	22.27	0	0	0	0	0	0	0	0	0	0	1		1	1	23
Total Type		3	12	13	14	12	20	8	14	3	3	23				
Total Unit		31	45	37	2256	365	180	30	103	13	17	1054				
District Rank		9	7	5	3	6	2	8	4	11	10	1				

* General and specialized hospitals: the general ones reached 9 hospitals, while the specialized ones got 21 specialty hospitals.
** It includes general medicine, surgery, specialty, and dental

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VIII Aug 2025- Available at www.ijraset.com

TABLE.VI
HIERARCHY OF COMPONENTS OF PRIVATE HEALTH SERVICES IN A SCALOGRAM ANALYSIS IN THE DISTRICTS OF TAIZ GOVERNORATE FOR THE YEAR 2014

Districts	Population	Pharmacies and Medicine Stores	Emergency Clinics	Beds	Medical lab	Medical Centers	Clinics	Dispensary	Dental labs	Hospital	Optics	Rays	Total Type	Total Unit	Districts Rank
Al-Qahirah	178.929	!	!	!	!	!	!	!	!	!	!	!	11	.082	1
Salh	182.852	!	!	!	!	!	!	!	!	!	!	!	11	.009	2
Al-Mudaffar	214.252	!	!	!	!	!	!	!	!	!	!	!	11	914	3
Al-Ta’ziyah	242.185	!	!	!	!	!	!	!	!	(	(	(	8	195	4
Maqbanah	227.483	!	!	!	!	!	!	!	!	(	(	(	8	167	5
Dimnat Khadir	138.346	!	!	!	!	!	!	!	!	(	(	(	8	158	6
Al-Shamayatayn	185.278	!	!	!	!	!	!	!	!	(	(	(	8	148	7
Mawiyah	160.484	!	!	!	!	!	!	!	(	(	(	(	7	86	8
Al-Ma’afer	135.359	!	!	!	!	!	!	!	(	(	(	(	7	64	9
Sharab Rawnah	179.969	!	!	!	!	!	!	!	(	(	(	(	5	60	10
Al-Mawasit	140.922	!	!	!	!	!	!	!	(	(	(	(	5	53	11
Sharab Salam	133.696	!	!	!	!	!	!	!	(	(	(	(	5	33	12
Hifaan	91.973	!	!	!	!	!	!	!	(	(	(	(	5	26	13
Al-Mukah	76.526	!	!	!	!	!	!	!	(	(	(	(	5	25	14
Al-Misrakh	122.186	!	!	(	!	!	!	!	(	(	(	(	4	41	15
Mawzaa	42.418	!	!	(	!	!	!	!	(	(	(	(	4	12	16
Gabal Habashe	145.259	!	!	(	!	!	!	!	(	(	(	(	3	20	17
Al-Wazi'ya	32.647	!	!	(	!	!	!	!	(	(	(	(	3	5	18
Saber Al-Muadem	133.037	!	!	(	!	!	!	!	(	(	(	(	2	22	19
Mashrah and Hadnan	30.103	!	!	(	!	!	!	!	(	(	(	(	2	7	20
Al-Silw	60.382	!	(	(	(	(	(	(	(	(	(	(	1	2	21
Sama'a	50.743	!	(	(	(	(	(	(	(	(	(	(	1	1	22
Bab Al-Mandab	22.270	!	(	(	(	(	(	(	(	(	(	(	1	1	23

Total Type	23	20	14	14	13	12	12	8	3	3	3
Total Unit	1054	180	2256	103	37	65	45	30	31	17	13
District Rank	1	2	3	4	5	6	7	8	9	10	11

Based on table V

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The results of the scalogram analysis show the hierarchical structure of sectoral and spatial private health services, based on eleven components of the private sector, presented in both the following tables V, VI and fig. 3.

TABLE. VII
SECTORAL HIERARCHY LEVELS OF PRIVATE HEALTH SERVICES

Hierarchy level	Health Service sector	Distribution
First	Pharmacies and drug stores	Present in all districts
Second	Emergency clinics	Present in 20 districts
Third	Beds, medical laboratories	Present in 14 districts
Fourth	Medical centers	Present in 13 districts
Fifth	Medical clinics and dispensaries	Present in 12 districts
Sixth	Dental laboratories	Present in 8 districts
Seventh	Hospital, Optics, Rays	Present in 3 districts

TABLE. VIII
SPATIAL HIERARCHY LEVELS OF PRIVATE HEALTH SERVICES

Hierarchy level	Hierarchy Spatial	Distribution
First	Salh, Al-Qahirah, Al-Mudaffar	Includes all components of the private health service
Second	Al- Ta’ziyah, Maqbanah, Dimnat Khadir, Al-Shamayatayn	Includes eight health service components
Third	Mawiyah, Al-Ma'afer	Include seven components of the private health service.
Fourth	Sharab Rawnah, Al-Mawasit, Sharab Salam, Hifaan	Include five components of the private health service
Fifth	AL-Misrakh, Mawzaa	Include four components of the private health service
Sixth	Gabal Habashe, Al-Wazi’ya	Include three components of the private health service
Seventh	Saber Al Muadem, Mashrah and Hadnan	Include two components of the private health service
Eighth	Al-Silw, Sama'a, Bab Al-Mandab	Include one component of the private health service

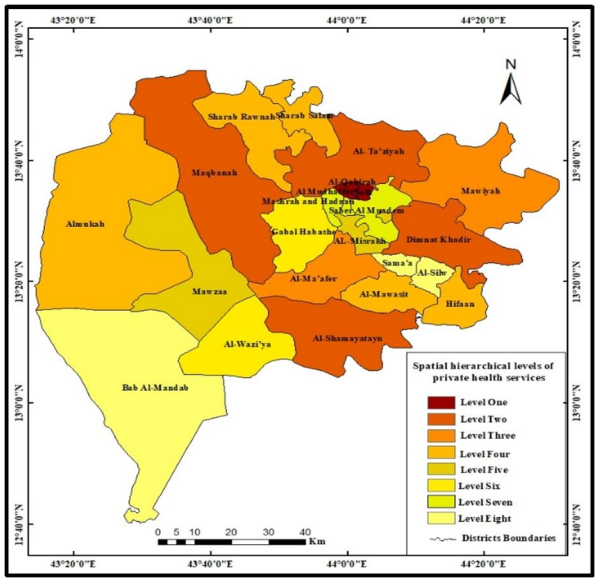


Fig. 3 Spatial hierarchical levels of the components of private health services in Taiz Governorate according to the scalogram technique for the year 2014, based on Table VIII.

V. THE GENERAL SECTORAL – SPATIAL HIERARCHY OF HEALTH SERVICES COMPONENTS (PUBLIC- AND PRIVATE) IN TAIZ GOVERNORATE

The study integrates all similar health service components, including both the public and private sectors, and even within the private sector itself, under a single designation. This was due to the abundance of components used and to ensure that no component was excluded from the analysis, thus providing a more precise analytical overview. For instance, urban hospitals were merged with private hospitals, health centres were consolidated, and clinics were combined based on their types. This reduced the number of components utilized in the analysis from eighteen to fourteen.

The overall hierarchical and spatial sequence of the public healthcare service components in Taiz Governorate is depicted in Table IX. Following that, the standard chart analysis scale is applied in Table X, with the summarized results presented in Tables XI, XII and fig. 4 as follows:

TABLE. IX
THE GENERAL SECTORAL-SPATIAL HIERARCHY OF HEALTH SERVICE COMPONENTS IN TAIZ GOVERNORATE 2014

Districts	Population	Hospital	Rural Hospital	Dispensary	Medical centers	Sanitary units	Clinics	Dental labs	Medical labs	Rays	Beds	Doctors	Nursing Staff	Pharmacies And medicine stores	Optics	Total Type	Total Unit	District Rank
Al-Ta'ziyah	242.185	0	0	6	14	17	8	2	1	0	90	14	64	86	0	0	302	7
Maqbanah	227.483	0	3	5	20	25	11	2	3	0	168	29	70	69	0	1	405	5
Al-Mudaffar	214.252	12	0	4	11	1	127	9	16	4	804	50	82	171	3	3	294	3
Al-Shamayatayn	185.278	1	1	2	21	18	12	1	8	0	200	45	148	93	0	2	550	4
Salh	182.852	15	0	4	10	2	106	9	31	2	330	149	294	125	4	3	1081	2
Sharab Rawnah	179.969	0	2	3	7	13	7	0	1	0	79	10	47	14	0	0	183	8
Al-Qahirah	178.929	12	0	12	8	1	193	3	32	7	1303	185	274	198	10	3	1238	1
Mawiyah	160.484	0	1	2	7	20	10	0	1	0	49	9	33	42	0	0	174	9
Gabal Habashe	145.259	0	0	0	4	20	6	0	2	0	0	6	58	12	0	7	108	17
Al-Mawasit	140.922	0	2	1	12	10	11	0	0	0	48	18	58	25	0	9	185	11
Dimnat Khadir	138.346	0	1	3	8	3	17	3	3	0	106	25	36	82	0	1	187	6
Al-Ma'afer	135.359	0	1	2	10	4	7	0	1	0	49	18	31	31	0	0	154	10
Sharab Salam	133.696	0	2	1	9	11	2	0	0	0	59	14	53	11	0	9	162	13
Saber Al Muadem	133.037	0	1	0	7	14	4	0	0	0	28	7	59	18	0	8	138	16
Al-Misrakh	122.186	0	1	0	7	11	6	0	2	0	28	13	65	33	0	9	166	12
Hifaan	91.973	0	2	0	13	9	3	1	0	0	38	21	59	11	0	9	157	14
Al-Mukah	76.526	0	1	0	3	10	7	0	1	0	38	7	43	14	0	9	124	15
Al-Silw	60.382	0	1	0	6	9	0	0	0	0	17	9	35	2	0	7	79	18
Sama'a	50.743	0	0	0	3	7	0	0	0	0	0	2	19	1	0	5	32	23
Mawzaa	42.418	0	0	0	3	5	4	0	1	0	0	3	26	7	0	7	49	20
Al-Wazi'ya	32.647	0	0	0	4	9	2	0	0	0	0	4	23	3	0	6	45	21
Mashrah and Hadnan	30.103	0	0	0	2	4	2	0	0	0	0	3	23	5	0	6	39	22
Bab Al-Mandab	22.270	0	1	0	1	5	0	0	0	0	25	4	22	1	0	7	59	19
Total Type		4	14	12	23	23	20	8	14	3	18	23	23	23	3			
Total Unit		40	20	45	190	228	545	30	103	13	4459	645	1622	1054	17			
District Rank		12	9	10	5	4	6	11	8	14	7	3	1	2	13			

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VIII Aug 2025- Available at www.ijraset.com

TABLE. X
THE GENERAL HIERARCHY OF HEALTH SERVICES COMPONENTS IN THE SCALOGRAM ANALYSIS IN THE DISTRICTS OF TAIZ GOVERNORATE 2014

Districts	Population	Nursing Staff	Assistants And medical	Doctors	Laboratory units	Medical center	Clinics	Beds	Medical labs	Rural Hospi	Dispensary	Dental labs	Hospital	Optics	Rays	Total Type	Total Unit	District Rank
Al-Qahirah	178.929	!	!	!	!	!	!	!	!	(	!	!	!	!	!	13	223(	1
Salh	182.852	!	!	!	!	!	!	!	!	(	!	!	!	!	!	13	208[illegible]	2
Al-Mudaffar	214.252	!	!	!	!	!	!	!	!	(	!	!	!	!	!	13	129[illegible]	3
Al-Shamayatayn	185.278	!	!	!	!	!	!	!	!	!	!	!	!	(	(	12	550	4
Maqbanah	227.483	!	!	!	!	!	!	!	!	!	!	!	(	(	(	11	405	5
Dimnat Khadir	138.346	!	!	!	!	!	!	!	!	!	!	!	(	(	(	11	287	6
Al-Ta’ziyah	242.185	!	!	!	!	!	!	!	!	(	!	!	(	(	(	10	302	7
Sharab Rawnah	179.969	!	!	!	!	!	!	!	!	!	!	(	(	(	(	10	183	8
Mawiyah	160.484	!	!	!	!	!	!	!	!	!	!	(	(	(	(	10	174	9
Al-Ma’afer	135.359	!	!	!	!	!	!	!	!	!	!	(	(	(	(	10	154	10
Al-Mawasit	140.922	!	!	!	!	!	!	!	(	!	!	(	(	(	(	9	185	11
Al-Misrakh	122.186	!	!	!	!	!	!	!	!	!	(	(	(	(	(	9	166	12
Sharab Salam	133.696	!	!	!	!	!	!	!	!	!	!	(	(	(	(	9	162	13
Hifaan	91.973	!	!	!	!	!	!	!	!	!	(	!	(	(	(	9	157	14
Al-Mukah	76.526	!	!	!	!	!	!	!	!	!	(	(	(	(	(	9	124	15
Saber Al Muadem	133.037	!	!	!	!	!	!	!	!	!	(	(	(	(	(	8	138	16
Gabal Habashe	145.259	!	!	!	!	!	!	(	!	(	(	(	(	(	(	7	108	17
Al-Silw	60.382	!	!	!	!	!	(	!	(	!	(	(	(	(	(	7	79	18
Bab Al-Mandab	22.270	!	!	!	!	!	(	!	(	!	(	(	(	(	(	7	59	19
Mawzaa	42.418	!	!	!	!	!	!	(	!	(	(	(	(	(	(	7	49	20
Al-Wazi'ya	32.647	!	!	!	!	!	!	(	(	(	(	(	(	(	(	6	45	21
Mashrah and Hadnan	30.103	!	!	!	!	!	!	(	(	(	(	(	(	(	(	6	39	22
Sama'a	50.743	!	!	!	!	!	(	(	(	(	(	(	(	(	(	5	32	23

Total Type	23	23	23	23	23	20	18	14	14	12	8	4	3	3
Total Unit	1622	1054	645	228	190	545	4459	103	20	45	30	40	17	13
District Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Based on table IX

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TABLE. XI
GENERAL SPATIAL HIERARCHICAL LEVELS OF HEALTH SERVICES COMPONENTS (PUBLIC AND PRIVATE) IN TAIZ GOVERNORATE

Hierarchy level	Health Service sector	Distribution
First	Nursing Staff, Pharmacies, and Medicine Stores, Doctors, Sanitary Units, Medical Centers	Present in all districts
Second	Clinics	Present in 20 districts
Third	Beds	Present in18 districts
Fourth	Medical labs, Rural Hospital	Present in 14 districts
Fifth	Dispensaries	Present in 12 districts
Sixth	Dental laboratories	Present in 8 districts
Seventh	Urban Hospital	Present in 4 districts
Eighth	Optics, Rays	Present in 3 districts

TABLE. XII
GENERAL SPATIAL HIERARCHY LEVELS OF HEALTH SERVICE COMPONENTS (PUBLIC AND PRIVATE) IN TAIZ GOVERNORATE

Hierarchy level	Hierarchy Spatial	Distribution
First	Salh, Al-Qahirah, Al-Mudaffar	Includes all components of health service
Second	Al-Shamayatayn	Includes twelve of the health service components
Third	Maqbanah, Dimnat Khadir, Al-Ta’ziyah	Include eleven components of the health service.
Fourth	Sharab Rawnah, Mawiyah, Al-Ma’afer, Al-Mawasit,	Includes ten components of the health service
Fifth	Al-Misrakh, Sharab Salam, Hifaan, Al-Mukah, Saber Al Muadem	Include nine components of the health service
Sixth	Gabal Habashe, Al-Silw, Bab Al-Mandab	Include eight components of the health service
Seventh	Mawzaa, Al-Wazi'ya, Mashrah and Hadnan	Include seven components of the health service
Eighth	Sama'a	Include five components of the health service

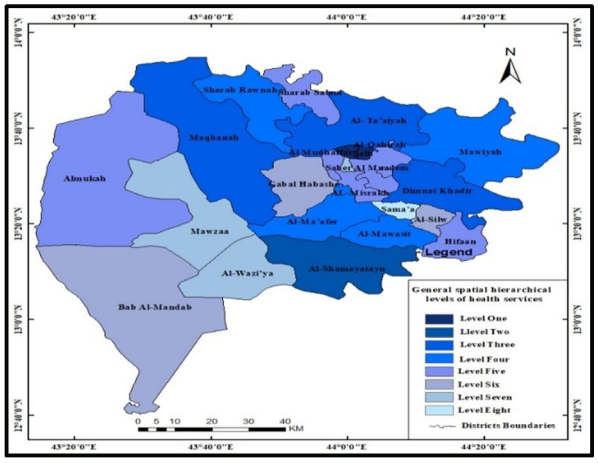


Fig. 4 Spatial hierarchical levels of components of public and private health services in Taiz Governorate according to the Scalogram analysis technique 2014, based on Table XII

VI. CONCLUSIONS

The Scalogram analysis provides a comprehensive overview of the hierarchical structure of healthcare components in Taiz Governorate for the year 2014. This analysis reflects the prevailing conditions and the level of healthcare service delivery during the pre-civil war period, as outlined below:

1) Spatial Hierarchical Structure: The analysis reveals eight spatial hierarchical levels across both public and private sectors, highlighting significant centralization issues, as well as deficiencies in governance and health planning in the provision of healthcare services in Taiz Governorate. Taiz City, comprising the three districts of Al-Qahirah, Al-Mudaffar, and Salh, is identified as the highest tier in the spatial health hierarchy, with a relative weight of 13%. This tier encompasses 12 out of 13 health service components, with the exception of one component: the rural hospital. Conversely, the Sama'a district ranks lowest, incorporating only five components of the general healthcare services.

2) Sectoral Hierarchical Levels: The analysis identifies eight sectoral hierarchical levels for the components of general healthcare services in both the public and private spheres. The initial level comprises four elements: nursing staff, pharmacies, drug stores, physicians, medical units, and medical centers. Collectively, these components account for an estimated 35.7% of the total healthcare service components within the governorate. At the final sectoral level, optometry and radiology represent the most limited components of healthcare services.

3) Public Healthcare Sector Hierarchy: Within the public healthcare sector, a hierarchy of four levels has been established. The first level includes nursing staff, physicians, medical units, and medical centers. Notably, the governorate hospital is positioned at the fourth level due to its absence across nineteen directorates. In contrast, the private healthcare sector is characterized by seven hierarchical levels, wherein pharmacies and drug stores occupy the foremost level, while optometry and radiology are relegated to the seventh level.

4) Spatial Hierarchical Structure of Public Sector Services: The spatial hierarchy in the public sector encompasses three hierarchical levels, with the Al-Shamayatayn district leading the first level by including all components of government healthcare services. In comparison, the last level consists of the directorates of Al-Ta'ziyah, Jabal Habashe, Al-Wazi'yah, Mawza'a, Mashrah and Hadnan, and Sama'a. For the private sector, the spatial hierarchy consists of eight levels, with the districts of Al-Qahirah, Salh, and Al-Mudaffar at the top level for encompassing all components of private healthcare services. Conversely, the districts of Al-Silw, Sama'a, and Bab Al-Mandab are categorized at the lowest level, where private healthcare services are limited to a single component: pharmacies and drug stores.

VII. ACKNOWLEDGEMENT

I want to thank the employees of the Health Office in Taiz Governorate, the Social Fund for Development, the Yemeni Red Crescent Society, and all the directors of public hospitals, health centers, and units in Taiz Governorate Yemen. I also thank the University of Taiz, Yemen, and the School of Earth Sciences, Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, India, for helping me develop and continue my studies and supporting my research.

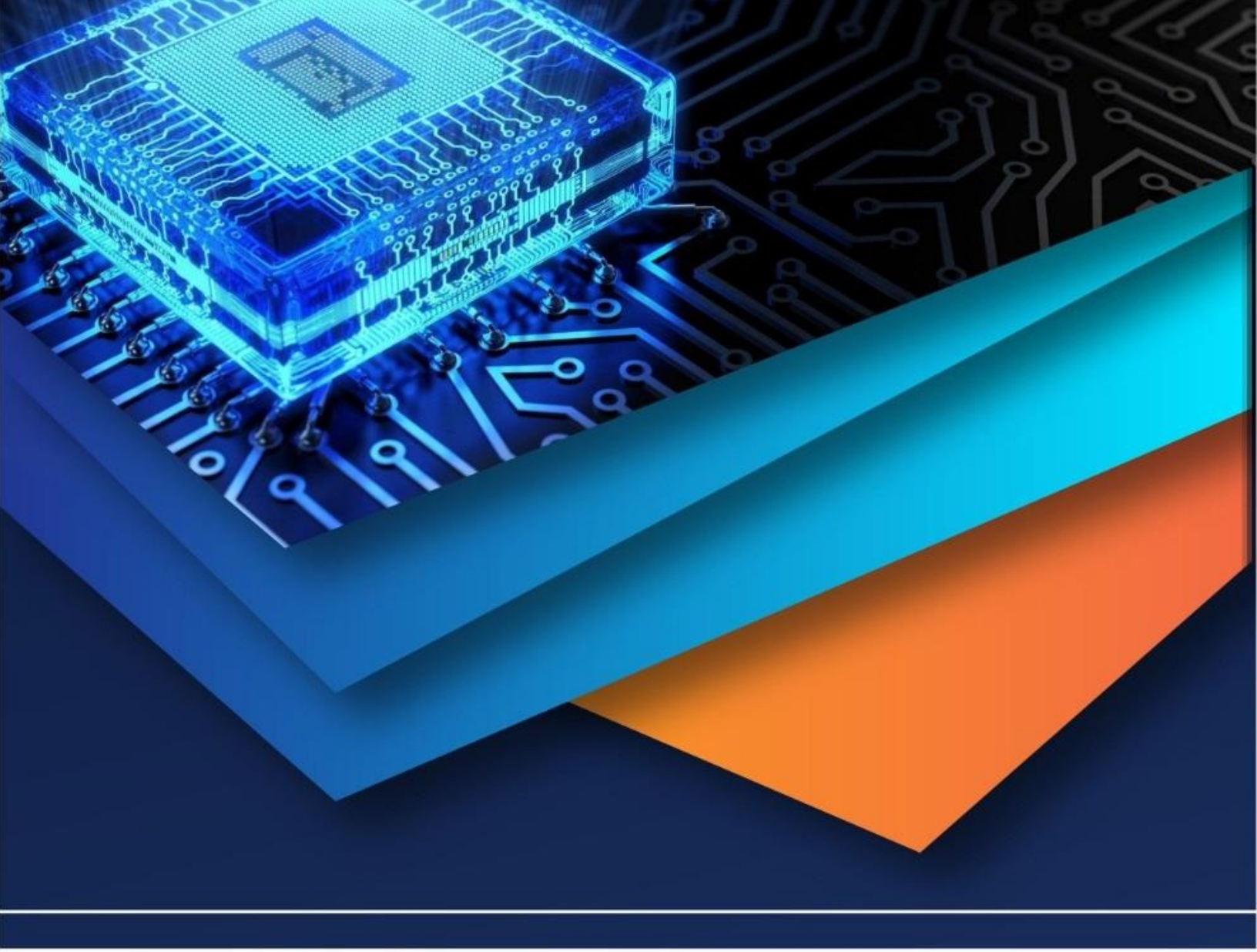
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