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A Survey of Urban Hierarchy System with Emphasis of Systematic Relations Between Cities (Case Study: Ardabil Province)

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Abstract: This paper attempts to present the urban hierarchy in Ardabil province (I.R. Iran) between 1986-1996-2006. During this period, the urban hierarchy of this province is unbalanced but improving. Regarding the political, economical and cultural aspects, Ardabil city (the center of the province) attracts more immigrants and this fact has made urban hierarchy not follow the Rank-Size Role. In 1986, the population of Ardabil (the most populated city) was 9 times more than Meshkinshahr (the second populated city)and 10 times more than Parsabad(the third populated city). Although in 1986, Parsabad was the third populated city but in 1996 it became the second city and the population of Ardabil was 6 times more than it. In 2006 urban hierarchy in province has improved and the population of the first city (Ardabil) has been 5 times more than the second city (Parsabad) and 7 times more than the third city (Meshkinshahr). The use of the other methods (such as Mehta Index and Entropy Index) also gives the same results. On the whole, the urban hierarchy in urban network of Ardabil province has been unbalanced but moving to be balanced during this period. Providing equal opportunities for every city of the province and presenting better services in small cities could help the optimal spatial hierarchy in this province.

Key words: Urban Hierarchy · Population · Ardabil Province

INTRODUCTION

Every city has own rule and importance. The cities during historical had established based on geographic factors, (topography and climate) -close to water scares-, military factors- the creation of industry and mines - existence of fertile plains and lands- it established by religion factors and cultural factors and then with playing its special rule replaced in regions and in relation with it perimeter cities replaced in to one " city network hierarchy" [1, 2].

Entirely "city network hierarchy" means that one region cities member's population are important and it rule then took gradually this hierarchy, continually. Effects by category of economical changes and human interferences in to nature. City hierarchy system was based on central places of ideas [3, 4].

In City hierarchy system, every city steps with numbers and determines variety activities and there is usually direct relation between numbers and variety of activities and city population, also which one city is in high categories and has more important working and most working, thus will has more people. One of the basic problems in region and place developing, place organism and lock of hierarchy is according to relation among residences. Because of this, determining and performance of hierarchy in residences is necessary to be in different levels because of disturbed population, activities, services and function in the best framework [5].

Nowadays urban population increase and problems relate to big cities, region attention has been to the best disturbed to the population of cities. Distribution of urban is desired in one city hierarchy system more important than limiting of one city in special measure and if the city hierarchy be suitable with their social function and economy function, the problem of city developing would be less than before it [6, 7].

Hierarchy of urban improvement is the best forms of place organize. Because of it cause in equable distribution economical function and services and appearance of different living ways in variety geographical environments. In this proportional distribution of urban city form smaller cities unit metropolis in contact with together function and cities measure is in contact with them functions [8].

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MATERIALS AND METHODS

In this paper, it has been tried to study hierarchy system of Ardabil province's cities base on 1986, 1996 and 2006 census using three models: the rank-size model, the Mehta's four cities index model and the entropy model. Finally, some comments have been presented to solve the problems.

Ardabil province is located on northwest of Iran. Its area is about 17867 km^2 that has been allocated 1.09 percent of total area of the country. Its center is Ardabil. According to the least divisions, it has 10 cities and 21 towns.

In 1986, Ardabil province had 1046234 population (42.5 percent is urban and 57.5 percent is rural) that is equivalent to 1.74 percent of country population.

City Hierarchy from the Rank-Size Rule: The rank-size rule is the oldest one that describes urban system. It is proposed by a Germany geographer, Felix Aurbach.

Aurbach explained that if we arrange settlements based on population, the n-th city population equals to $\frac{1}{n}$ the first urban [9]:

$$P_r = \frac{P_1}{r^q} \quad (1)$$

Which P_r is the r-th city population, P_1 is the primate city population, r is the r-th city rank, q is constant coefficient which is calculated as following equation:

$$q = \frac{\text{Log}\frac{P_1}{P_r}}{\text{Log } r} \quad (2)$$

According to Aurbach theory, there is a reversed relation between rank and size of cities. This rule was studied by other researchers such as Lokta, Goodrich, singer. At least, G.K. zipf described a logarithmic mathematical relation as [9]:

$$\text{Log } P_r = \text{Log } P_1 - q\text{Log } r \quad (3)$$

In this rule, q describes city size and the primate city dominant in urban organism. After Zipf, Richardson determined three urban organism according to q quantity: if q equals one (q=1), then city size distribution follows the rank-size rule. If q be less than one (q<1), then distribution form will be the primate city. If q be more than one, shows that the middle cities have more importance than before situations.

The hierarchy study of Ardabil province's cities show that urban organism in Ardabil province has more deviation in the size-rank rule. This variation is more in small cities and low level population. Tables 1, 2 and 3 show real amount of population and prosecutable quantity based on size- rank rule in the research years. The compression of tables shows that in this twenty years process, real amount of population is close to size-rank rule. In these tables real population has been prepared from corresponding to each national census

Table 1: Real size and rank-size theory of Ardabil province's cities (year 1986)

Rank	City population first to this city population	City name	Real population (year 1986)	Desired population in rank- size theory	Log R (x)	Log P (y)
1	1	Ardabil	281973	281973	0.000	5.450
2	9	Meshkin shahr	32459	140987	0.301	4.511
3	10	Parsabad	29438	93991	0.477	4.469
4	12	Khalkhal	23642	70493	0.602	4.374
5	14	Germi	19946	56395	0.699	4.300
6	28	Bilesavar	10078	46996	0.778	4.003
7	46	Givi	6121	40282	0.845	3.787
8	55	Namin	5138	35247	0.903	3.711
9	57	Lahrud	4977	31330	0.954	3.679
10	63	Nir	4449	28197	1.000	3.648
11	70	Hashtjin	4001	25634	1.041	3.602
12	72	Jafarabad	3922	23498	1.079	3.594
13	72	Kolur	3911	21690	1.114	3.592
14	72	Abi biglu	3910	20141	1.114	3.592
15	87	Sareen	3238	18798	1.176	3.510
16	91	Hir	3088	17623	1.204	3.490
17	138	Aslanduz	2042	16587	1.230	3.310
18	175	Razey	1607	15665	1.255	3.206
19	420	Tazekand ingut	672	14841	1.279	2.827

Table 2: Real size and rank-size theory of Ardabil province's cities (year 1996)

Rank	City population first to this city population	City name	Real population (year 1996)	Desired population in rank- size theory	Log R (x)	Log P (y)
1	1	Ardabil	340386	340386	0.000	5.532
2	6	Parsabad	60485	170193	0.301	4.782
3	7	Meshkin shahr	49787	113462	0.477	4.697
4	10	Khalkhal	35612	85097	0.602	4.552
5	12	Germi	28166	68077	0.699	4.450
6	26	Bilesavar	13253	56731	0.778	4.122
7	43	Namin	7852	48627	0.845	3.895
8	50	Givi	6805	42548	0.903	3.833
9	58	Jafarabad	5863	37821	0.954	3.768
10	67	Nir	5091	34039	1.000	3.707
11	71	Hashtjin	5065	30944	1.041	3.705
12	88	Abi biglu	4765	28366	1.079	3.678
13	93	Lahrud	3874	26184	1.114	3.588
14	95	Kolur	3662	24313	1.146	3.564
15	109	Sareen	3583	22692	1.176	3.554
16	109	Hir	3121	21274	1.204	3.494
17	120	Aslanduz	2838	20023	1.230	3.453
18	190	Razey	1788	18910	1.255	3.252
19	338	Tazekand ingut	1006	17915	1.279	3.003

Table 3: Real size rank-size theory of Ardabil province's cities (year 2006)

Rank	City population first to this city population	City name	Real population (year 2006)	Desired population in rank- size theory	Log R (x)	Log p (y)
1	1	Ardabil	418262	418262	0.0000	5.621
2	5	Parsabad	82256	209131	0.3010	4.915
3	7	Meshkin shahr	63655	139421	0.4770	4.804
4	11	Khalkhal	39754	104566	0.0602	4.559
5	14	Germi	28932	83652	0.6990	4.461
6	29	Bilesavar	14180	69710	0.7780	4.152
7	40	Namin	10456	59752	0..845	4.019
8	58	Givi	7261	52283	0.9030	3.861
9	58	Jafarabad	7178	46474	0.9540	3.856
10	68	Anbaran	6161	41826	1.0000	3.790
11	77	Nir	5460	38024	1.0410	3.737
12	80	Abi biglu	5242	34855	1.0790	3.719
13	81	Hashtjin	5145	32174	1.1140	3.711
14	91	Sareen	4599	29876	1.1460	3.663
15	105	Aslanduz	3791	27884	1.1760	3.599
16	141	Lahrud	2971	26141	1.2040	3.473
17	147	Kolur	2841	24604	1.2300	3.453
18	155	Hir	2707	23237	1.2550	3.432
19	221	Razey	1895	22014	1.2790	3.278
20	230	Tazekand ingut	1817	20913	1.3010	3.259
21	489	Korayim	854	19917	1.3220	2.931

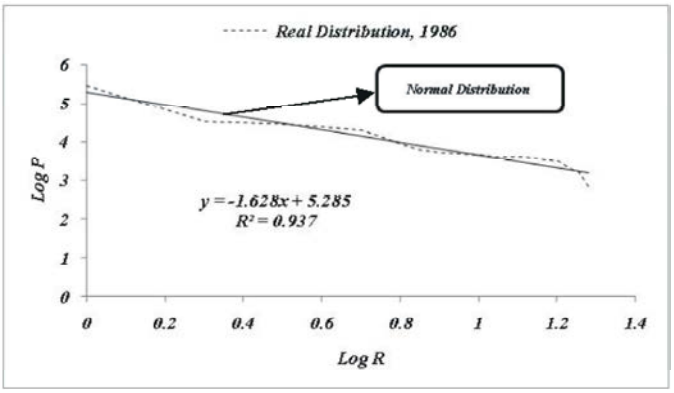

Fig. 1: Log-R vs Log-P of Ardabil provinces and its difference with normal distribution line in 1986

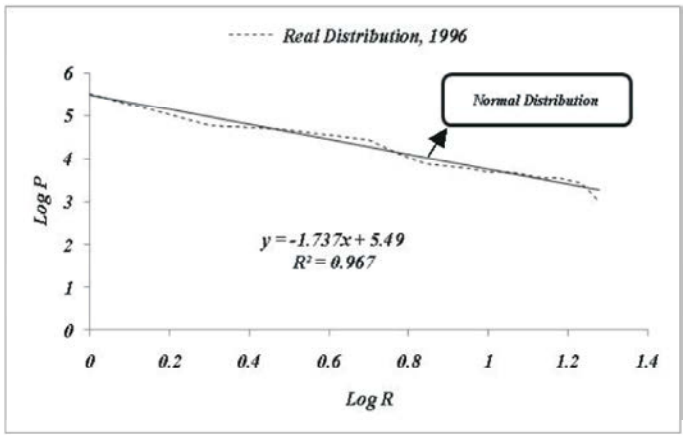

Fig. 2: Log-R vs Log-P of Ardabil provinces and its difference with normal distribution line in 1996

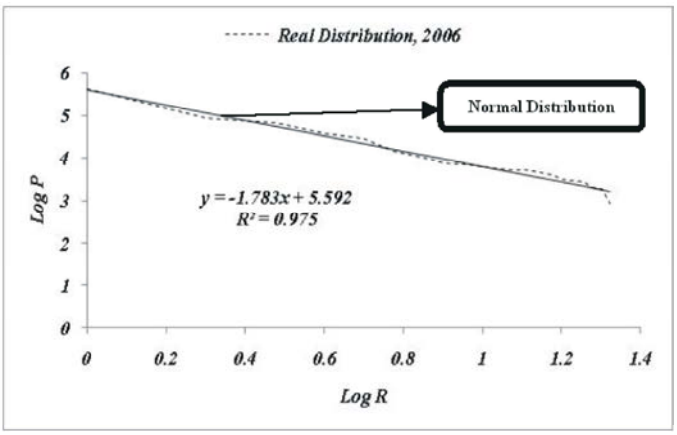

Fig. 3: Log-R vs Log-P of Ardabil provinces and its difference with normal distribution line in 2006

[10, 11, 12]. Also, as shown in Figures 1, 2, 3 differences between real distribution and Normal Distribution is decreasing from the year 1986 to the year 2006. The least difference is obtained in the year 2006.

This fact explains successful politics of government about protect of middle cities development for keeping and absorbing population. For example in the year 1986, the primate city of province has 9 times as much as the second city did and 10 times as much as the third city, while this variation has been reached to 5 and 7 times in the year 2006, respectively. In-continuity in the last row of the table is because of populated rural area conversion to urban one in recent years.

Amount of much population in Ardabil city, has led to high difference between Ardabil province cities population according to rank-size rule. During a ten years

period (1996-2006), 80000 people have been added to Ardabil population, whereas during this period only 20000 people have been added to the second city population. This difference describes in continuity. It seems that urban development in middle cities has been done according to available abilities and potentials and government persuasive policies. Centralization has led to this unwell proportioned development. So, not only middle cities support but also decentralization in Ardabil city is required.

Entropy Index Rule: This rule is a criterion to show a balance in a distribution. More high quantity shows a trend to a balance. Total form of this model is as the following equation:

$$H = -\sum_{i=1}^{n} P_i \, \mathrm{Ln} P_i \quad (4)$$

$$G = \frac{H}{\mathrm{Ln}\, K} \quad (5)$$

Which H is total frequency in neperian logarithm, P_i is the ratio of i-th city population to the total cities population, G is entropy amount and K is number of categories. H was calculated in the years 1986, 1996 and 2006 respectively as:

$$H_{1986} = -(-1.23) = 1.23,\ \mathrm{Ln}\, k = \mathrm{Ln}\, 6 = 1.79 \rightarrow G = \frac{1.23}{1.79} = 0.687$$

$$H_{1996} = -(-1.47) = 1.47,\ \mathrm{Ln}\, k = \mathrm{Ln}\, 6 = 1.79 \rightarrow G = \frac{1.47}{1.79} = 0.821$$

$$H_{2006} = -(-1.54) = 1.54,\ \mathrm{Ln}\, k = \mathrm{Ln}\, 6 = 1.79 \rightarrow G = \frac{1.54}{1.79} = 0.86$$

According to the model, whatever entropy index approaches to zero, indicating more centralization and lack of balance in population distribution and if approaches to one, indicating balanced regional distribution. Entropy index f or the years 1986, 1996 and 2006 was calculated 0.687, 0.821 and 0.86, respectively. These values show that Ardabil hierarchy is going to a balance situation.

Mehta Index: Mehta index is calculated via dividing the primate city population to total population of the 1-th to 4-th rank cities [8]:

$$\text{Mehta Index (MI)} = \frac{P_1}{P_1 + P_2 + P_2 + P_4} \quad (6)$$

If MI sets between 0.65 until 1, the level of the primate city is the most (high superior), if MI sets between 0.54 to 0.65, the level of the primate city is more (superiority), if MI sets between 0.41 to 0.54, the level of the primate city is desired and if MI sets less than 0.41, then the level of the primate city is the least one [8]. Amount of MI has been calculated for the years 1986, 1996, 2006 respectively as:

$$MI_{1986} = \frac{281973}{281973 + 32459 + 29438 + 23642} = 0.76$$

$$MI_{1996} = \frac{340386}{340386 + 60485 + 49787 + 35612} = 0.70$$

$$MI_{2006} = \frac{418262}{418262 + 92256 + 63655 + 39754} = 0.69$$

According to calculations, Ardabil city has been dominant in city organism during the time period. Also, the primate city hasn't been changed considerably during the year 1996 to 2006 and has obeyed high superior pattern. Of course, this number has been improved roughly as compared with the year 1986.

RESULT AND DISCUSSION

Determining indexes and application of quantity methods about settlement categorization in city systems causes not only lead to acquaintance of difference between settlements but also they can be used for determination of center, different types of services and adjustment of un-equivalency between settlements.

Based on materials discussed about ranking of Ardabil province cities according to three models (rank-size model, MI model, entropy index), Ardabil city was located on the top of the hierarchy pyramid and Parsabad and Meshkinshar were determined as main poles of Ardabil population. This type of cities makes needless their residents with concentration of service and possibilities.

About cities ranking, with due regard to population hierarchy, difference between province cities in the year 2006 is low due to the year 1996 but is high due to the year 1986. This is because of successful performance of centralization move and support of middle city development on behalf of the government.

More ever, low populated cities have had high ranking change and movement. It shows that some of smaller province cities have been successful in population absorption and ranking increase.

Ardabil city as center of province expands day a day and increase its problems. To prevent more problems and optimal distribution of population in all cities, support of small cities against high superior pattern of Ardabil city and balanced distribution of population province area can be proposed.

CONCLUSION

Final results show that although Ardabil city size has no strong agreement with above mentioned three models (rank-size method, MI model, Entropy index), but its trend is improving. On the other hand, this agreement has been improved from 1986 to 2006, significantly. It means that intensive policies about centralization and support of small cities development have been done correctly. Population absorption and ranking increase in small cities during 20 years has been implemented truly.

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