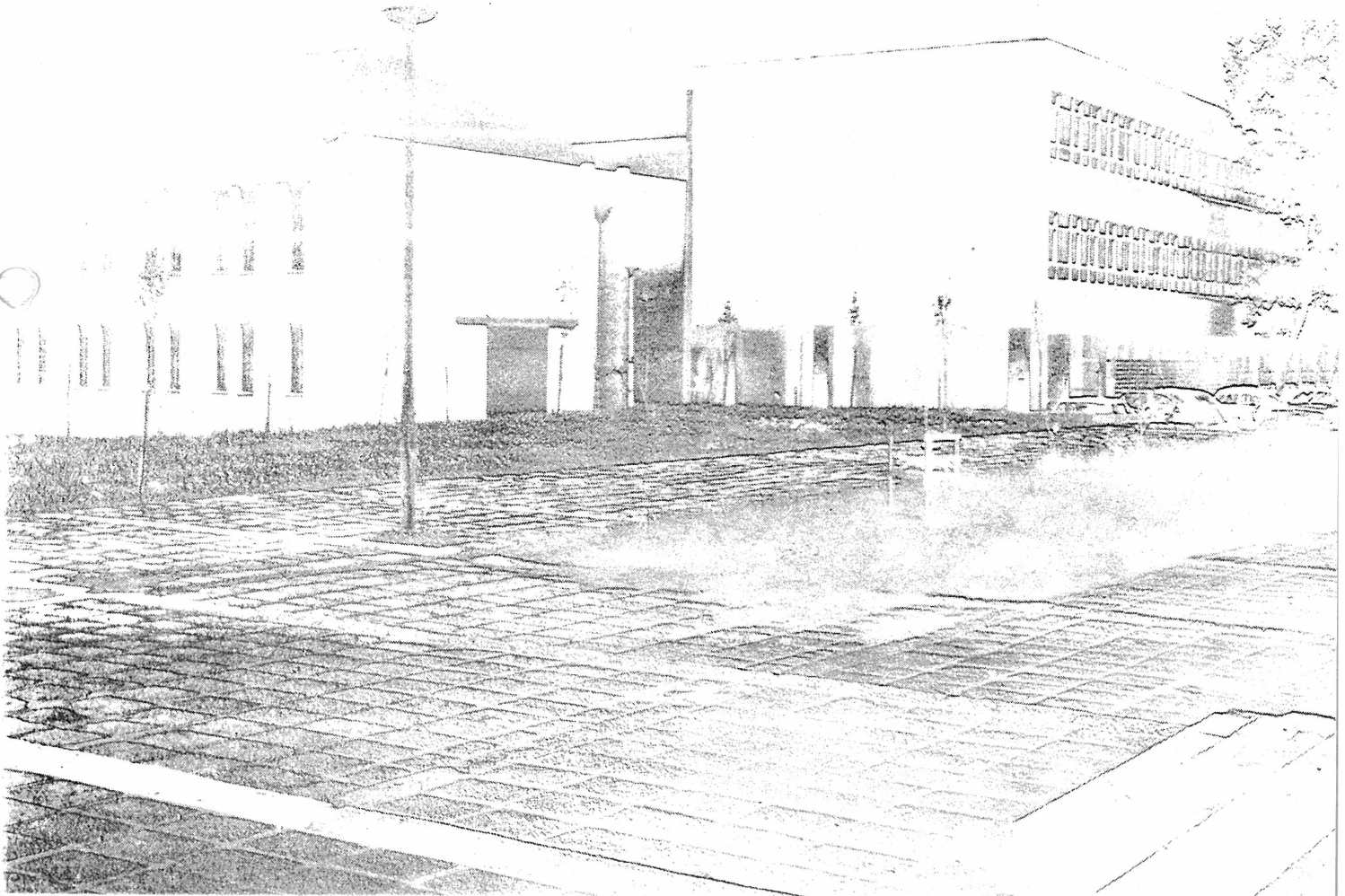


KARADENİZ TEKNİK ÜNİVERSİTESİ MİMARLIK BÖLÜMÜ
MİMARLIK BÜLTENİ
KARADENİZ TECHNICAL UNIVERSITY DEPARTMENT OF ARCHITECTURE



A METHOD FOR DETERMINING THE AREA OF INFLUENCES OF
CITIES IN THE TRABZON SUB-REGION OF EASTERN BLACK SEA:
FREQUANTATION APPROACH.

Dr. ŞİNASİ AYDEMİR

I. I

The aim of this study is to develop a method to delimit the area of influences of cities in the Trabzon Sub-Region of Eastern Black Sea in Turkey and to search for possibilities of redefining the existing boundaries of this region.

The region has been mainly a geographical concept, concerned mostly with physical space. While geography is concerned with partition and limitation of the space, it can also be defined as 'an area within which the combination of environmental and demographic factors have created a homogeneity of social structure.

Regions can be defined in terms of their areal associations such as uniform regions, or in terms of the functions performed in them. In this sense, a region is an area where people are bound together by mutual dependencies arising from common interests.

Geographical definitions of regions are more static, but definitions in terms of human activities such as flows of goods, information, etc., are more realistic and flexible and this give an opportunity for development. For this reason, we tried to redefine the region using human interaction or frequency of visits made different purposes. That delimits an accessible, reasonably large area termed as region. Then functional areas or regions are defined.

When one speaks of human interaction and density of frequency of visits among settlements, one also speaks of order among them such as rank-size or rank in terms of centrality in a given region. This sort of thinking brings in the problems of demarcation of boundaries among settlements or regions which may differ from legally defined boundaries. Functional classification of settlements and the hierarchy in the region that have been investigated in this study show the functional classification and specialization in the region in providing central functions. This gives a clear picture of the region under investigation

The methods of determining the regions differ with the aim and there are various techniques to deal with this problem. What is

intended here is to develop an interaction oriented frequentation model to show how people have access to urban services with least effort in a behavioural sense.

In this study an attempt was made to determine the area of influences of cities in the Trabzon Sub-Region. Ofcourse, there are many aspects of this study which have to be dealt with in sequence. Other aspects related to this study, such as population growth and accessibility, are studied.

The concept of region and regionalism and the techniques for definition of regional boundaries criticized in terms of their applicability and the data used. As a definition technique for regions, area of influences and the recent studies related to this are carefully reviewed. Theoretical and empirical studies are compared, such as classical central place studies and urban rank-size, gravity type models and catchment areas of centres. As an empirical study, functional classification of urban centres are briefly reviewed with qualitative and methods to show the urban hierarchy.

1.2

Studies in Turkey on regionalism and definition of regions are discussed in the light of general conclusions which were drawn from earlier studies. The need for a clear identification of functional (nodal) regions is expressed.

2.1

The Trabzon Sub-Region is studied in terms of urban and rural development since 1940. The region is one of the developing parts of the country, and the differences among urban areas are greater than rural areas, such as high density on the coastal part of the region and rapid population increase in urban areas against continous decline in rural population. While the number of urban centres is increasing (x), the number and the size of the rural centres are decreasing. Distribution of urban population by urban size is as follows:

% of tot. urban pop.	urban pop. size
7.5	less than 5000
26.3	5001-10000
28.1	10001-25000 (xx)
38.1	25001-over

x. The number of urban centers increased from 24 to 41 between 1940-1960

xx. Three major urban centers are: Trabzon: 97000, Giresun: 38000, Rize: 36000 pop.

By 1985, 47% of the region's population will live in urban centres as estimated by the state agencies.

2.2

There are over 2000 villages (rural centres) in the region and the distribution of total rural population by rural centre size is given in the following table

% of tot. rural pop.	rural centre pop. size
20.20	less than 500
36.70	501-1000
20.89	1001-1500
22.22	1501-over

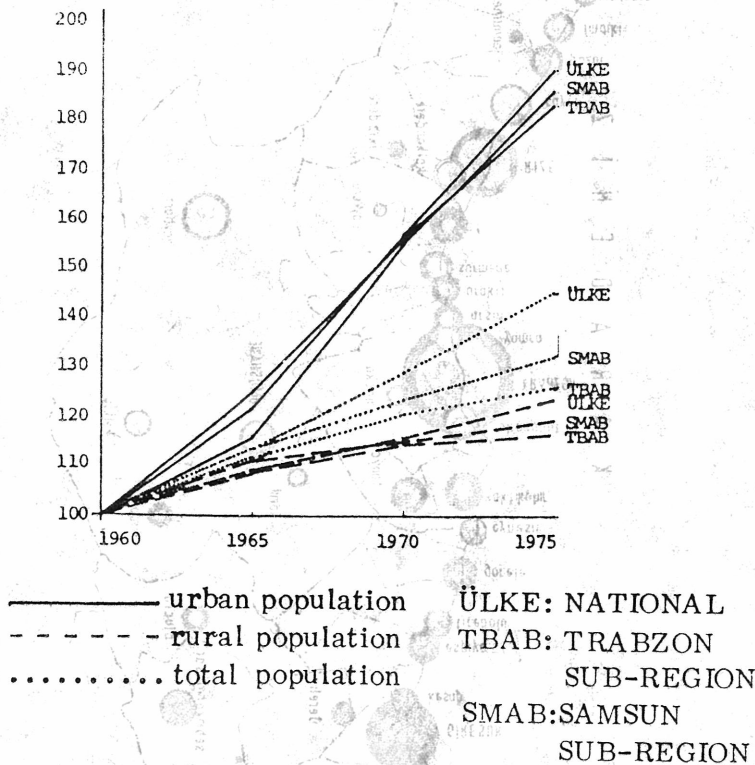


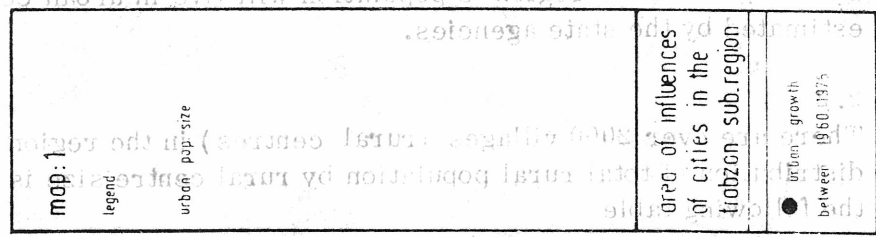
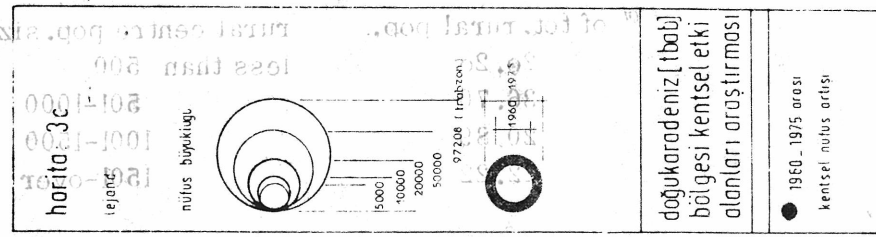
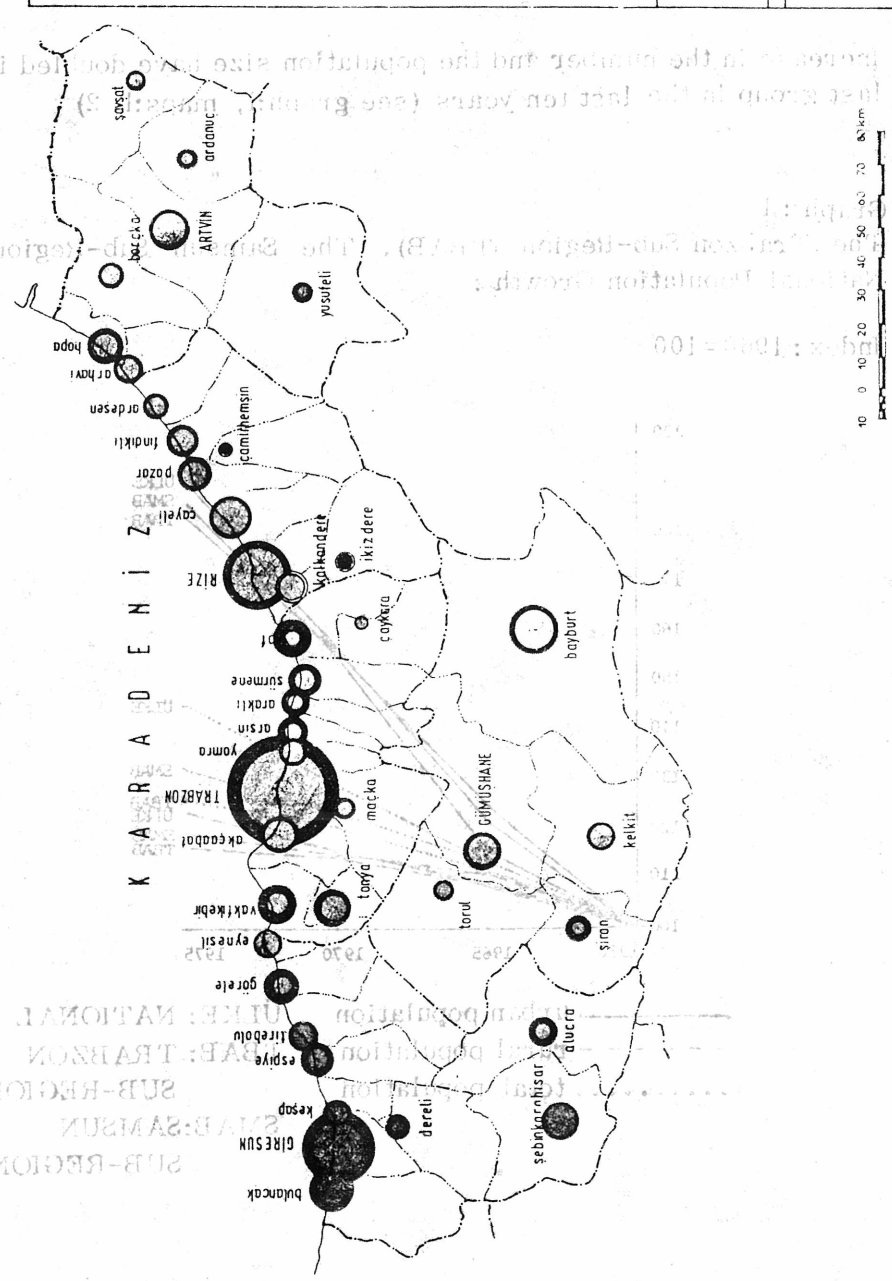
Increase in the number and the population size have doubled in the last group in the last ten years (see graph:1, maps:1, 2)

Graph : 1

The Trabzon Sub-Region (TBAB), The Samsun Sub-Region and National Population Growth :

Index : 1960=100





of the region's population will live in urban centres as

urban villages (rural centres) in the region and the rural population by rural centres is given in

of the rural pop. less than 500

1500-10000
10001-50000
501-1000
10001-50000
50000-97206 (Trabzon)

urban growth between 1960-1975

area of influences of cities in the Trabzon sub-region

urban growth between 1960-1975

area of influences of cities in the Trabzon sub-region

urban growth between 1960-1975

area of influences of cities in the Trabzon sub-region

urban growth between 1960-1975

area of influences of cities in the Trabzon sub-region

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area of influences of cities in the Trabzon sub-region

urban growth between 1960-1975

area of influences of cities in the Trabzon sub-region

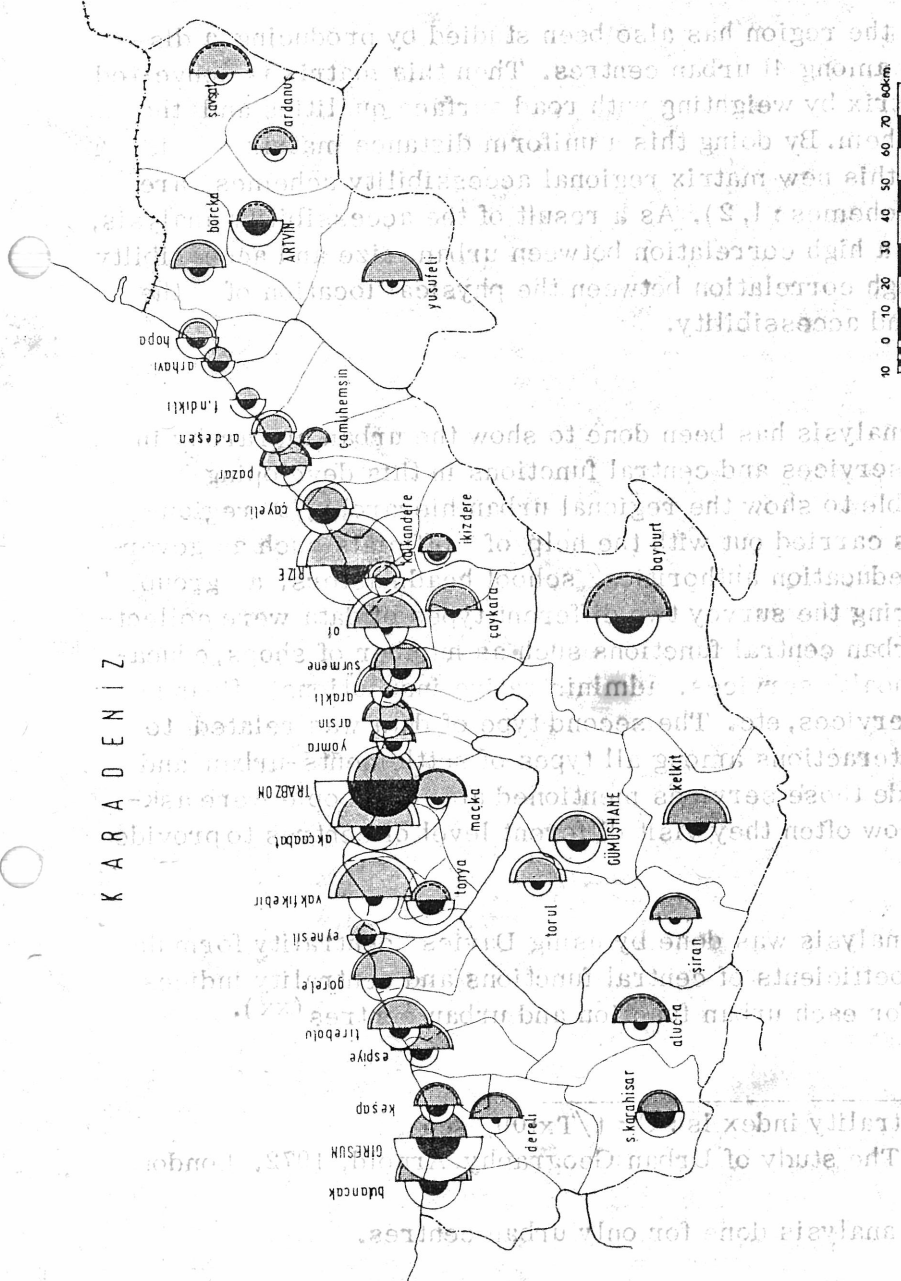
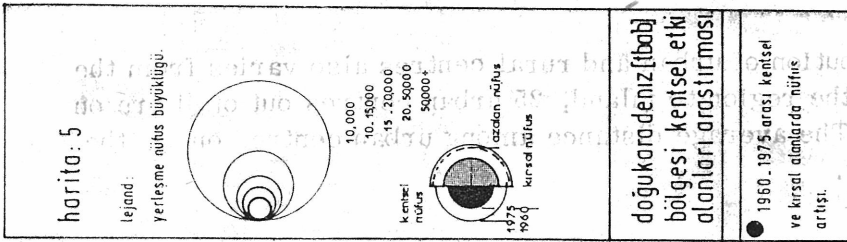
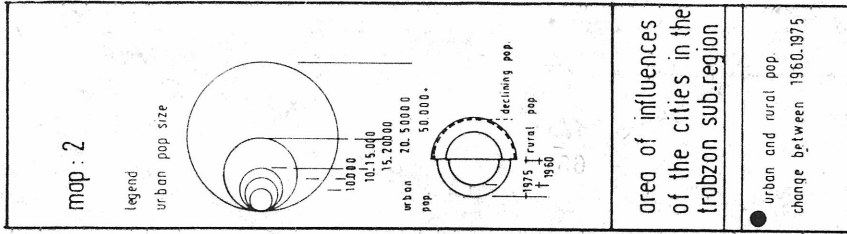
urban growth between 1960-1975

area of influences of cities in the Trabzon sub-region

urban growth between 1960-1975

area of influences of cities in the Trabzon sub-region

urban growth between 1960-1975



As a result of the centrality analysis five groups of central places

Physical distribution of urban and rural centres also varies from the coastal part of the region to inland, 25 urban centres out of 41 are on the coast line. The average distance among urban centres on the coast is 14.9km.

2.3

Accessibility in the region has also been studied by producing a distance matrix among 41 urban centres. Then this matrix is converted into another matrix by weighting with road surface qualities and the speed made on them. By doing this a uniform distance matrix is produced. With this new matrix regional accessibility schemes are produced (see schemes : 1, 2). As a result of the accessibility analysis, it was not found a high correlation between urban size and accessibility but there is a high correlation between the physical location of the urban centres and accessibility.

3.1

The centrality analysis has been done to show the urban hierarchy in terms of urban services and central functions in this developing region. To be able to show the regional urban hierarchy, a region-wide survey was carried out with the help of officials such as governors, mayors, education authorities, school headmasters, a group of students. During the survey two different types of data were collected related to urban central functions such as number of shops, education facilities, health services, administrative institutions, finance and insurance services, etc. The second type of data was related to the volume of interactions among all types of settlements—urban and rural - to provide those services mentioned above. People were asked where and how often they visit different level of centres to provide their needs.

The centrality analysis was done by using Davies' centrality formula (x). Location coefficients of central functions and centrality indices were produced for each urban function and urban centres^(xx).

(x) Davies' centrality index is: $C = t/Tx100$, see
Carter, H. The study of Urban Geography. Arnold, 1972, London.

(xx) Centrality analysis done for only urban centres.

3.2

As a result of the centrality analysis five groups of central places

were identified. The hierarchy among urban centres is as follows :

5. group centres : Trabzon
4. group centres : Rize, Giresun, Artvin
3. group centres : Vakfıkebir, Çayeli, Bulancak
2. group centres : Bayburt, Görele, Kelkit, Tirebolu, Akçaabat, Pazar, Arhavi, Tonya, Gümüşhane, Sürmene, Espiye.
1. group centres : Remaining 16 urban centres.

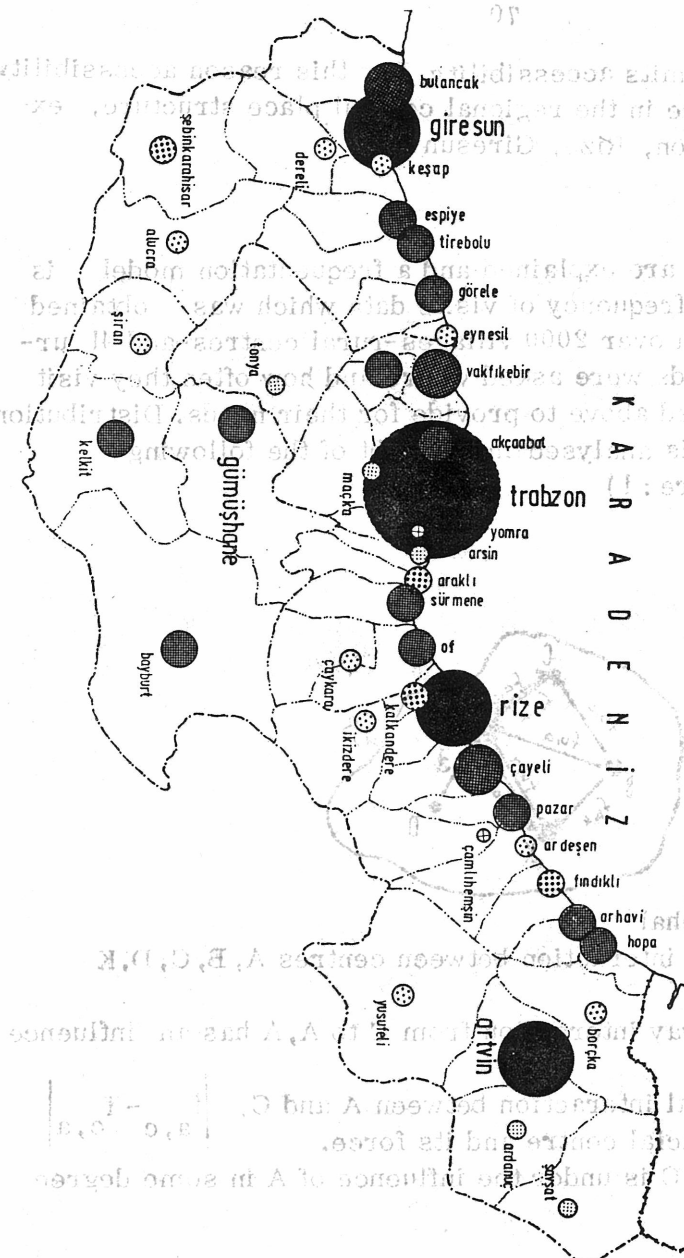
Grouping of urban centres by centrality was based on in-group and between group differences (see map : 3 table : 1) From this grouping the following correlations are found by regression analysis :

Urban centre size	/ no. of functional units. $r=0.936$
	/ no. of central functions. $r=0.842$
	/ centrality . $r=0.967$
Centrality	/ no. of functional units. $r=0.957$

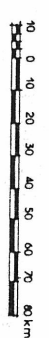
Table : 1. Urban Hierarchy by centrality indices.

$$C = t/T \times 100$$

Trabzon	2013	Arhavi	140	Yusufeli	62
Rize	642	Tonya	130	Keşap	61
Giresun	545	Gümüşhane	123	Şiran	60
Artvin	479	Sürmene	123	Dereli	54
Vakfıkebir	278	Espiye	115	İkizdere	51
Çayeli	259	Of	114	Çaykara	51
Bulancak	221	Şebinkarahisar	97	Şavşat	49
Bayburt	167	Fındıklı	95	Maçka	48
Görele	164	Araklı	90	Arsin	42
Kelkit	160	Kalkandere	79	Torul	39
Tirebolu	151	Borçka	75	Ardanuç	39
Akçaabat	147	Alucra	73	Yomra	22
Pazar	146	Eynesil	67	Çamlıhemşin	20
Hopa	142	Ardeşen	67		



K A R A D E N İ Z



harita:8	
legend:	
merkeziyetlik indeksleri:	
●	700+ (2013)
●	400-699
●	200-299
●	100-199
●	75-99
●	50-74
●	25-49
●	0-24
merkeziyetlik indekslerine göre kentsel kademeleme.	
döğükardenz [lho] bölgesi kentsel etki alanları arastırması.	

map:3	
legend:	
centrality indices:	
the urban hierarchy according to centrality indices.	
area of influences of cities in the trabzon sub-region	

Regional topography limits accessibility. For this reason accessibility does not play much role in the regional central place structure, except places like Trabzon, Rize, Giresun (x).

4.1

The area of influences are explained and a frequentation model is established. By using frequency of visits data which was obtained by questionnaires from over 2000 villages-rural centres-and 41 urban centres. Households were asked where and how often they visit those centres mentioned above to provide for their needs. Distribution of frequency of visits is analysed in the light of the following assumptions (see figure : 1)

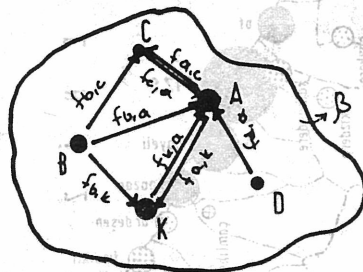


Figure : 1 A hypotheticalal region B and interaction between centres A, B, C, D, K

1. If there is one-way interaction from C to A, A has an influence on C.
2. If there is mutual interaction between A and C, $|f_{a,c} - f_{c,a}|$ show the influential centre and its force.
3. If $f_{c,a} > f_{a,c}$ C is under the influence of A in some degree or vice versa.
4. If $f_{c,a} = f_{a,c}$ C and A have equal influence (equal force).

Centre A may be in interaction with more than one centre like B, C, D, K. In this case total visits made to each centre (frequency of visits) can be found by the following equation :

$$F_A = \text{total frequency of visits made to A}$$

$$F_{\sqrt{A}} = \text{total frequency of visits made from A}$$

(x) Correlation between no. of accessible places from each urban centre and centrality is : $r = 0.369$

[not visible]	[not visible]
[not visible]	[not visible]

An origin-destination matrix based on the above assumptions is prepared. Each element of the matrix represents the frequency of trips between two urban centres. This matrix is multiplied by the degree of population each urban centre. The resulting matrix is then divided by the total population to obtain the matrix of influence.

$$F = \frac{f_{a,b} + f_{c,a} + \dots + f_{a,m}}{\sum_{b=1}^m f_{a,b}} = \sum_{b=1}^m \frac{f_{a,b}}{\sum_{b=1}^m f_{a,b}}$$

The centres in region B can be put in a hierarchy according to their field forces, and the area of influences can be presented by vectors connecting each centre (see figures: 2, 3).

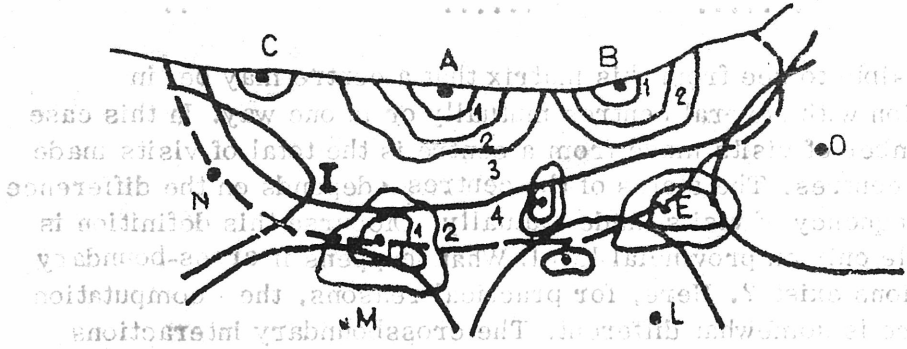


Figure : 2. Area of influences presented by vectors.

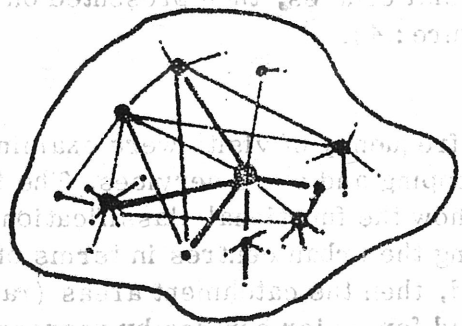


Figure : 3. Area of influences presented by vectors.

4.2

An origin-destination matrix based on the above assumptions is produced for computation of frequency of visits among centres. Each centre is identified by its census of population code number. This computation was done for all central functions to show functional specialization among them (see tables : 2, 3).

Table : 2 Origin -destination matrix

Central Functions	Origins of Visits	Destinations of Visits	Frequency of Visits (x)
f 111	0801.0.001	08	15
	0801.01.001	0805	18
	0801.01.001	61	10
	0801.01.001	0804.0.002	25

It is possible to see from this matrix that a centre may be in interaction with several centres mutually or in one way. In this case total number of visits made from a centre is the total of visits made to those centres. The status of the centres depends on the difference of the frequency of visits made mutually. Ofcourse this definition is applicable only on provincial level. What happens if cross-boundary interactions exist ? Here, for practical reasons, the computation procedure is somewhat different. The crossboundary interactions among centres in different provinces were calculated on the following two bases:

1. Interactions between centres in a province boundary are calculated in the matrix form as above, then presented on 1 : 100000 scale maps.
2. All cross-boundary interactions among the other centres are calculated additively either on the provincial centres, then directed to the final destination at the same level of provincial or sub-provincial centres, then presented on 1 : 500000 scale maps (see figure : 4).

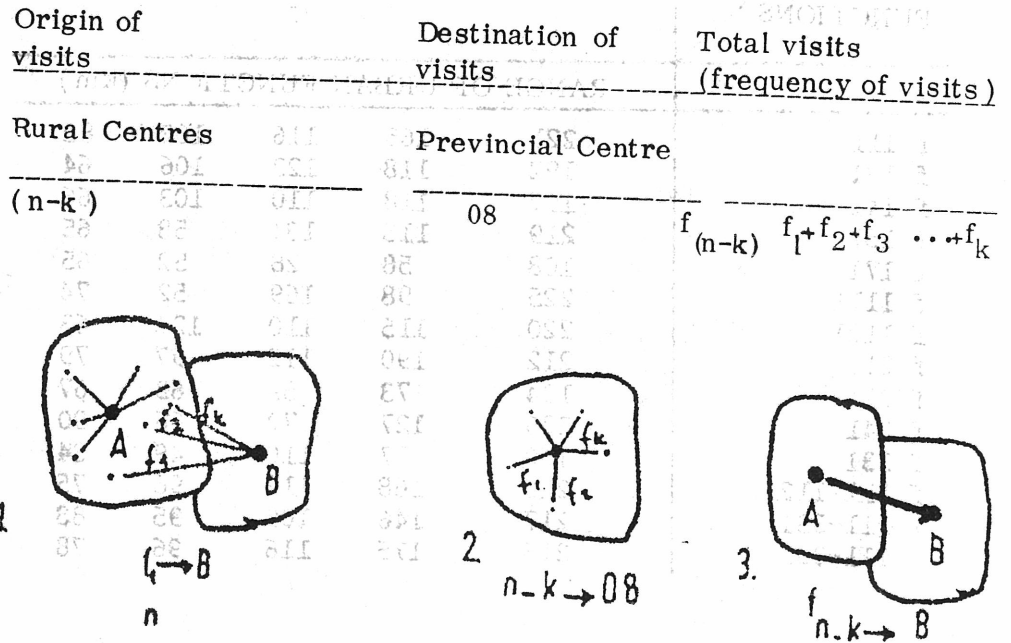
4.3

The distribution of frequency of visits were examined separately for each type of shopping and other services. The field force indices were produced to show the functional classification of urban centres. The hierarchy among the urban centres in terms of functional specialization were showed, then the catchment areas (range of goods and services) were found for major centres by regression analysis. Finally, additive field force indices were produced to show overall

(x): Visits made in the last two years.

functional specialization and the area of influences for all type of goods and services (see tables : 3, 4, 5, maps : 4, 5).

Figure : 4 Calculation of cross-boundary interactions.



Interaction from rural centres to province or sub-province

Interaction from province to province

Table : 3. Area of influences in distance. (Range of goods)

Centres	Regression equation	r	km.
Trabzon	$Y = 2999.93 - 13.46 X$	- 0.614	216
Rize	$Y = 2532.14 - 14.55 X$	- 0.448	175
Gümüşhane	$Y = 5779.36 - 49.77 X$	- 0.623	116
Giresun	$Y = 3698.70 - 38.55 X$	- 0.514	96
Artvin	$Y = 2131.23 - 26.98 X$	- 0.865	78
Bayburt	$Y = 12575.55 - 136.59 X$	- 0.874	91
Kelkit	$Y = 3024.38 - 23.22 X$	- 0.613	89
Pazar	$Y = 1390.79 - 17.07 X$	- 0.305	80
Şavşat	$Y = 3858.49 - 57.15 X$	- 0.864	66
Şiran	$Y = 4854.65 - 73.65 X$	- 0.719	65
Of	$Y = 4199.47 - 47.72 X$	- 0.517	52
Şebinkarahisar	$Y = 11385.42 - 275.57 X$	- 0.999	41
Vakfikebir	$Y = 9239.58 - 233.53 X$	- 0.703	40
Görele	$Y = 6097.83 - 193.26 X$	- 0.558	41

Table : 4. Functional area of influences of centres

URBAN CENTRES \ URBAN FUNCTIONS	TRABZON	RIZE	GÜMÜŞHANE	GİRESUN	ARTVIN
	RANGE OF URBAN FUNCTIONS (km)				
f 111	221	165	116	102	82
f 131	192	118	123	106	64
f 141	197	118	110	103	66
f 151	219	115	131	58	65
f 171	108	58	28	52	65
f 1111	225	98	169	52	74
f 1121	220	115	110	124	63
f 211	212	190	112	97	79
f 221	134	73	59	63	67
f 241	286	127	72	66	90
f 331	160	77	110	49	84
f 111-1121	215	168	112	96	75
f 211-331	217	146	109	95	88
f 111-331	216	175	116	96	78

Table : 3. Area of influences in distance (Range of goods)

Centres	Regression equation	r	km.
Görsle	$Y = 6097.83 - 193.26 X$	-0.258	41
Vakıflıkaplı	$Y = 2339.58 - 233.23 X$	-0.703	46
Sepikaralıhan	$Y = 17382.42 - 272.27 X$	-0.990	47
Of	$Y = 4199.47 - 47.72 X$	-0.217	52
Siran	$Y = 4854.62 - 73.62 X$	-0.719	62
Şavşat	$Y = 3828.49 - 27.12 X$	-0.864	66
Pazar	$Y = 1390.79 - 17.07 X$	-0.302	80
Kelkit	$Y = 3024.38 - 23.22 X$	-0.613	89
Bayburt	$Y = 12272.22 - 136.29 X$	-0.874	91
Artvin	$Y = 2131.23 - 26.98 X$	-0.862	78
Giresun	$Y = 3688.70 - 38.22 X$	-0.214	96
Gümüşhane	$Y = 2779.36 - 49.77 X$	-0.623	116
Rize	$Y = 2232.14 - 14.22 X$	-0.448	175
Trabzon	$Y = 2999.93 - 13.46 X$	-0.614	216

Table : 5. Regional urban hierarchy and grouping of centres by field force indices.

Urban centres	Field force indices = $\lambda^{(x)}$		Grouping
Trabzon	21.73	10.00 +	8
Rize	8.32		
Giresun	6.76	6.00 - 9.99	7
Bayburt	5.07		
Gümüşhane	4.76	4.00 - 5.99	6
Of	4.36		
Vakfikebir	3.97		
Görece	3.52	3.00 - 3.99	5
Şiran	2.72		
Şebinkarahisar	2.46		
Pazar	2.26	2.00 - 2.99	4
Kelkit	2.12		
Maçka	1.98		
Sürmene	1.93		
Çaykara	1.71		
Bulancak	1.66		
Espiye, Artvin, Şavşat	1.64		
Akçaabat-Araklı	1.58		
Alucra	1.37	1.00 - 1.99	3
Keşap-Tirebolu	1.32		
Ardeşen	1.20		
Arhavi	1.14		
Çayeli	1.10		
Fındıklı-Ardanuç	1.04		
Hopa	1.00		
Borçka	0.93		
Kalkandere	0.87		
Torul-Tonya	0.74	0.50 - 0.99	2
Eynesil	0.51		
Arsin	0.45		
Dereli	0.40		
Yusufeli-Ikizdere	0.36	0.00 - 0.49	1
Çamlıhemşin	0.34		
Yomra	0.28		

$$x \quad \lambda = \frac{F}{\sum F_1} \times 100$$

$$F = f_{111} + f_{131} + \dots + f_{331} = \sum_{111}^{331} f = \text{Frequency of visits made to any centre}$$

$$F_1 = \sum_1^{41} (f_{111} + \dots + f_{331}) = \sum_1^{41} \sum_{111}^{331} f = \text{Total frequency of visits in the region}$$

map : 4
 legend:
 density of the frequency of visits 1/2 years

state boundary
 regional
 provincial

urban pop size

aggregated field forces

area of influences of cities in the trabzon sub-region

density of the frequency of visits at the centres for the provision of daily, week, monthly needs.

harita: 20
 lejant

yerleşmeler arası toplam
 gi-gel frekansı yoğunluğu /aylık

200 100 50 0

devlet sınırı
 bölge sınırı
 il sınırı

yerleşme büyüklüğü
 50.000.000
 20.50.000
 10.20.000
 0-10.000

dogukaradeniz (tbob) bölgesi kentsel etki alanları araştırması

halkla ilgili araştırma ahi. yollarla kisit hizmetlerin karşılanma merkezleri ve frekans yoğunluk durumu (superpozit hal)

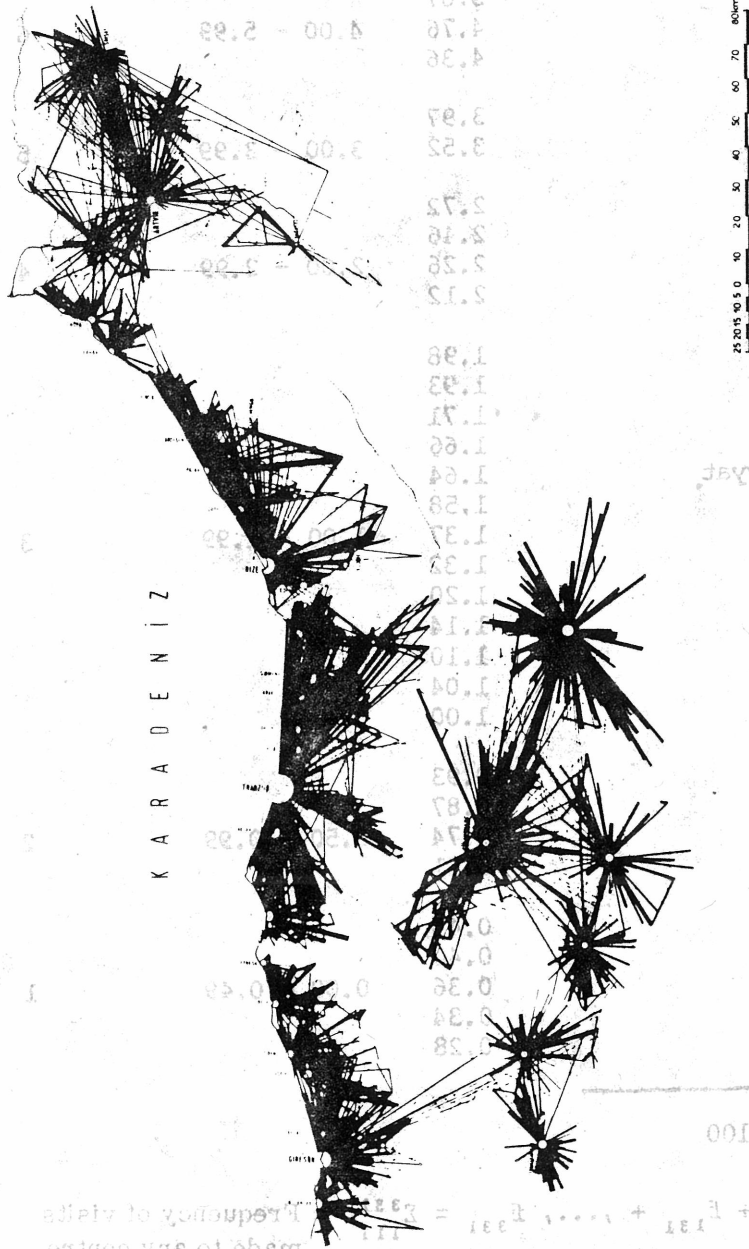


Table 2. Region of centres by field forces indices

City	Indices
Trabzon	5.07
Rize	4.70
Giresun	4.36
Bayburt	3.97
Görebirlik	3.52
Gözele	3.00
Göran	2.72
Sakirhan	2.46
Pazar	2.28
Kelkit	2.12
Taşköy	1.98
Sinop	1.93
Çaykara	1.71
Bulanık	1.66
Erzurum	1.64
Akçabucuk	1.58
Aluc	1.37
Keşap-Tirebolu	1.32
Ardeşen	1.20
Artvin	1.16
Çayeli	1.10
Erzurum-Ardeşen	1.04
Hopa	1.04
Borçka	0.93
Kalkandere	0.87
Tortum-Tortum	0.74
Yenişehir	0.74
Arslan	0.70
Dereli	0.60
Yarımcağzı	0.36
Çamlıhemşin	0.34
Yarımcağzı	0.28

$$x = \frac{F}{\sum F} \times 100$$

Total tendency of visits in the region

$$F = F_1 + F_2 + \dots + F_n$$

Tendency of visits made to any centre

$$F_i = \frac{F_i}{F} \times 100$$

map: 5

legend:
 density of the frequency of visits: 1/2 years

State boundary
 regional provincial

urban pop. size

1:111.331
 aggregated field forces

area of influences of cities in the trabzon sub-region

● intra-regional and inter-regional (cross-boundary) interactions

harita: 22

legend:
 yerleşmeler arası git-gel frekans yoğunluğu: 1/2 yıl

1200
 600
 200
 100

devlet sınırı
 bölge sınırı
 il sınırı

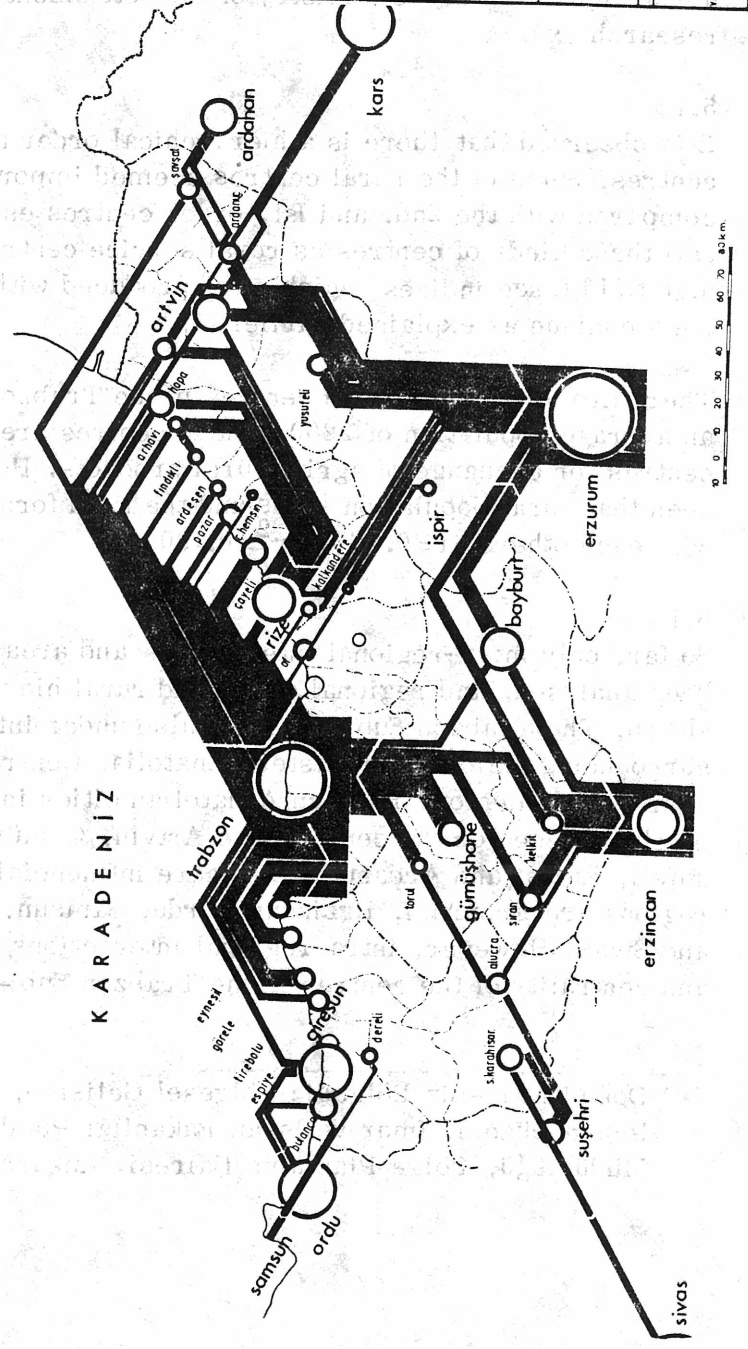
yerleşme büyüklüğü

50-100.000
 20-50.000
 10-15.000
 0-10.000

1:111.331

doğukaradeniz (tbab) bölgesi kentsel etki alanları arastırması.

● il sınırları içinde tbab ve tbab dışına yayılan frekans yoğunluk merkezleri



4.4

As a result of the additive field force indices it is possible to order and group the centres in the region as follows :

5th. order centres : Regional centre. Trabzon

4th. order centres : Competing centres. Rize-Giresun

3rd. order centres : Centres with limit-Of, Vakfıkebir, Görele,
ed influence. Ş. karahisar.

2nd. order centres : Self-contained Şiran
centres.

Ist. order centres : Dependant centres. Remaining 16 centres.

The hierarchical order among urban centres in the region was observed with the field force indices, is quite different from the hierarchy shown in the Ministry of Re-settlement and Construction's research (x).

5.1

It is observed that there is a hierarchical order among the rural centres. Some of the rural centres seemed important when they were compared with the 2nd. and Ist. order centres especially. Here, we call these kinds of centres as rural service centres with considerable high field force indices which were produced with the same data and the technique as explained earlier.

There are 42 rural service centres in the Trabzon Sub-Region with an average population of 2200. These centres are also rural market centres for exchange of agricultural products. Here, it was not seen that rural population sizes and the field force indices correlate with each others ($r=0.346.$, $r^2=0.120$)

6.1

So far, only intra-regional interactions and area of influences have been analysed, and regional urban and rural hierarchy have been shown. The Trabzon Sub-Region is also under influence of the surrounding regions like Eastern Anatolia, Central Anatolia and the Samsun Sub-Region. Eastern Annatolian cities in particular have much influence on the centres like Artvin, Gümüşhane, Bayburt, Yusufeli, Şavşat and Ardanuç. The more influential centres in those regions are Erzurum, Erzincan, Ordu, Samsun, Ardahan, Suşehri and Sivas. However, intra-regional interactions depend on the size and centrality of the centres in the Trabzon Sub-Region.

(x) Doğu Karadeniz Bölgesi: Bölgesel Gelişme, Şehirleşme ve Yerleşme Düzeni. İmar ve İskan Bakanlığı Planlama ve İmar Genel Müdürlüğü, Bölge Planlama Dairesi. Ankara, 1972

Since the centres are bigger in population size and more accessible to the other centres in the region, they are also dependant on the neighbouring regions ($r = 0.502$). Inter-regional interactions and the frequency of visits determine the area of influences of the Trabzon Sub-Region, especially at the cross-boundaries (x) (see map 5).

7.1 RESULTS :

In this study an attempt has been made to show the area of influences in the Trabzon Sub-Region. The methods used are Davies' centrality index and the frequantation model based on the frequency of visits made among the centres.

The service centres are identified and the urban hierarchy is established according to the services provided by them. The functional specialization among the centres in the region is also shown by the location coefficients of central functions.

- . Trabzon is a regional centre according to its importance in terms of central functions provided.
- . Rize and Giresun are two competing centres at the same level.
- . Vakfikebir, Çayeli, Bulancak have considerable potential in terms of services provided in them.
- . The regional potential in terms of central functions performed among the urban centres are aggregated on the coastline rather than inland.
- . Centrality seemed as a function of the urban size and the central functions.
- . Centrality seemed as a function of accessibility; the higher the accessibility the more the centrality.

The analysis of the frequency of visits made among the urban centres showed a somewhat different urban hierarchy and functional specialization above mentioned. Regression analysis showed the range of goods and services from each urban centre. The main conclusions of the analysis are :

- . Trabzon is the most specialized centre in the region : regional centre.
- . The functional specialization among the other centres varies in the region. There are some self-contained urban centres such

There is a negative correlation between urban size and interregional frequency of visits ($r = 0.266$)

as Rize and Giresun.

- The regional functional specialization among the centres is seen in the provision of goods, building materials, personal services and health services.
- There are about 42 rural service centres, some of which act at the same level with some of the 2nd. and 1st. group centres in the regional urban hierarchy.

Finally, it is possible to put threshold limits for urban functions and services which are necessary for planning purposes. The functional specialization among the urban centres should accelerate as a regional policy. The Trabzon Sub-Region can be divided in two sub-regions, and the regional boundaries can be re-drawn as seen map 6.

The service centres are identified and the urban hierarchy established according to the services provided by them. The functional specialization among the centres in the region is also shown by the location coefficients of central functions.

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The analysis of the frequency of visits made among the urban centres showed a somewhat different urban hierarchy and functional specialization above mentioned.

The main range of goods and services from each urban centre. The main conclusions of the analysis are:

This is a summary of:
Doğu Karadeniz Bölgesi Trabzon Alt Bölgesi (TBAB) Kentsel Etke Alanlarının Saptanması İçin Bir Yöntem: Etkileşim Esası. İTÜ. Mimarlık Fakültesi, Karadeniz Matbaacılık ve Gazetecilik A.Ş., Trabzon, 1978.

There is a negative correlation between urban size and interregional frequency of visits ($r = -0.288$)

