GOING-OVER HEALTH PERFORMANCE IN PUNJAB: DISTRICT AND DIVISION WISE ANALYSIS.

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Introduction

Access to health care is basic human need. A healthy population forms efficient and productive work force that plays important role in economic development. That is the reason almost all the SDGs are directly or indirectly related to health.

Health is the most indispensable factor in social sector, which plays a major contribution in the overall economic well-being of any country Bloom et al, (2001).

Akram et al, (2008) found that there is significant impact of health on economic development in case of Pakistan. So, it is essential to have a better health structure for contributing in the economic activity.

There are budgetary constraints in Pakistan just like many developing economies, so there is need to efficiently use the available resources. For this purpose there is need to assess the existing efficiency level for effective policies.

In Pakistan, implementation of health policies devolved to the provinces in 2010 after the 18th Amendment. Punjab is the most populous Province of Pakistan with more than fifty percent of the population of the country.

Health care system in Punjab consists of: Health department, Population Welfare Department (PWD), Public Health Engineering Department (PHED) and Local Government & Community Development Department (LGCDD), so these departments are supposed to take care of health care system and make efficient use of available resources. It is well known that common purpose of efficiency assessment is to determine whether entities are employing their resources in the most efficient way or not.

The purpose of measuring efficiency is to compare the different units, the earlier level of efficiency with the existing level of efficiency, the planned efficiency with the actual efficiency level or performance can be measured by comparing the efficiency of entities functioning under the similar conditions (Wholey & Hatry, 1992).

Profit maximization, cost minimization or output maximization are the formal criterion for measuring the efficiency. An organization or entity is recognized as technically efficient, if the maximum output is produced from a given set of inputs or specific amount of output is produced from minimum set of inputs.

There are two common approaches, which are used to measure the efficiency: parametric and nonparametric.
Parametric technique (stochastic frontier analysis (SFA)) was developed by Aigner et al. (1977), and Meeusen and Broeck (1977).
Non-parametric technique, which is also famous as linear programming models of Charnes et al. (1978) and Fare et al. (1985), known as data envelopment analysis (DEA).
Both techniques have some restrictions; an explicit functional form is required by SFA while DEA does not require this condition.

Simar and Wilson (1998, 2000) recognized several restrictions with respect to the simple DEA approach i.e. these DEA models do not incorporate the data generating process (DGP) and the efficiency estimates by DEA are serially correlated. So, the general DEA estimates are statistically invalid because of these two main flaws. Simar and Wilson (2000) also explored that DEA efficiency estimates are exaggerated.

In case of these limitations, Simar and Wilson (1998, 2000) proposed an alternative estimation and statistical inference procedure based on a DEA bootstrap approach which is still a significant approach in case of finding the bias corrected T.E efficiency scores.

In this study, the DEA bootstrap is employed for analysis. The aim of this study is to evaluate the technical efficiency (T.E) of each district of Punjab by considering each district as an entity or decision-making unit (DMU).

Methodological Framework and Data Collection

We are employing DEA bootstrap technique to measure the bias corrected estimates of technical efficiency of 35 districts of Punjab by considering each district as one decision making unit (DMU).

We are using the output oriented variable returns to scale (VRS) model for getting the efficiency scores. which is due to understanding of the market constraints within the districts of Punjab, it may be suitable when it is not possible to assume that all observed units are operating at an optimal scale (Banker, Charnes, and Cooper 1984)

The choice of relevant inputs and outputs in estimating the efficiency of health care system is very important. As suggested by Afonso and Aubyn (2005), efficiency results may be sensitive to the type of inputs used. Therefore, effort has been made to select the more relevant variables.

In this study three inputs: no of public sector doctors in each district, no of public sector nurses in each district and no of beds in public sector health institutions. These inputs have been used in existing literature for example see (change et al, 2004; Gannon, 2005; Moshiri et al., 2011; Rasool et al, 2014; Mantranga and spienza, 2015).

Two outputs: infant mortality rate and under five mortalities have been used. Same have been used by (Novignon and Lawanson, 2017). The data on inputs and outputs is collected from the Health Department of Government of Punjab and from Punjab Development Statistics (MICS) 2007, 2011 and 2014.

Inputs	Doctors	Total number of doctors working in public institutions of each districts of Punjab
	Nurses	Total number of Nurses working in public institutions of each districts of Punjab
	Beds	No. of Beds in all public health care centers and hospitals of each district of Punjab
Outputs	Infant mortality	Probability of dying between birth and the first birthday among 1000 birth.
	Under five mortalities	Probability of dying between birth and under first five years among 1000 birth.

Regression Analysis

After calculating the efficiency scores, at the second stage, the determinants of efficiency have been explored. For this purpose, efficiency scores have been put into panel data consisting of efficiency scores of 2007, 2011 and 2014, following model has been developed for this purpose

$$Y_{it} = K_{it}\,\beta + W_i\,\alpha + \varepsilon_{it}$$

Where i = cross section dimension = 1, 2, 3… 35, t = time series dimension= 2007, 2011, 2014.

$\mathbf{Y_{it}}$ = Efficiency score of i^{th} district in t^{th} year , is the dependent variable

$\mathbf{K_{it}\,\beta}$ = Matrix of regressors containing: district wise health expenditures, district wise literacy rate, district wise unemployment rate, availability of improved drinking water and sanitation, district wise total number of reported crimes (murder, attempted murder, docaity, robbery, kidnaping, theft), it has been used as a proxy for governance structure, if there is very high frequency of such crimes it indicates that there is bad governance and vice versa. The data of these variables have been collected from health department and Punjab Development Statistics 2007, 2011 and 2014.

Empirical Analysis

The results are obtained after 2500 bootstrapped iteration. In this study, output oriented DEA Bootstrap technique is applied, so if the efficiency score is 1 that means specific district is fully efficient while, if the estimated efficiency score is less than 1, then it will define that specific district is inefficient or less efficient.

In case of output oriented model, different set of output is produced by utilizing same set of inputs. So, for minimizing the inefficiencies, maximum level of output should be obtained with the fixed set of inputs. Table in next slide represents biased corrected efficiency scores.

Year	2007			2011			2014			Mean	Mean Rank	Mean Rank
Districts	BC	Rank	Division	BC	Rank	division	BC	Rank	division	District	District	Division
Bahawalpur	0.929	1	0.809	0.692	9	0.715	0.703	8	0.700	0.774	2	0.741
B. Nagar	0.723	11	(1)	0.707	4	(2)	0.675	10	(2)	0.702	9	(2)
RY Khan	0.775	5		0.747	3		0.722	4		0.748	3	
DG Khan	0.563	26	0.664	0.613	16	0.608	0.764	3	0.687	0.647	14	0.653
Layyah	0.614	21	(4)	0.548	23	(4)	0.672	11	(3)	0.611	18	(4)
M. Garh	0.710	12		0.704	7		0.707	7		0.707	7	
Rajanpur	0.769	6		0.569	20		0.603	17		0.647	13	
Faisalabad	0.660	15	0.644	0.569	21	0.607	0.584	19	0.617	0.604	20	0.623
Jhang	0.753	10	(5)	0.643	14	(5)	0.662	14	(5)	0.686	10	(5)
TT Singh	0.519	29		0.610	17		0.603	18		0.577	22	
Gujranwala	0.615	20	0.575	0.498	29	0.508	0.532	30	0.548	0.548	27	0.544
Gujrat	0.586	23		0.437	32		0.418	33		0.481	32	
Hafiz Abad	0.618	19	(8)	0.534	26	(8)	0.552	27	(7)	0.568	24	(8)
M. Bahaudin	0.557	28		0.524	27		0.566	24		0.549	26	
Narowal	0.565	25		0.511	28		0.555	26		0.544	28	
Sialkot	0.509	30		0.542	24		0.667	12		0.572	23	
Lahore	0.495	31	0.640	0.401	33	0.572	0.381	34	0.545	0.426	34	0.586
Kasur	0.626	18	(6)	0.644	13	(7)	0.663	13	(8)	0.644	16	(7)
N. Sahib	0.760	9		0.651	11		0.559	25		0.657	12	
Sheikhupura	0.680	13		0.593	18		0.579	21		0.617	17	
Multan	0.449	32	0.696	0.617	15	0.642	0.582	20	0.662	0.550	25	0.667
Khanewal	0.767	8	(3)	0.561	22	(3)	0.779	2	(4)	0.703	8	(3)
Lodhran	0.769	7		0.687	10		0.577	22		0.678	11	
Vehari	0.800	4		0.702	8		0.709	6		0.737	4	
Sahiwal	0.804	3	0.783	0.706	6	0.778	0.690	9	0.764	0.733	5	0.775
Okara	0.671	14	(2)	0.772	2	(1)	0.720	5	(1)	0.721	6	(1)
Pakpattan	0.873	2		0.856	1		0.880	1		0.870	1	
Rawalpindi	0.346	35	0.434	0.387	35	0.445	0.337	35	0.497	0.356	35	0.459
Attock	0.386	34		0.538	25		0.652	15		0.526	30	
Chakwal	0.560	27	(9)	0.456	31	(9)	0.468	31	(9)	0.495	31	(9)
Jhelum	0.444	33		0.398	34		0.532	29		0.458	33	
Sargodha	0.584	24	0.620	0.707	5	0.605	0.541	28	0.555	0.611	19	0.593
Bhakkar	0.647	17	(7)	0.649	12	(6)	0.640	16	(6)	0.645	15	(6)
Khushab	0.591	22		0.592	19		0.571	23		0.585	21	
Mianwali	[illegible]	16		[illegible]	30		[illegible]	32		[illegible]	29	

Summary Statistics (2007)

Percentiles		
1%	0.345	Mean 0 .639
5%	0.385	Min 0 .345
10%	0.448	Max 0.928
25%	0.559	Std. Dev. 0.134
50%	0.625	
75%	0.759	
90%	0.800	
95%	0.873	
99%	0.928	

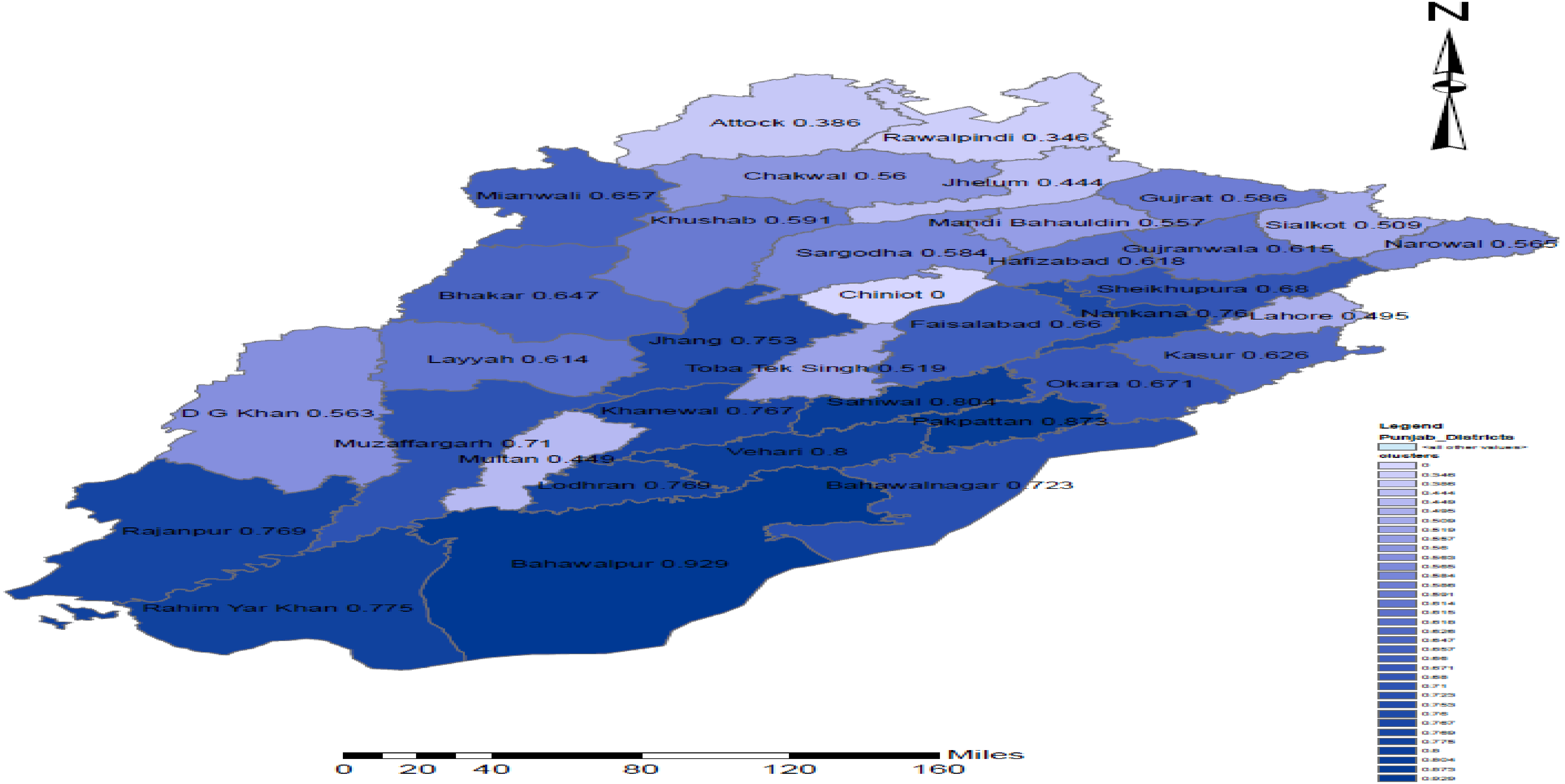
Summary Statistics (2011)

Percentiles		
1%	0.387	Mean 0.595
5%	0.398	Min 0.387
10%	0.437	Max 0.856
25%	0.524	Std. Dev. 0.112
50%	0.593	
75%	0.692	
90%	0.707	
95%	0.773	
99%	0.856	

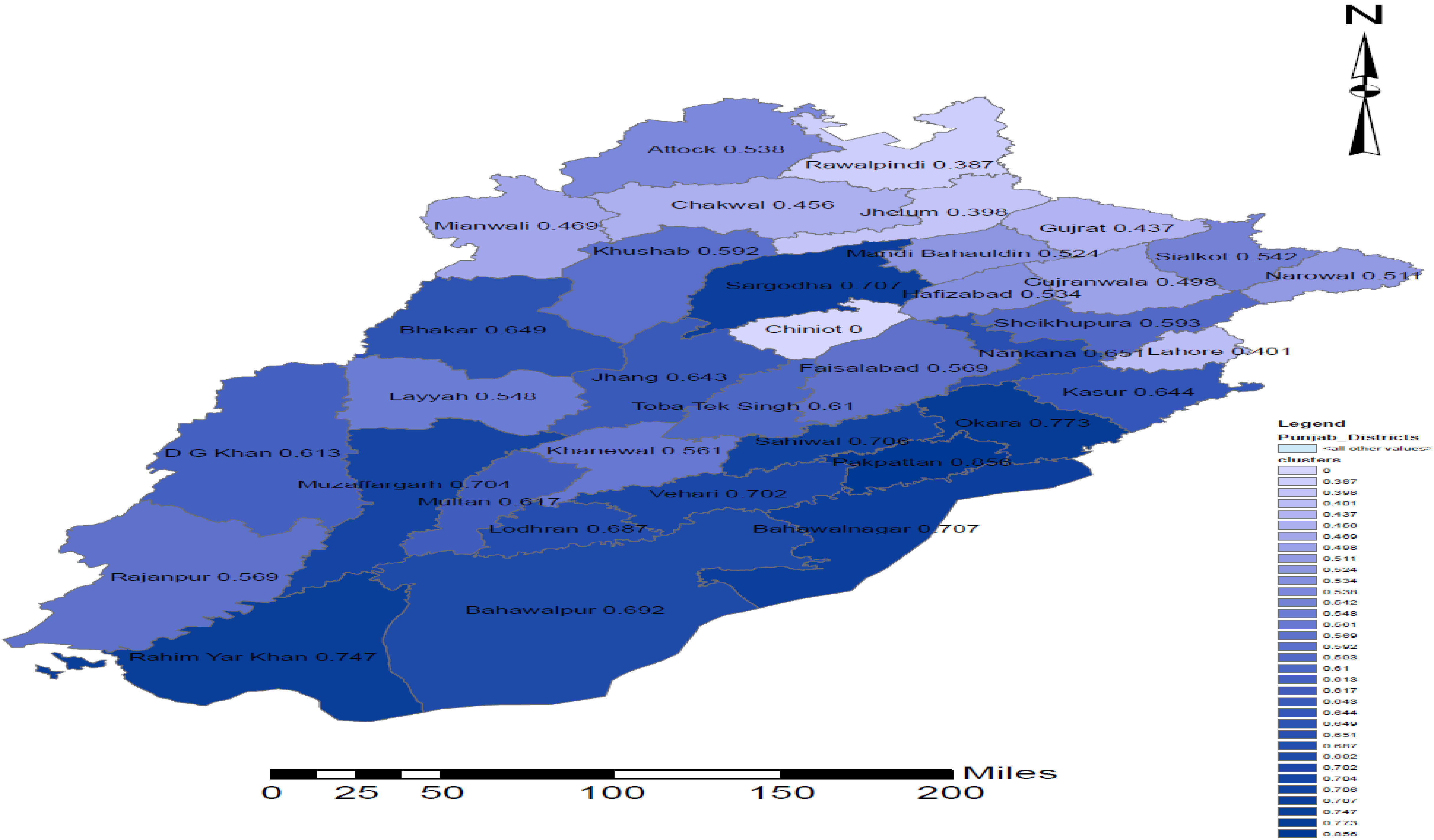
Summary Statistics (2014)

Percentiles			
1%	0.337	Mean	0.608
5%	0.381	Min	0.337
10%	0.466	Max	0.880
25%	0.552	Std. Dev.	0.113
50%	0.603		
75%	0.690		
90%	0.721		
95%	0.779		
99%	0.880		

Cartography 2007



2011


N
Attock 0.538
Rawalpindi 0.387
Chakwal 0.456
Jhelum 0.398
Mianwali 0.469
Gujrat 0.437
Khushab 0.592
Mandi Bahauldin 0.524
Sialkot 0.542
Narowal 0.511
Sargodha 0.707
Gujranwala 0.498
Hafizabad 0.534
Bhakar 0.649
Chiniot 0
Sheikhupura 0.593
Nankana 0.651
Lahore 0.401
Faisalabad 0.569
Jhang 0.643
Layyah 0.548
Kasur 0.644
Toba Tek Singh 0.61
Okara 0.773
D G Khan 0.613
Khanewal 0.561
Sahiwal 0.706
Pakpattan 0.856
Muzaffargarh 0.704
Multan 0.617
Vehari 0.702
Lodhran 0.687
Bahawalnagar 0.707
Rajanpur 0.569
Bahawalpur 0.692
Rahim Yar Khan 0.747
Legend
Punjab_Districts
<all other values>
clusters
0
0.387
0.398
0.401
0.437
0.456
0.469
0.498
0.511
0.524
0.534
0.538
0.542
0.548
0.561
0.569
0.592
0.593
0.61
0.613
0.617
0.643
0.644
0.649
0.651
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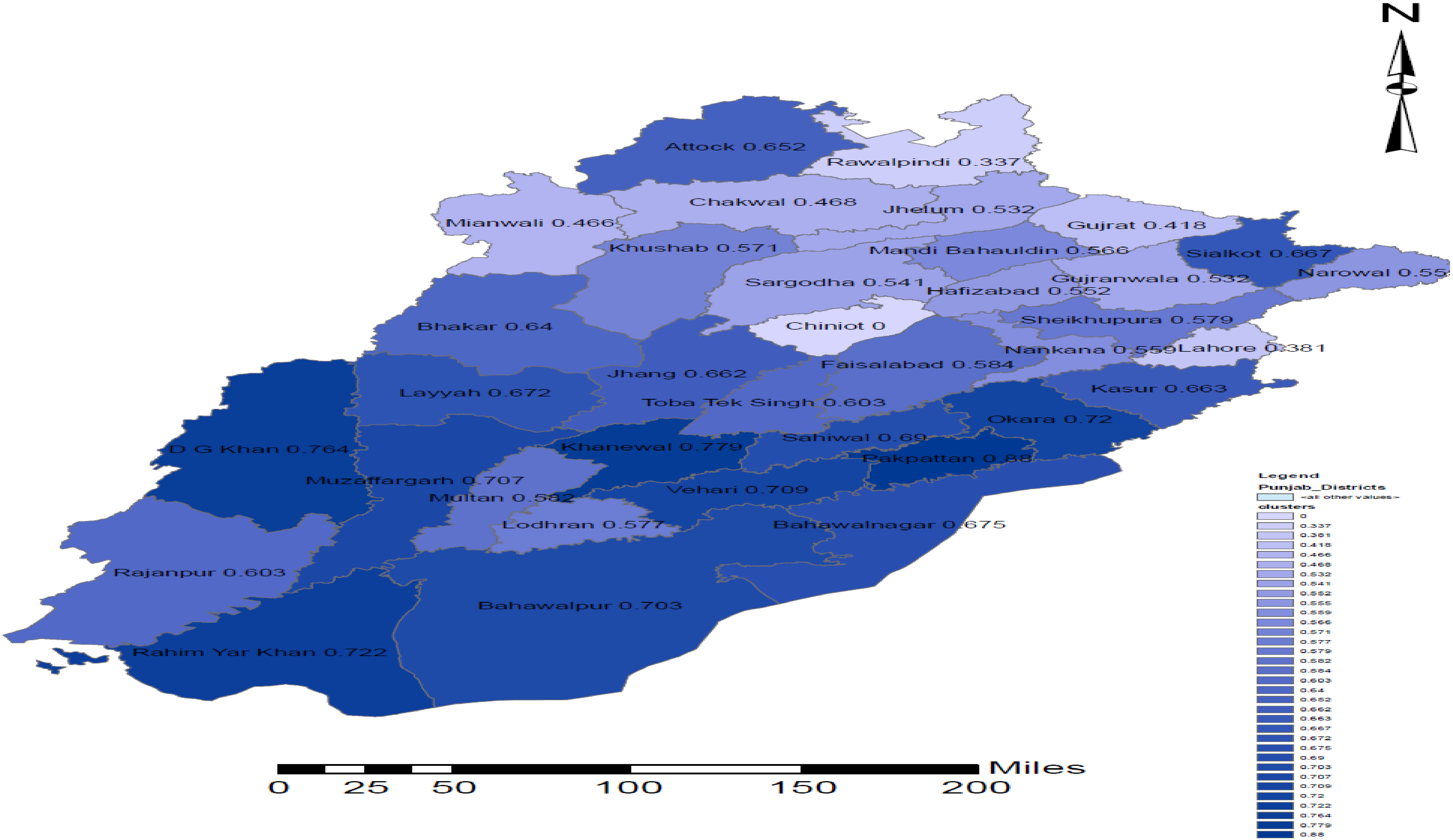
0.707
0.747
0.773
0.856
Miles
0 25 50 100 150 200



N
Attock 0.652
Rawalpindi 0.337
Chakwal 0.468
Jhelum 0.532
Mianwali 0.466
Gujrat 0.418
Khushab 0.571
Mandi Bahauldin 0.566
Sialkot 0.667
Narowal 0.55
Gujranwala 0.532
Sargodha 0.541
Hafizabad 0.552
Sheikhupura 0.579
Chiniot 0
Bhakar 0.64
Nankana 0.559
Lahore 0.381
Faisalabad 0.584
Jhang 0.662
Kasur 0.663
Layyah 0.672
Toba Tek Singh 0.603
Okara 0.72
Sahiwal 0.69
D G Khan 0.764
Khanewal 0.779
Pakpattan 0.88
Muzaffargarh 0.707
Multan 0.582
Vehari 0.709
Lodhran 0.577
Bahawalnagar 0.675
Rajanpur 0.603
Bahawalpur 0.703
Rahim Yar Khan 0.722
0 25 50 100 150 200 Miles
Legend
Punjab_Districts
<all other values>
clusters
0
0.337
0.381
0.418
0.466
0.468
0.532
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0.552
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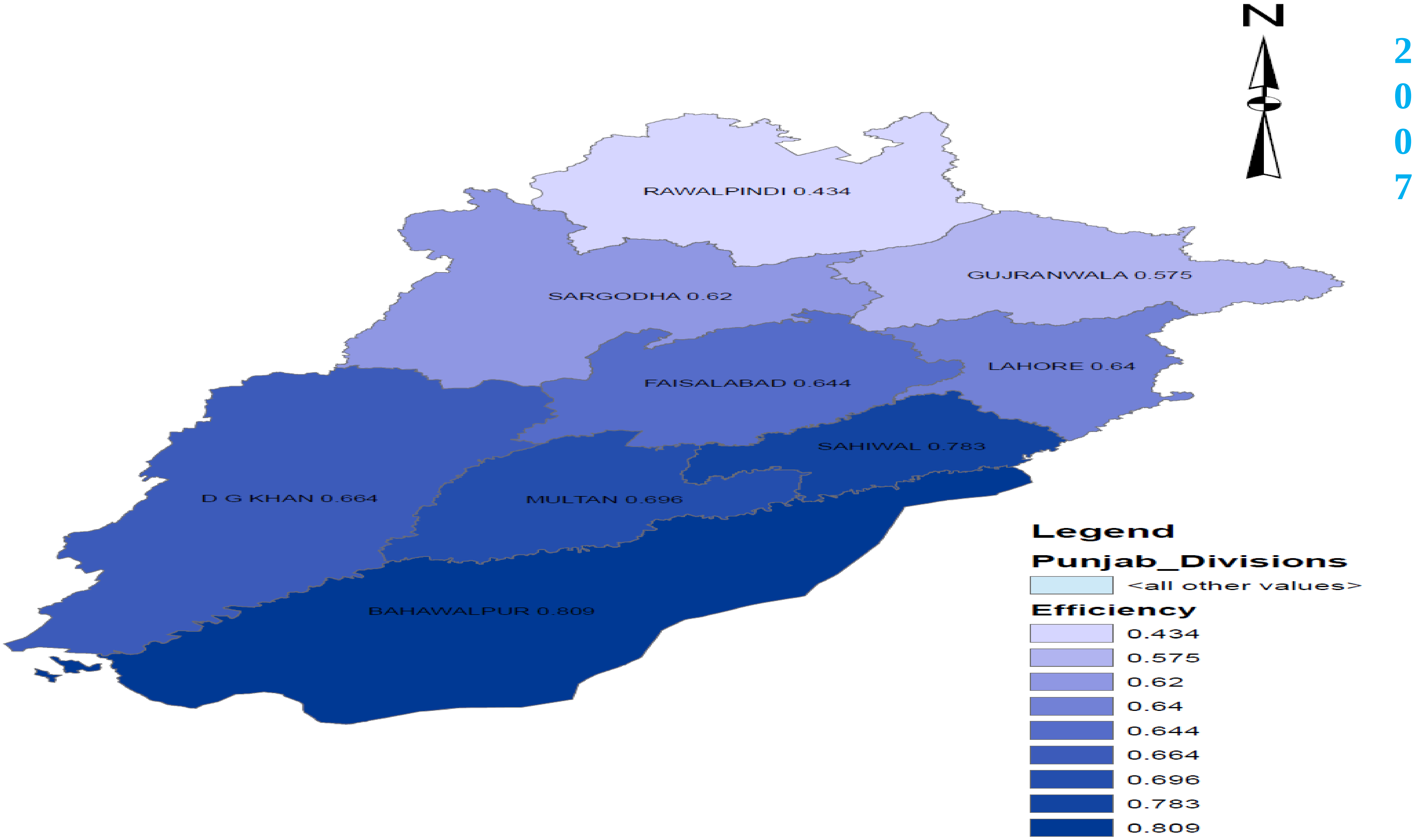
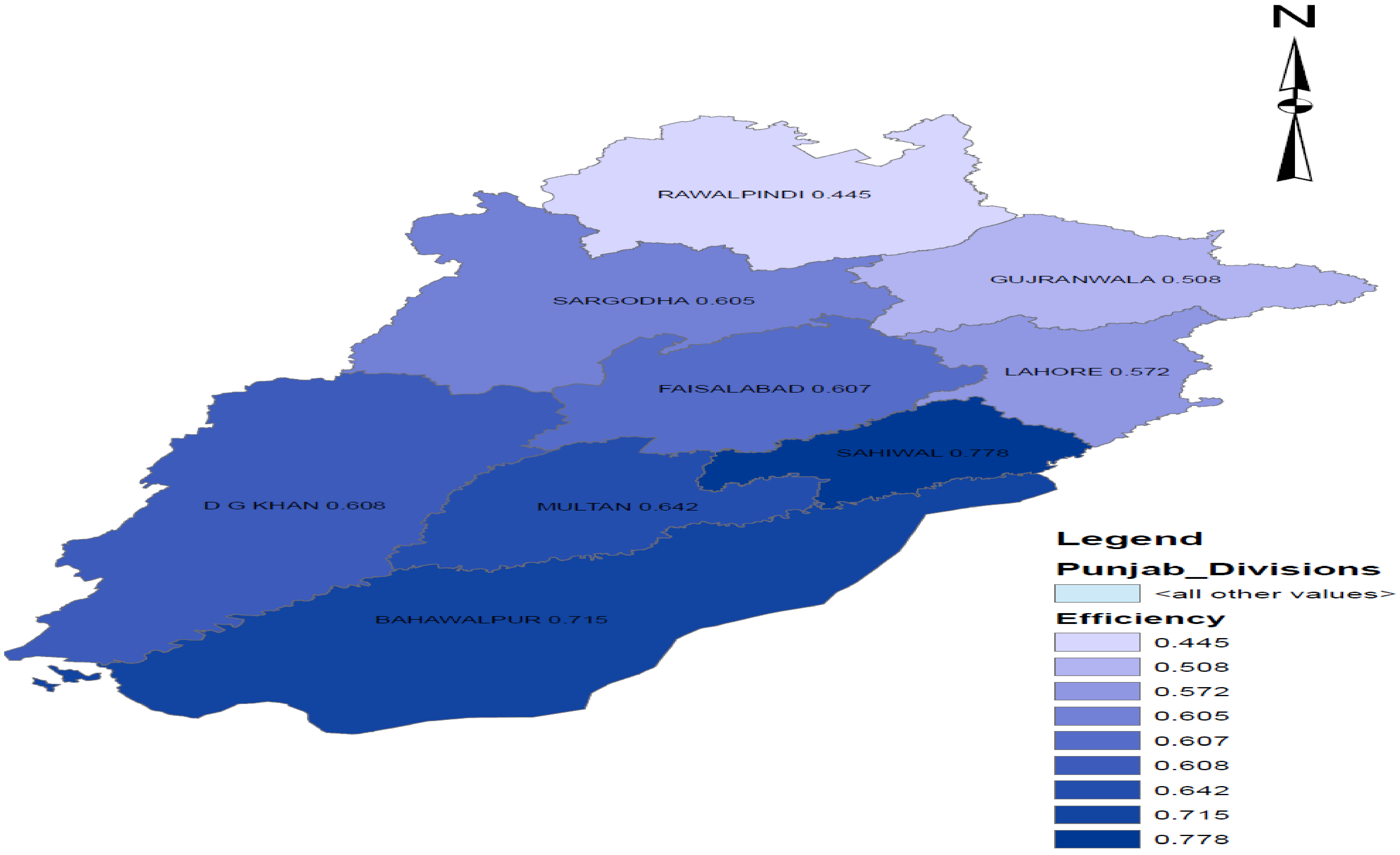
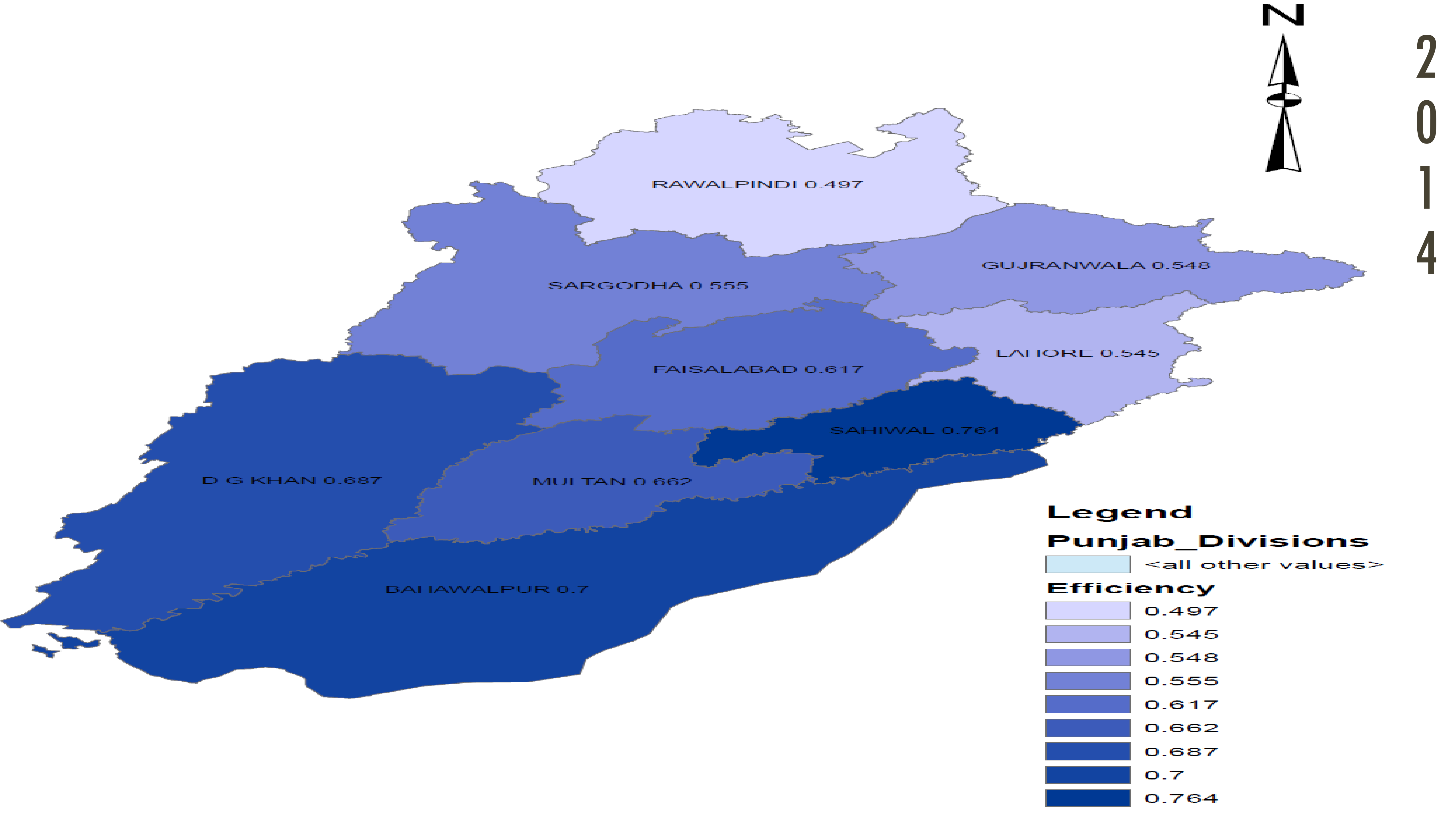
0.764
0.779
0.88

2014


N
2007
RAWALPINDI 0.434
GUJRANWALA 0.575
SARGODHA 0.62
FAISALABAD 0.644
LAHORE 0.64
SAHIWAL 0.783
D G KHAN 0.664
MULTAN 0.696
BAHAWALPUR 0.809
Legend
Punjab_Divisions
<all other values>
Efficiency
0.434
0.575
0.62
0.64
0.644
0.664
0.696
0.783
0.809


N
RAWALPINDI 0.445
GUJRANWALA 0.508
SARGODHA 0.605
LAHORE 0.572
FAISALABAD 0.607
SAHIWAL 0.778
D G KHAN 0.608
MULTAN 0.642
BAHAWALPUR 0.715
Legend
Punjab_Divisions
<all other values>
Efficiency
0.445
0.508
0.572
0.605
0.607
0.608
0.642
0.715
0.778



N
2014
RAWALPINDI 0.497
GUJRANWALA 0.548
SARGODHA 0.555
LAHORE 0.545
FAISALABAD 0.617
SAHIWAL 0.764
D G KHAN 0.687
MULTAN 0.662
BAHAWALPUR 0.7
Legend
Punjab_Divisions
<all other values>
Efficiency
0.497
0.545
0.548
0.555
0.617
0.662
0.687
0.7
0.764

DETERMINANTS OF EFFICIENCY

Regression Analysis

Breusch and Pagan Lagrangian multiplier test for random effects

	Var	sd = sqrt(Var)
efficiency	.0146208	.1209167
e	.0050916	.0713558
u	.0027412	.0523568
Test: Var(u) = 0,	chi2(1) = 4.48 Prob > chi2 = 0.0343***	

Results of Random Effect Model
Dependent variable: District wise efficiency score

Efficiency	Coef.	Std. Err.	z	Prob.
Health expenditure	0.009	0.012	0.80	0.427
Literacy rate	-0.004	0.0009	0.000	0.000***
Unemployment rate	0.007	0.003	2.23	0.026 ***
Crimes	-0.0009	0.001	-0.92	0.356
Clean water	0.006	0.002	2.54	0.011 ***
Constant	0.198	0.263	0.75	0.452
R-sq: overall 0.4047		Wald chi2(4) = 29.71 Prob > chi2 = 0.0000		

Policy Suggestions

There is need to improve the allocation, distribution and absorption of the public health care expenditures, this public spending should be well directed, target oriented and there should be efficient absorption. Efforts may be made to enhance the availability and provision of improved drinking water & sanitation facility. Easy access and high Standard of public health care may be provided so that unemployed and employed may benefit. There is need to improve the governance structure of the districts so that there may be efficient use of resources.

Thank You