HUMAN GEOGRAPHIES – Journal of Studies and Research in Human Geography
8.1 (2014) 17–26. ISSN-print: 1843–6587/$–see back cover; ISSN-online: 2067–2284–open access
www.humangeographies.org.ro

HUMAN GEOGRAPHIES
Journal of Studies and Research in Human Geography

REGIONAL DIVERSITY AND DEVELOPMENT BETWEEN THE SOUTHERN PROVINCES OF PAKISTAN: A PRINCIPAL COMPONENT ANALYSIS

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Abstract: Economic development is an important consideration for a country like Pakistan, especially for the southern provinces; Sindh and Balochistan. Unequal economic development in these southern provinces creates regional disparities. These regional disparities enhance significant political and social issues like rural poverty and uneven economic growth. During the last several decades these provinces have been facing increasing problems of regional inequalities in economic development. Hence it is necessary to investigate the problem areas with poor use of resources by advance statistical techniques like Principal Component Analysis. The results will pin point those areas where development activity and planning can be directed towards improving economic infrastructure and prosperity of the people. The broad objective of economic development is to balance the inherent land resources and optimization of resource use towards achievements of productivity over a long period.

Key words: Development variable, Economic development, Principal component analysis, Regional disparity, Rural poverty, Southern provinces.

Article Info: *Manuscript Received*: April 29, 2013; *Revised*: November 28, 2013; *Accepted*: May 25, 2014; *Online*: May 31, 2014.

Introduction

Sindh and Balochistan are important provinces, representing southern Pakistan have a considerable physical and environmental variety. The landscape varies from the rugged mountain ranges of the western margins of the Indus plain and the interior of Balochistan, to the fluvial morphology of Lower Indus basin, whereas the eastern desert fringe is occupied by the sand dunes. Climatically, it is mostly arid and semi-arid with summer monsoon rains in Sindh and winter rains in Balochistan.

The large diversity in the surface configuration, climate, mineral wealth, soil and irrigation facilities creates a marked difference between these provinces. The wide difference is also reflected by the distribution of population densities. The central and southern areas of Sindh dominate the scene, where vast alluvial fertile land, an elaborate canal irrigation system, wide agricultural tracts and industrial complexes make it the most productive part of the southern Pakistan. The areas of Balochistan by contrast are relatively depressed except a limited pocket of Quetta (Ahmed and Mahmood, 2007). By considering the above realities an attempt has been made to investigate the uneven economic growth in southern Pakistan, utilizing multivariate technique. For this purpose a number of variables that cover various aspects of the economy have been selected. The selection has been done from diverse secondary sources (population and agricultural census reports and meteorological data etc.). The primary data for Normalized Difference Vegetation Index (NDVI) is generated from coarse resolution satellite imageries.

Significance of the Study

Large inter-regional disparities in welfare and living conditions may become an important obstacle for development, which may stimulate social tensions (Quadrado, Heijman and Folmer, 2001). Sindh and Balochistan have wide regional disparities both in terms of physical and human setting, increasing rural poverty and lack of basic amenities for the majority of

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doi:10.5719/hgeo.2014.81.17

population [3]. Such dissimilarities give rise to variations in administrative problems and make it necessary that the principal areas of settlement and economic development be distinguished from the total area of Sindh and Balochistan. In addition, a further classification of such area into various levels of intensity will be useful refinement, especially for our decision-makers and planners for policy implementation.

While there is no easy solution to such problems, a first step can be taken by recognizing the need for conscious regional planning as an integral part of Sindh and Balochistan's economic and social planning. The concern of the present research is to provide solution to the problem of wide regional disparities in term of restriction of large size of provincial metropolis and solution for reducing urban rural inequality. It is revealed from the existing literature that no systematic work has been done for investigating the economic inequality in the whole region. It is, therefore, necessary to highlight the causes of the regional disparity.

Hence the main objectives of this study are the identification of regional disparities using social, political and geographical variables, identification of the depressed areas where levels of economic development are extremely poor and to bring out the factors which are responsible for such poverty. Further have also been discussed suggestions to solve the problems of the regional disparity.

Study Area

Sindh is flanked by the Arabian Sea and the Rann of Kutch in the south. There are four major relief elements: Khirthar range and the Sindh Kohistan in the west, the Thar Desert in the east and the Indus valley lying in-between the hills and the desert (Pithawalla, 1976). Khirthar range marks the boundary between the province of Sindh and Balochistan. The Indus valley has been divided into western and eastern sections by river Indus. The low-lying plains south of Thatta are identified as the old Indus Delta (Rahman, 1975) (Figure 1).

East of the Indus, there are two limestone ridges. The larger of these extends southward for about 40 miles from Rohri. It consists of nearly horizontal numulitic limestone scarped on the western side at a height of about 200 feet above the plain. The other one, in the south is known as Ganjo Takkar. It is on the northern most hill of this ridge where the city of Hyderabad, the second largest city of Sindh is located. Some other smaller detached hills occur in the old delta area, significant among which are the Makli Hills and Pir Patho in Thatta district. Isolated hills of granite rising to 1,169 feet above sea level are found on the northern edge of the Rann of Kutch in Nagar Parkar area of the Tharparkar district.

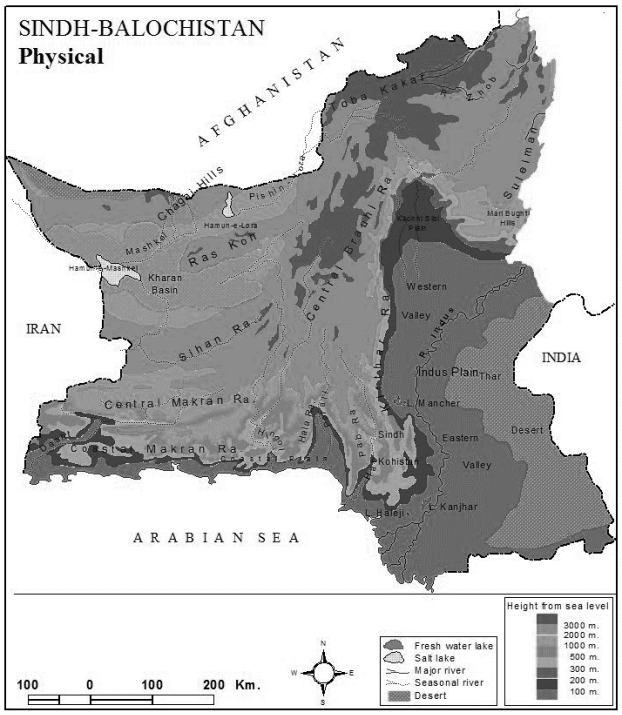

Figure 1. Sindh-Balochistan – Physical map

These are known as Kalinjhar hills. River Indus is the most important single feature that dominates the province of Sindh.

Balochistan is the largest province of Pakistan in terms of area, covering 347,190 sq. km. occupying nearly 44% of its landmass, located in southwestern half of the country. It is a land of contrasts. Bare, barren and rugged mountains hedge in green valleys dotted with bountiful orchards. Vast deserts give way to verdant oasis, immense coastline teeming with marine life and mangrove. The altitude also ranges widely from places, which are at sea level, or even below the sea level to the Khilafat peak Harnai valley. Ziarat district, the highest point in the province rises to a height of 11,507 feet above sea level.

The geographical location gives Balochistan a unique geo-political significance has been further augmented by the need and interest of the land-locked Central Asian States for an opening to the sea. The Makran Coastal Highway and the Gwadar Deep-sea Port are Pakistan response to these imperatives of regional politics and economy of Central Asian States. The Makran coast lies in front of the Straits of Hormuz, which is an important route of the oil tankers bound for Japan, North America and Europe enroute to the Persian Gulf.

Research Design

The research is based on districts as a viable regional unit. This is the third order of the administrative hierarchy of the country, after province and divisions.

The development scenario will cover both urban and rural areas because development is not an isolated process. District has been chosen as the unit of study because it already exists as a political and administrative unit and contains a sufficient mix of urban and rural characteristics to allow the creation of linkages (Zafar, 1990). It is also a functional unit and is sufficiently large in terms of both area and population and possesses physical and human resources.

Like other South Asian countries district is important because it forms the base for the whole administrative set up in the country (Joshi, 1938). Districts performs a number of rural and urban functions in Pakistan as they exist a wide physical and economic diversity like any other developing state as in India or developed states like U.K or Canada (Thinker, 1963).

The district has a number of characteristics which makes its selection suitable as a planning unit. Not only it already exists as a political and administrative unit but most data are available at this level. It can be further divided into smaller divisions to obtain the objectives of planning and development. The district is sufficiently large in terms of both area and population to make it functional. It contains both urban and rural localities and a number of resources like land, water, raw materials, population etc. At the national level goals of planning unit have to be taken care of and thus districts can play an important role in such planning and development processes (Government of Pakistan, 1984). On the basis of the above considerations, district has been chosen as a basic unit for the analysis of economic imbalance of the area.

Data Source

The social variables approach to the measurement of regional inequality can meet some of the empirical lacuna (Khan and Islam, 1990). Therefore diverse sources have been used for obtaining the social and economic variables. Twenty eight variables have been selected to uncover the regional imbalance of Sindh and Balochistan. These variables have been extracted from different available economic, environmental and climatic data sources such as Provincial Census Reports of 1998, Agricultural Census 2000, Socio-economic Indicators at District Level Balochistan and Sindh 2002, District-wise Agriculture Statistics of Pakistan 2002-2003, Census of Manufacturing Industries 2006, Crop Area and Production by Districts 2007-08, Climatic Normals of Pakistan 1990, etc.

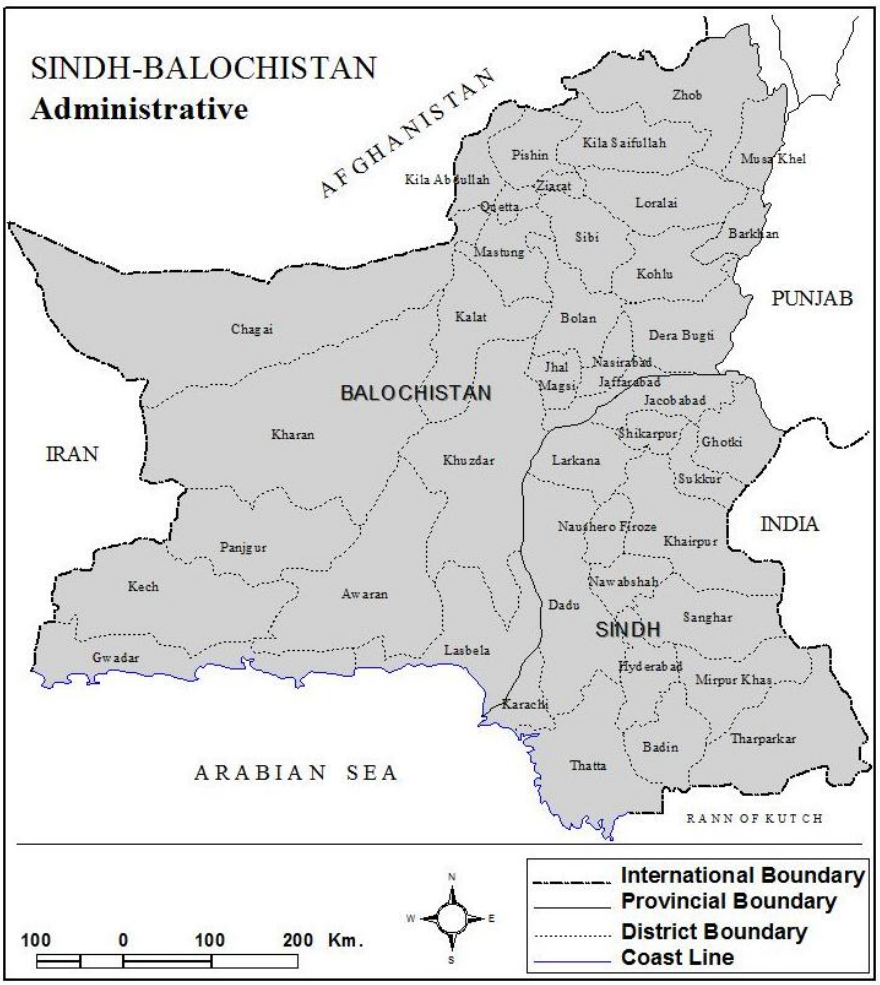

Figure 2. Sindh-Balochistan – Administrative map

To obtain NDVI of the study area two sets (1997 and 2007) of NOAA images have been used. During the last several years 1997 was the driest year while in 2007 normal amount of rain occurred. Each year four images have been selected by considering the crop calendar such as March which is a harvesting season of rabi (winter) crop, June pre monsoon and sowing time of kharif (summer), September post monsoon and harvesting month of kharif (summer) and December which is sowing period of rabi (winter) crop. Since NDVI is a pixel based values to convert it into block based data the zonal statistics command of GIS software ArcGIS has been employed (Lo, 1998).

The entire analysis of the regional inequalities and development pattern of Sindh and Balochistan was done using the computer software SPSS 14 for reducing the multisectoral dataset, PCA has been employed. Weighted component score is used as an index for ranking districts on the basis of the general characteristics of variable set (Thompson, 1962; Ahmad, 1965; Defo, 1996; Soares, Marques and Monteiro, 2003; Mahmood and Ahmed, 2006; Campo, Monteiro and Soares, 2008). PCA has been employed for 24 districts of Sindh and Balochistan. Karachi division has been taken as a single unit because of its role as the largest urban center of southern provinces of Pakistan (Figure 2).

Results and Discussions

Although the number of variables used in this study are not very large but these have been able to capture the overall development pattern in the districts of Sindh and Balochistan. Development is a multidimensional phenomenon which involves a complex interaction between political, social, cultural and economic factors. The ultimate goal of development is improvement in quality of life of the people and in the enhancement of productive capacity. For this purpose, it is necessary to quantify levels of availability of social, economic and physical infrastructure, which makes a place attractive for living.

a. The Variables

Development is a multifaceted phenomenon involving an integration of multiple factors. The basic objectives of development are enhancing the prosperity of people and increasing the productive potential of areas. It is necessary to measure various levels of the availability of socio-economic, agro-ecological and physical infrastructure in various districts of southern Pakistan which make this study meaningful and comprehensive.

The data for this study consist of observations from a number of different sources (such as censuses of population, agriculture, manufacturing and satellite images of NOAA) on 28 variables in 42 districts (16 district of Sindh and 26 districts of Baluchistan) classified under the following sub-headings :

I. Agriculture
1. Cultivated area (% of total area)
2. Intensity of land use
3. Intensity of cropping
4. Orchid yield per hector
5. Irrigated area total per 1000 acres of cropped area
6. Tractors per 1000 acres of cropped area
7. Fertilizer consumption per 1000 acres of cropped area

II. Population / migration
8. Urban population (%)
9. Population potential (000)
10. Immigration (%)

III. Income and wealth
11. Cash value of crop output per rural population
12. Manufacturing value added per urban population
13. Bank branches per 100,000 population

IV. Labor force
14. Industrial labor force
15. Non agricultural labor force
16. Unemployment ratio (%)

V. Education
17. Literacy ratio (%)
18. Primary enrolment (%)
19. Secondary enrolment (%)
20. Female to male literacy ratio

VI. Environment
21. Normalized Difference Vegetation Index (NDVI)
22. Forest area (%)

VII. Transportation and communication
23. Roads per 100 sq. km.
24. PTCL telephone connection per1000 population

VIII. Climate
25. Mean annual temperature
26. Total annual rainfall
27. Total winter rainfall
28. Total summer rainfall

The choice of these variables in presenting the socio-economic, environmental and climatic profile of each district is solely determined by data availability constraints. The time reference point of most of these variables is the last available published census of population.

b. The Component Analysis Results

Using SPSS 14 software a correlation was first run among the 28 variables for 42 districts. PCA based on the correlation matrix identified four principal components which have eigen values greater than 1. Eigen values are measures of the relative importance of each component. Thus, the closer the principal component is to the entire original variable, the larger the first eigen value, i.e., the more representative the principal component is of the whole matrix of data (Rogerson, 2001).

The Principal Component Analysis developed four components having eigen values greater than 1. Each eigen value measure the relative importance of relevant components. Thus the closer the Principal Component is to the entire original variable, the larger the first eigen value that is, the more representative the Principal Component is of the whole data matrix. The result starts with initial statistics. The eigen value (or the sum of squared component loadings for a component) divided by the total number of variables (twenty eight) employed in this study indicated the percent of variance accounted for by a component. The first four components separately account for 28.5%, 19.6%, 9.9% and 7.5% of the total variance. These component, collectively account for 65.46% of the variance in the data set (Table 1).

The output of a Principal Component Analysis is a strong function of input. The components that emerge from a Principal Component Analysis are the ones that capture the nature of the data set. As suggested by a number of researchers that in a sample of large size factor loading in the present study ± 0.30 are considered significant. In the present study ± 0.30 has been taken as significant keeping in view the number of variable used (Table 1). The first four component scores as have emerged in the analysis are explained below.

Component 1: Urbanization and Modernization

Component 1 combined at least twelve variables of PTCL (Pakistan Telecommunication Co. Ltd.) telephone connections, literacy rate, urban population, female to male literacy, non-agricultural labor force, unemployment, urbanization, modernization, infra structure development (etc).

Clearly this component is identified as component of urbanization, modernization and infrastructure development. The variable of tractor has a loading of 0.626 and the variable of fertilizer used has a loading of 0.479 on this component, clearly indicate that besides variables of urbanization have loaded heavily on this component, these two variable signify the importance of modernization of rural areas in Sindh and Balochistan (Table 1). The variables that load high on this component are from the sectors of communication, education, urban population, industrial employment, banking, spatial interaction and accessibility. Most of the variables relate to socio-economic infrastructure. One variable of forested area also loads heavily on this component showing the importance of forest cover which is indeed on economic potential for relevant area.

Component 2: Agricultural, Rural Development and Green Cover Area

Component 2 is the component of agricultural, rural development and green cover area. There are nine variables load heavily on this component. On the top is Normalized Difference of Vegetation Index (NDVI) which shows the importance of green cover. Other vegetable of cultivated area ratio, metalled roads, intensity of land-use, mean annual temperature, winter total rain and orchid yield show the relationship of variable with cropping agriculture and marketing. Education and transport are the responsibilities of government in countries like Pakistan.

Component 3: Income and Wealth

This component includes primary environment, value cash crop per capita rural population, manufacturing values added and irrigated area. These four variables load heavily on this component. The component accounts for 10.9 per cent of the total variance. Two variables signify the importance of agricultural as well as industrial income whereas primary enrolment is the responsibility of government in developing countries like Pakistan.

Component 4: Water and Cropping

This component accounts for 7.8 per cent of the total variance explained (Table 1). Component 4 includes three variables all belonging to climatic condition and cropping. Two variables of rainfall load heavily on this component showing the importance of water and rain for the country. Analysis of the variation explained by these components reveals clearly the increasing importance of modernization resulting from urbanization and industrialization in relation to agricultural and infrastructural development in determining the overall development pattern of districts in Southern Pakistan. It also emphasizes the spatial pattern of development in these areas.

c. Component Score Analysis

The first component has emerged covering the variables capturing the importance of modernization and urban development process. The variables scoring added heavily on this component are PTCL connections, literacy rate, percentage of urban population,

Table 1: Rotated Component Matrix

Variables	Component				
	1	2	3	4	Component Name
PTCL Tel. connection / 1000 pop.	**0.943**	0.032	0.114	-0.086	Urbanization and Modernization
Litracy rate %	**0.894**	0.326	0.091	-0.133	
Urban population %	**0.893**	0.095	-0.197	-0.035	
Female to male literacy %	**0.874**	0.192	-0.095	-0.085	
Non-agriculture labour force	**0.815**	-0.172	0.150	-0.063	
Immigrants %	**0.802**	-0.015	-0.190	0.354	
Bank branch / 100,000 pop.	**0.793**	-0.002	0.466	-0.180	
% of Urban Industrial labour force	**0.691**	0.244	-0.427	0.269	
Tractor / 1000 acres	**0.626**	-0.190	-0.079	0.481	
Population potential	**0.610**	0.401	-0.295	0.501	
Forest area %	**0.520**	-0.025	0.440	0.201	
Fertilizer	**0.479**	-0.155	0.322	-0.219	
NDVI	-0.029	**0.887**	-0.076	0.097	Agricultural, Rural Development and Green Cover
Cultivated area%	-0.069	**0.862**	-0.037	-0.100	
Unemployment ratio	-0.192	**-0.840**	-0.068	-0.048	
Metalled road / 100 sq.km.	0.284	**0.839**	-0.051	-0.075	
Higher Secondary enrolment %	0.397	**0.774**	-0.091	-0.172	
Intensity of landuse	-0.130	**0.703**	0.232	0.202	
Mean Annual Temperature	0.004	**0.682**	-0.527	-0.150	
Winter total rain	0.044	**-0.676**	0.521	0.072	
Orchid yield per hector	-0.044	**0.397**	0.151	-0.037	
Primary enrolment	0.056	0.157	**0.790**	-0.073	Income and Wealth
Value of cash crop / rural population	-0.096	0.102	**0.725**	0.042	
Manufacturing value added	0.144	0.122	**-0.386**	-0.067	
Irrigated Area / 1000 of cropped	-0.102	-0.020	**-0.191**	0.008	
Summer total rain	-0.076	0.208	-0.096	**0.794**	Water and Cropping
Total rain	-0.104	-0.359	0.285	**0.749**	
Intensity of cropping	-0.027	0.147	-0.152	**-0.190**	
Eigen value	7.967	5.479	2.768	2.115	
% of variance	28.454	19.567	9.886	7.555	
Cumulative %	28.454	48.021	57.907	65.461	

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

female to male literacy ratio, percentage of non-agricultural labor force, immigrants number of bank branches, percent industrial labor force, tractor (per 1000 population), population potential, forest area percentage and fertilizer.

Component Score 1

The first component has been defined as the component of modernization resulting from industrialization and urbanization, captures 28 per cent of the total variance in the data set. Districts like Karachi, Quetta both being provincial head quarters have top ranking on first component. Higher level of development is associated with a higher component score. Whereas Hyderabad, Sukkur have also obtained high scores because of the lead in industrial and urban development.

Moderate scores have been obtained by Ziarat, Gwadar, Lasbela Chaghai, Dadu, Kachi, Larkana, Nawabshah, Mirpur Khas, Sibi, Sanghar, and Khairpur. Lower levels in development have been found in Panjgur, Shikarpur and rest the districts of Sindh and Balochistan (Figure 3).

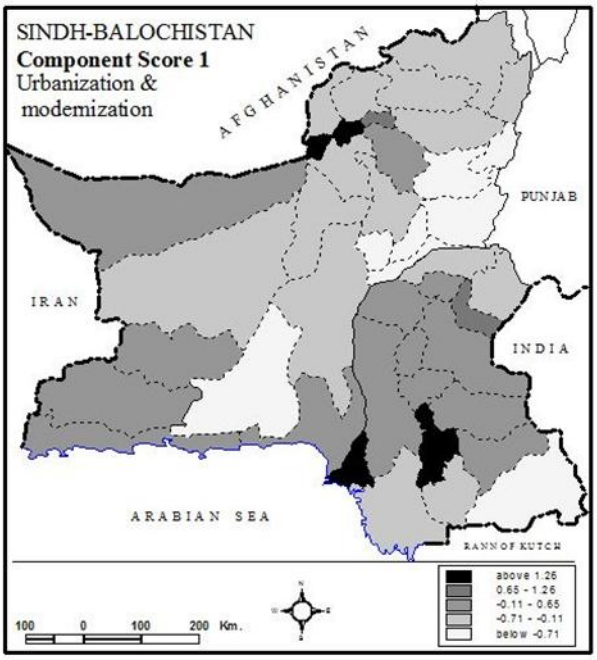

Figure 3. Sindh-Balochistan – Component score 1

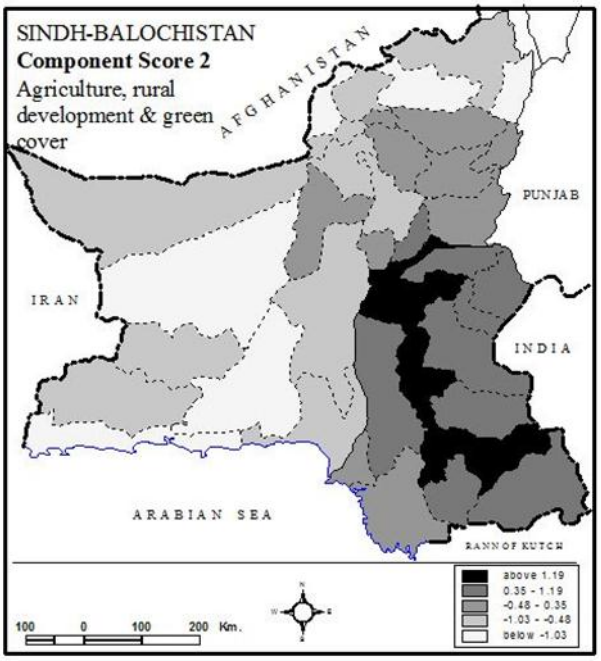

Figure 4. Sindh-Balochistan – Component score 2

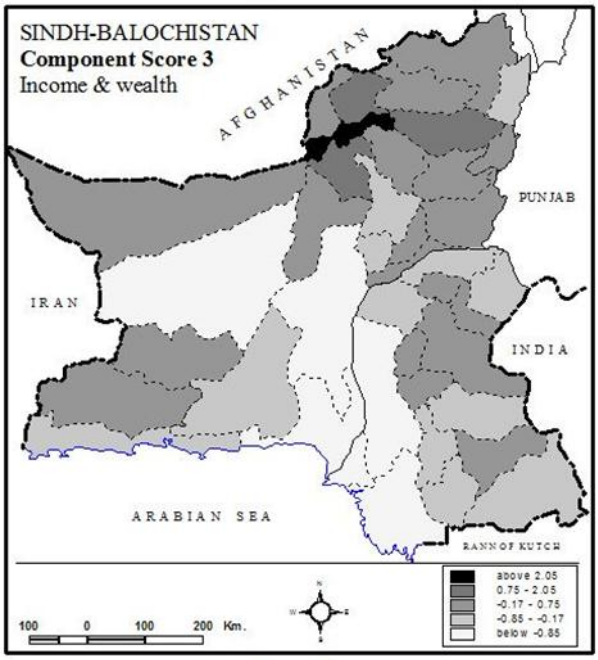

Figure 5. Sindh-Balochistan – Component score 3

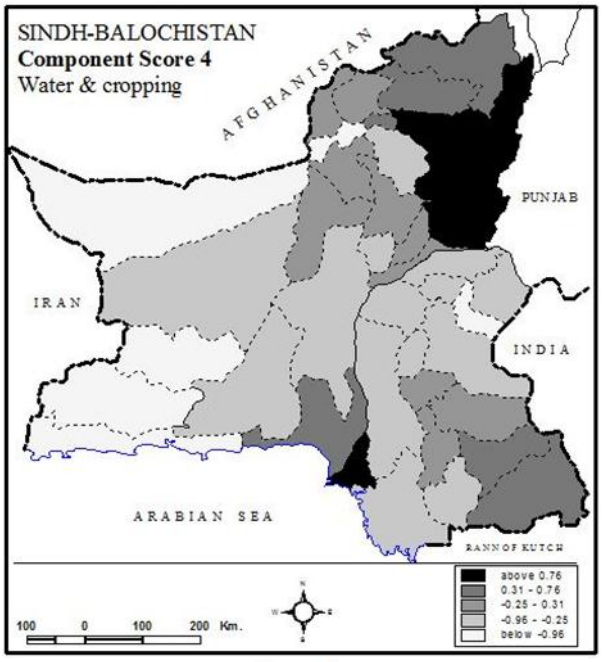

Figure 6. Sindh-Balochistan – Component score 4

Component Score 2

Component Score 2 is the component of agriculture and rural infrastructure development. Districts scoring high on this component are Naushero Feroz, Hyderabad, Shikarpur, Nawabshah, Jafarabad, Larkana, Mirpurkhas, Jecobabad and Khairpur have 1 or above scores. Those falling in moderate levels of rural development are Sanghar, Sukkur, Ghotki, Badin, Nasirabad. Whereas majority of the districts of Balochistan fall into the category of very low development level of rural areas (Figure 4). Districts scoring high on this component are those with considerable share in cash crops e.g. rice, sugarcane etc.

Component Score 3

Component score 3 emerges as component of income and wealth. This component explains 3.01 per cent of total variance in the data set. This includes variables of values of cash crop per capital rural population, manufacturing value added. Primary enrolment is also an important variable reflecting government's responsibility in imparting primary education in developing countries like Pakistan.

Table 2. Weighted Component Score of Top Ten and Bottom Ten Districts

Top Ten Districts			Bottom Ten Districts		
Districts	Province	Weighted Component Score	Districts	Province	Weighted Component Score
Karachi	Sindh	29.53	Kila Saifullah	Balochistan	-7.16
Quetta	Balochistan	19.04	Kila Abdullah	Balochistan	-7.51
Ziarat	Balochistan	18.86	Gwadar	Balochistan	-7.60
Hyderabad	Sindh	18.21	Panjgur	Balochistan	-8.64
Sukkur	Sindh	12.36	Jhal Magsi	Balochistan	-9.29
Naushero Firoze	Sindh	12.09	Bolan	Balochistan	-9.59
Nawabshah	Sindh	9.24	Khuzdar	Balochistan	-12.11
Mirpur Khas	Sindh	9.11	Musa Khel	Balochistan	-13.20
Shikarpur	Sindh	7.74	Kharan	Balochistan	-16.97
Larkana	Sindh	7.03	Awaran	Balochistan	-17.64

Though manufacturing value added has a loading of 0.386 and irrigated area variable has very insignificant loading 0.191. Districts with high scores on these components are Ziarat, Quetta, Mastung and Loralai (Figure 5). Districts with moderate level of component score 3 are Pishin, Barkhan, Kech, Kalat, Killa Abdullah, Nawshero Feroz, Killa Saifullah, Sukkur, Zhob etc. Districts with very low component score 3 are Lasbela, Dadu, Thatta, Kharan and Karachi is at the tail end of the ranking.

Component Score 4

This component has been identified as reflecting the component of climatic elements. This component explains 7.87 per cent of the total variance of the data set. Summer rain and total rainfall are the main variables loaded heavily on this component. Those districts have obtained high score which receive both total and summer rainfall. Karachi, Dera Bugti, Kohlu, Loralai, and Barkhan have high scores on this component. Moderate scores were obtained by Musa Khel, Tharparkar, Zhob, Ziarat etc. Low scores were obtained by Kech, Quetta and Gawadar etc. (Figure 6).

Weighted Component Scores

In order to obtain a composite index Weighted Component Scores (WCS) were computed by combining component score 1, 2, 3 and 4. These are total score giving an overall composite index for all individual 42 districts. Table 2 reveals the top and bottom ten ranked districts obtained by WCS. All these districts have been grouped into five categories for capturing the very high development level, high development level, moderate development level, low development level and very low development level (Figure 7).

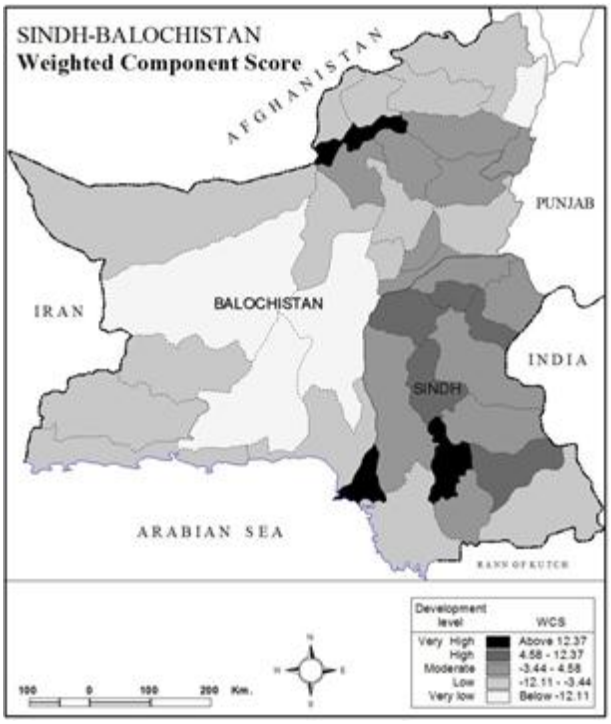

Figure 7. Sindh-Balochistan – Weighted Component score

Both the administrative head quarters of Sindh and Balochistan (Karachi and Quetta) have obtained top first and second ranking respectively. Ziarat and Hyderabad secured third and forth position and falling into very high development level. It is interesting that Ziarat stands at third position in terms of WCS because of forest cover and fruit orchids. In Ziarat orchids can further be planned for better economic prospects of the province and country. High development level category includes seven districts namely Sukkur, Nawshero Feroz, Nawabshah, Mirpur Khas

Shikarpur, Larkana and Khairpur. All these districts comprise fertile alluvial plain, good irrigational facilities and better transportation network.

Districts with moderate development level are Sanghar, Loralai, Jecobabad, Ghotki and Jaffarabad Badin, Sibi, Dadu, Barkhan, Mastung and Nasirabad. Districts fell into the category of low development level are Kohlu, Dera Bugti, Kech, Tharparkar, Lasbela, Kalat, Zhob (etc). These districts are mostly belonging to Balochistan having very rough topography, dry weather, water insufficiency and poor infrastructure. Three districts fall into the least developed category namely Musa Khel, Kharan and Awaran. These are located in the interior of Balochistan province having a very poor economic development.

Conclusion

The findings of this study are limited by some data constraints like direct income variables at district level. An important conclusion that can be derived from the present study is that specifically the results show a clear picture of the development scenario of the entire region of southern provinces of Pakistan. In future further studies can be done using other advance techniques to make the study more meaningful.

The result depicts a very grim picture of economic regions of southern Pakistan. Only few pockets of economic prosperity can be identified. Karachi being the largest megalopolis of the province of Sindh obtained the top position. Quetta has emerged as the second most developed districts of the whole region. The highly developed regions are those that having industrial base and large urban population. Districts with large rural population in both the provinces have shown very poor level of development. Overall five economic regions can be identified based on the composite index of WCS showing very highly developed regions, highly developed, moderately developed, low developed and least developed economic regions.

It is interesting to note that the first group of developed district is non-contiguous showing three pockets of development. Second, third, fourth and fifth groups include mostly contiguous districts. Last two groups of the least developed include all districts from Balochistan and only two that are Tharparkar and Thatta from Sindh. It is indeed right time to start the development process in the poor districts of Sindh and Balochistan to bring them as par with the developed districts of Southern Pakistan. In order to achieve the objective it is necessary to develop the urban and rural infrastructure in these areas. The results clearly show that the province of Balochistan needs immediate development projects so that the goal of poverty reduction could be achieved.

It is concluded that there is a marked spatial disparity observed in terms of economic development in Southern Pakistan. More than half of the districts of Balochistan fall into the category of poor economic development. Therefore it is necessary to start the sustainable economic development process in the deprived areas. It is possible only through the exploration and utilization of indigenous resources, proper marketing for agricultural and fishing products, solid schemes for expansion of irrigation system, strong transportation network, capital investments and the development of industrial infrastructure.

Today, Pakistan's prosperity is linked with the economic development of Balochistan. The greater efforts of government should continue on infrastructure development and launching of new projects and schemes. In case least attention is paid toward development of human resources, the development process will serve no interest to the local people. Improving the quality of life of common people should be the goal of development in the deprived areas of southern Pakistan.

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