Shape Analysis of Administrative Areas in Punjab

Harbans Singh
Associate Professor and Head P G Department of Geography, SCD Govt Collegev Ludhiana (Pb.), India

Abstract

Shape analysis of administrative areas in Punjab reveals that there were large variations in the shape index from higher to lower level. Shape index was highest for development blocks and lowest for the state. Shape index of administrative areas have substantialy improved after the successive reorganization of administrative units at different hierarchical level. Newly carved administrative units have more efficient shapes than their predecessors. It is also found that physical and historical factors along with international border have strong bearing on the shape of administrative areas in the state.

Introduction

Shapes are of intrinsic importance to the understanding of spatial structure of administrative areas. And the most desired shape for an administrative unit would seem to be the one that provide a high degree of compactness. A compact shape may be defined as that which maximises the nearness of the location within the area to each other relative to their nearness to location outside the area (Cox. 1972). The advantages for such a shape for administrative units are obvious viz, it maximises closeness of the people to one another, average access to the most central point of the unit is maximised and the cost of distributing public services to all parts of the unit are minimised. Therefore it is important to examine the shape characteristics of administrative units before suggesting any spatial reorganisation for them. The preponderance of irregular and elongated shapes of most of the administrative units in Punjab is the result of shape of Punjab itself (Triangular) as well as its physical characteristics especially river system and topography.

All administrative areas of the world are organised at different hierarchical levels have specific shape, which differ not only from those at different levels of hierarchy but also at the same level. Even the same area may take different shapes if defined separately in terms of time space, cost space or effort space (Massam, 1972. 2).Shape also influences the management efficiency, resource allocation and utilisation.

The ideal compact shape is a circle because it has the minimum length of boundary for a given area. Compact shapes are generally more conveniently manageable. These facilitate administrative functions which involve movement of people or goods. These favour the development process by way of rendering economy in provision of infrastructural facilities like school, roads and health services. Administrative supervision become more effective as shape of administrative area becomes more compact. Shape is one of the attributes of spatial structure of administrative areas having influence on development process. Qualitative and Quantitative analysis of shape of administrative areas at different hierarchical levels may help to investigate efficient shape. The reforms in the shape of any administrative area are possible for their qualitative and quantitative analysis.

Objectives of Study

1. To study the spatial patterns of shape index in administrative areas in Punjab.

2. To analyse the variations of shape index in administrative areas at different hierarchical levels.

3. To study the variations in shape index between newly carved administrative units and their parent administrative areas after the successive reorganization.

Research Methodology

The choice of technique for the measurement of shape is always guided by the purpose and the type of study. In the case of administrative areas, due note is to be taken of an already existing administrative centre, uneven pattern and distribution of population and specific channels of population mobility. Most of above requirements are satisfied by the shape Efficiency Index devised by Massam and Goodchild.

In the present study the Shape Efficiency Index used by Massam and Goodchild has been followed. Various steps involved in the calculation of the shape efficiency index are described. Since the method is based on the concept of moment of inertia therefore moment of inertia were calculated with reference to both actual and optimal locations of headquarters of the administrative area under consideration. The optimal location was represented by the mean centre of population distribution.

The formula used for calculating the moment of inertia was as follow:

$M = \Sigma\, dij^2 mi$

i. =1

Where M=moment of inertia

d=straight line distance between the administrative centre and the centre of lower order administrative units.

m =population of the lower order administrative units represented at their centres.

In the next step, the index of shape efficiency of any administrative area was calculated by dividing the optimal moment of inertia by existing moment of inertia. If the location of the administrative centre coincided with the mean centre of population, the shape efficiency index worked out as 1.The greater the gap between the two, the lower the shape efficiency. In this study district headquarters were taken as the control points for measuring the shape efficiency of state and divisional headquarters. For the measurement of shape efficiency of districts the sub-divisional headquarters were adopted as control points.

Accordingly villages should be taken as control points in case of development blocks. Due to enormity of work and time involved a modified form of shape efficiency measure has been devised. It has computed as follow:

Headquarter of development Block is located.

Median point of area in place of mean centre of population of the block has identified.

Six points making a hexagon around the medium point have marked on the perimeter of the block.

Moment of Inertia has been calculated with reference to block headquarters and mediun point of the area of block.

Lastly, the shape efficiency index have been calculated by dividing the moment of Inertia value for the median point of the area by that for actual headquarter of the

development block.Shape efficiency index map has been prepared for administrative areas at different hierarchical level.

Shape analysis of administrative areas in Punjab

Punjab, a land locked state, is relatively developed. Currently Punjab has been divided into 4 Divisions, 20 Districts, 77 Sub-divisions and 141 Development Blocks. Punjab as a whole showed a shape index of only 0.30. In the following, shape of administrative areas at different hierarchical levels have been analysed with the help of shape efficiency index.

Division

Among the four administrative divisions in Punjab, Jalandhar recorded the highest shape efficiency index value (0.88) and Patiala, the lowest (0.82). The range difference of only

0.06 cannot consider as high level of difference (Table 1.1).

Table 1.1

Punjab: Shape Efficiency Index of Divisions, 2011

Division	Shape efficiency index
Jalandhar	0.88
Patiala	0.82
Firozpur	0.85
Faridkot	0.83

It is quite revealing that the shape efficiency index value for newly created division of Faridkot is lower that of Ferozpur division of which it was a part of before being carved out in 1998. Generally, the shape of newly formed administrative units happens to be more compact as compared to those out of which they are formed. This makes an opposite case. This shows that political exigencies took over administrative rationalities in carved out new division in the state. However, low inter-division differentials and relatively high value of shape efficiency index for all the four divisions speaks of efficient shape of administrative division in the state (Fig.1a).

Shape Efficiency of Districts

A variety of factors including the topographical features, drainage pattern, international border location, historical factors and triangular shape of the state have played crucial role in defining the boundaries of administrative areas such as districts in Punjab. Triangular shape of the state has bearing on the shape of districts specially those located in its northern and north-eastern parts. Gurdaspur and Jalandhar districts display triangular shapes in consonance with the shape of the state combined with triangle pattern. Kapurthala, which is an ex-princely state, is fragmented into two parts even today. This factor is responsible for making its shape inefficient. Even international border have affected the shape of the administrative areas in Punjab. It is true in case of Firozpur, and Gurdaspur districts.

The shape of Ropar and Hoshiarpur district has been influenced by the orientation of the Shiwalik hills. Elongation of districts along river courses is another notable feature playing role in shaping the shape of districts and sub-divisions in the state.

Ludhiana and Firozpur districts elongate with the river Satluj and Kapurthala district with the river Beas. Hence, districts in Punjab exhibit a variety of shapes.

Table 1.2

Punjab: Districts classified by Shape Efficiency index, 2011

Shape Efficiency Index	Name of the district
High (Above state average, 0.61)	Hoshiarpur, Amritsar, Sangrur, Ludhiana, Tarn Taran, Kapurthala, SBS Nagar, Mansa, Faridkot, Moga, Jalandhar, Bathinda, SAS Nagar (Mohali), Barnala
Low (Below state average,0.61)	Ropar, Gurdaspur, Patiala, Fatehgarh Sahib, Mukatsar, and Firozpur

Shape efficiency index calculated for different districts in the state differ widely. The shape efficiency index value ranged from a high of 0.96 for Hoshiarpur district to a low of 0.49 for Ferozpur districts, giving a range difference of 0.47 (Table 1.2). On the basis of shape efficiency index value, districts have been classified into two categories as follow.

High Shape Efficiency Districts (Above state average, 0.61)

As many as fourteen or two-third districts in the state have high shape efficiency index. These include Hoshiarpur, Amritsar, Tarn Taran, Ludhiana, Kapurthala, Jalandhar, Moga, Faridkot, Bathinda, Mansa, Barnala,SBS Nagar, SAS Nagar (Mohali) and Sangrur. These districts were widely distributed in the state. Shape efficiency index which is a function of population distribution in an administrative unit in terms of its distance from the headquarters to that very unit of administration reveals that in these districts of Punjab, headquarters are quite centrally located in relation to the distribution of population there in. Such a situation helps in efficient distribution of services among the residents there. In statistical terms, shape efficiency index value for these districts is quite close to an ideal shaped, which is a circle.

Large majority of districts in this category are newly carved districts. This indicated that at the time of creating new districts importance of quality of structural attributes to make administrative units efficient was ignored. Secondly, it is observed that newly created administrative units, in general, have better quality of spatial structure than their parent district. Hence, this is also not true about all these districts. For example, Barnala and Mansa which has been created out of Sangrur and Bathinda districts have lower shape indices than Sangrur (Fig. 1b).

Low Shape Efficiency Districts (Below state average, 0.61)

Six or more than one-fourth of the districts in the state have low shape efficiency index. These include Gurdaspur, Ropar, Patiala, Fatehgarh Sahib, Ferozpur and Muktsar districts. Within them, index value ranged from a high of 0.58 for Gurdaspur to a low of 0.49 for Ferozpur district (Fig.1b). Three of these districts (Gurdaspur, Ropar and Ferozpur) have border location and two are newly formed districts (Fatehgarh Sahib and Muktsar) and two have been reorganised (Gurdaspur and Ferozpur) to form new districts of Pathankot and Fazilka, respectively. It is expected that compactness of the shape of these two districts will improve after reorganisation.

However, a newly organised district of Fatehgarh Sahib and Muktsar having less efficient shapes is a cause of concern.

Shape Efficiency Index of Sub-divisions

Happily, the shape of sub-divisions in the state, in general, is more efficient than that of the districts in the state. There was, however, wide disparity in shape efficiency in case of sub-divisions. In fact, range difference in shape efficiency index value was much higher than their case in comparison to districts. It ranged from a high of 0.99 for SAS Nagar (Mohali), Batala, Barnala, Kharar and Bhathinda sub-division to a low of 0.29 for Bholath sub-division (Kapurthala district), giving a range difference of 0.70. Earlier in case of districts, this difference was of 0.47. More than three-fifths of the sub-division have shape efficiency index value of more than 0.80, which was true for only one-fourth of the districts. Against this, there were four sub-divisions, making only five percent in total, having index value less than 0.50, that is one-half of the ideal shape value (1.0). Sub-division has been grouped into two categories of high and low shape efficiency index for discussion on their shape.

High-shape efficiency sub-divisions (Above state average, 0.79)

As many as forty seven of seventy seven sub-divisions have shape efficiency index value of more than 0.79. Twenty three or nearly half of these have index value of more than 0.90. Even the five of them have it 0.99, which is almost equal to index for an ideal shape. Such sub-division was distributed in all parts of the state. However, a large majority of them was located south of river Satluj in the districts of Barnala, SAS Nagar (Mohali), Patiala, Mansa, Moga and Bathinda. All the subdivisions of the newly formed Barnala and SAS Nagar (Mohali), districts have shape efficiency index higher than 0.80.

Low shape efficiency sub-divisions (Below state average, 0.79)

Thirty sub-divisions making about 40 percent of all the sub-divisions in the state have shape efficiency index value below 0.79. Within them, index value ranged from a high of 0.78 for as manay as seven subdivisions (Amritsar-II, Jalandhar-II, Fazilka, Baghapurana, Dhuri, Phagwara and Talwandi-Sabo) to a low of 0.29 for Bholath (Fig. 1c). These were distributed in different parts of the state. However, these were confined to nine districts : three each from Ludhiana and Ferozpur districts, two each from Amritsar, Jalandhar and Sangrur districts and one each from Kapurthala, Moga, Bathinda and SBS Nagar. Fourteeen or less than one-fifth of sub-divisions in the state have less efficient shape index value being lower than 0.60. Within them, index value ranged from a high of 0.59 for Pathankot and Phillaur sub-divisions to a low of only 0.29 for Bholath sub-division. These were distributed in twelve districts of state. It was only Hoshiarpur and Jalandhar district where from two sub-divisions each was included in this category, otherwise these with one sub-division each from remaining two districts. It is interesting to note that except Taran Taran sub-division, none of the newly formed sub-divisions figure in this category. It speaks that newly formed district have improved spatial structure especially the shape of the sub-divisions included in these. Another notable fact is that Hoshiarpur district, which has most efficient shape among all the districts in the state, have two of its four sub-divisions in this category (Table 1.3).

Table 1.3

Punjab: Sub-divisions classified by Shape Efficiency Index; 2011

Levels of Shape Efficiency	Name of the Sub-division
High (Above state average, 0.79)	Mohali, Batala, Barnala, Kharar, Bathinda, Dera Bassi, Samana, Dharkalan, Patran, Nangal, Rajpura, Ropar, Lehra Gaga, Nabha, Tapa, Ludhiana-East, Rampura Phul, Tarn Taran, Balachaur, Budhladha, Khadur Sahib, Sultanpur Lodhi, Zira, Gidderbaha, Kapurthala, Amloh, Mukatsar, Nakodar, Moonak, Sunam, Bassi Pathana, Anandpur Sahib, Gurdaspur, Garhshanker, Khamano, Raikot, Jaito, Hoshiarpur, Mansa, khanna, Faridkot, Dera Baba Nanak, Firozpur, Fatehgarh Sahib, Moga, Baba Bakala, Nihalsingh Wala.
Low (Below state average, 0.79)	Amritsar-2, Jalandhar-2, Fazilka, Bagha Purana, Dhuri, Phagwara, Talwandi Sabo, Samrala, Sangrur, Payal, Jagraon, Jalalabad, Jalandhar-1, Amritsar-1, Abohar, Nawanshahr, Pathankot, Phillaur, Shahkot, Malout, Chamkaur Sahib, Patiala, Ajnala, Dasuya, Sardulgarh, Malerkotla Ludhiana-West, Patti, Mukerian and Bhulath

PUNJAB

Disparity in Shape Index of General Purpose Administrative Areas, 2011

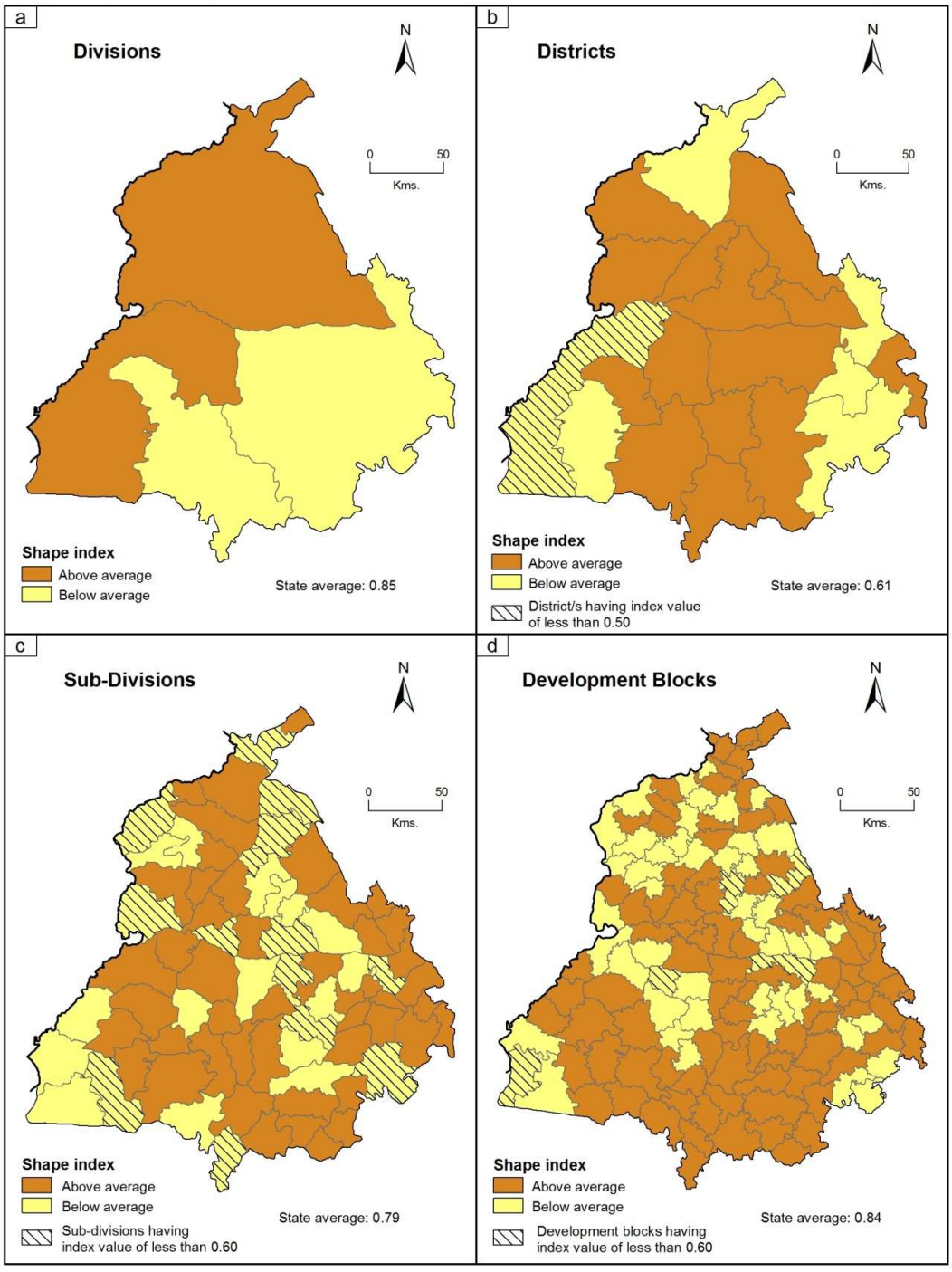

Fig. 1

Shape efficiency index of Development Blocks

There are 141 development blocks in the state. As many as twenty five of them have been created in last 28 years during 1986 to 2012. The quality of shape, as revealed in the shape efficiency index of development blocks is better than sub-divisions and districts both. Creation of new blocks over the time made a positive impact on quality of shape of development blocks in the state. In a study conducted in basis of situation existed in 1986 shape efficiency index for development blocks, as a whole has improved during the period. Average shape efficicecny index which was 0.79 in 1986 (Kant, 1988. 149) has gone upto 0.84 by 2014.

The shape efficiency of development blocks in Punjab ranged from a high of 0.99 for Rajpura, Sudhar and Bhawanigarh blocks to a low of 0.41 for Bhunerheri block (Patiala district). 51 or more than one-third of the blocks have shape efficiency index value 0.90 or more. Another 56 or two-fifths of blocks have shape efficiency indx between 0.90 and 0.80. In other words, more than three-fourths of the block have shape efficiency index of 0.80 or more. Against this, this ratio was three-fifth for sub-divisions and one-fourth of districts. In this way, as we move down the hierarchy of local administration in Punjab, quality of shape improves from higher to lower order administrative units. However, there was wide disparity in shape efficiency index of Blocks. Shape efficiency index value ranged from a high of 0.99 for Rajpura to a low of only 0.41 for Bhunnarheri, a peripherely located block in Patiala district. The range difference of 0.58 is the highest difference of all the administrative levels from division to sub-divisions (Table 1.4).

Evidentally, at the development level, on the one hand, shape efficiency index was the highest on average among all the hierarchical levels in local administration in Punjab. On the other hand, disparity level in index too was the highest. On the basis of shape efficiency index value, develoment blocks have been grouped into following two categories.

High Shape Efficiency development blocks (Above state average 0.84)

As many as 89 or more than four each of the district, development blocks in the state have shape efficiency index of more than 0.84. In more than half of these development blocks the index value is 0.90 or more. Such development blocks were distributed in different parts of the state.

Low shape efficiency development blocks (Below state average 0.84)

52 or 36 percent of development blocks have shape efficiency index value less than 0.84.. Within them, index value ranged from a high of 0.83 for Tarsika development block to a low of 0.41 for Bhunerheri in Patiala district. These were widely distributed in different parts of the state. However, five districts of Ferozpur, Hoshiarpur, Ludhiana, SAS Nagar and Tarn Taran have in combine two-fifth of all such blocks.

Six development blocks namely Hoshiarpur-2, Khuian Sarwar, Jalandhar-West, Ludhiana-2, Moga- 2 and Bhunerheri have shape efficiency index of less than 0.60. While Ludhiana-2 and Moga-2 have their headquarters outside the block territory, Khuian Sarwar and Bhunerheri have also peripheral location (Fig. 1d).

Table 1.4

Punjab: Development Blocks classified by shape efficiency index, 2011

Levels of Shape Efficiency	Name of the Development Blocks
High (Above state average, 0.84)	Rajpura (0.99),Sudhar (0.98),Bhawanigarh (0.98),Dhar Kalan (0.97),Lambi (0.97), Maur (0.97), Dera Bassi (0.97), Patiala (0.97), Samana (0.97), Pathankot (0.96), Bhikhiwind (0.96), Adampur (0.96), Chamkaur Sahib (0.96), Sardulgarh (0.96), Patran (0.96), Quadian (0.95), Bathinda (0.95), Sangat (0.95), Ropar (0.95), Morinda (0.95), Sangrur (0.95), Lehragaga (0.95), Nabha (0.95), Sujanpur (0.940, Bamyal (0.94), Ludhiana-1(0.94), Mahilpur (0.94), Majri (0.94), Sherpur (0.94), Narot Jaimal Singh (0.93), Harsha Chhina (0.93), Guru Harsahai (0.93), Malout (0.93), Garhshanker (0.93), Khamanon (0.93), Amloh (0.93), Kot Ise Khan (0.92), Jagraon (0.92), Budhlada (0.92), Khadoor Sahib (0.91), Chola Sahib (0.91), Mamdot (0.91), Talwandi Sabo (0.91), Sultanpur Lodhi (0.91), Dina Nagar (0.90), Jalalabad (0.90), Mukatsar (0.90), Gidderbaha (0.90), Kapurthala (0.90), Nurmahal (0.90), Anandpur Sahib (0.90), Fatehgarh Churian (0.89), Sidhwan Bet (0.89), Raikot (0.89), Nakodar (0.89), Mukerian (0.89), Balachaur (0.89), Mansa (0.89), Bhikhi (0.89), Dhuri (0.89), Malerkotla I(0.89), Patti(0.88), Mehal Kalan(0.88), Banga (0.88), Nurpur Bedi (0.88), Kharar (0.88), Sunam (0.88), Kotkapura (0.87), Shahkot (0.87), Andana (0.87), Gurdaspur (0.86), Makhu (0.86), Barnala (0.86), Dhilwan (0.86), Dasuya (0.86), Jhunir (0.86), Bassi Pathana (0.86), Sri Hargobindpur (0.85), Majitha (0.85), Lohian Khas (0.85),Talwara (0.85), Hoshiarpur (0.85), Dera Baba Nanak (0.84), Faridkot (0.84), Nathana (0.84), Rampura 0.84), Sehna (0.84), Khanna (0.84), Machhiwara (0.84),
Low (Below state average, 0.84)	Dorangla (0.83),Tarsika (0.83),Moga-2 (0.83),Pakhowal (0.83),Tanda (0.83),Batala (0.82), Ajnala (0.82), Chogwan (0.82), Jandiala Guru (0.82), Ghanaur(0.82), Dhariwal (0.81), Gandiwind (0.81), Khera (0.81)Firozpur (0.80), Nihal Singh Wala(0.80), Nadala (0.80), Bhunga (0.80), Saroya (0.80), Bhagta Bhaika (0.79), Aur (0.79), Bagha purana(0.78), Phagwara (0.78), Fazilka (0.77), Doraha (0.77), RurkaKalan (0.77), Kahnuwan (0.76),Naushera Panuan (0.76), Abohar (0.76), Sirhind(0.76), Verka (0.75), Ghal Khurd (0.75), Dehlon (0.75), TarnTaran (0.74), Samrala (0.74), Jalandhar-East (0.74), Bhogpur (0.74), Hajipur (0.74), Nawan Shahar (0.73), Zira (0.72), Phul (0.71), Sanaur (0.71), Kalanaur (0.69), Malerkotla-II (0.69), Rayya (0.67), Valtoha (0.61), Hoshiarpur-2 (0.56), Khuian Sarwar (0.55), Jalandhar-West (0.54), Ludhiana-2 (0.49), Moga-2 (0.42) and Bhunerheri (0.41).

Main Findings

Punjab showed shape index of 0.30 only, which is due to peripheral location of state capital and its triangular shape. Jalandhar division has highest shape efficiency index of 0.88 and Patiala at the lowest with index value of 0.82. However, low inter-division

differentials and relatively high value of shape efficiency index for all the four divisions speaks of efficient shape of administrative division in the state

Variety of factors like topography, drainage and international border has impact on the shape of districts. Large majority of the districts located in the central part of Punjab have high centrality index. Firozpur district located with international border and elongated shape has noted for lowest shape index (less than 0.50) in the state.

Shape efficiency index of subdivisions, in general, was for higher than the districts in the state. Topographic barriers and international location has played very little role on shape index of sub-divisions.Majority of newly organised districts and sub-division within the districts have better quality of shape efficicency in comparison to other kind of districts and sub-divisions. It is however, to be noted that disparity in shape efficiceny was much wider at sub-divisional level in comparison to district level in the state.

Development blocks have the highest shape efficiency index of all the administrative units at different hierarchical levels in local government administration in Punjab state. However inter-block disparity efficiency index was also the highest of all hierarchical levels.

Bibliography

Blair, D. J. and Bliss, T. S. 1984. The Measurement of Shape in Geography. *Quantitative Bulletin* 11.Nottingham: Department ogf Geography.

Government of Punjab. 2012. *Statistical Abstract of Punjab*, Chandigarh: Economic adviser to Government of Punjab.

Hagget, P. 1965. *Locational Analysis in Human Geography*, London: Edward Arnold.

Kant, S. 1989. Study of Shape of Administrative Areas in India, *Transaction, Institute of Indian Geographers* 11: 7-17.

Lee, D. R. and G. T. Sallee. 1970. A Method of measuring shape, *Geographical Review 60*: 555-563