

CLUSTER ANALYSIS FOR EXPLORING REGIONAL INDUSTRIAL SCENARIO IN ODISHA STATE, INDIA

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This study assesses the current industrial scenario using cluster analysis, and explores plausible perspectives for location of apposite industries in the geographical region bounded by the river valleys and flood plains of the State, Odisha state. Different clusters of industries are concentrated in different areas of the state. Most of the industries in small scale industries (SSI) sector are found to be ubiquitous. Majority of the industry categories available in the region have significant vertical (both backward and forward) linkages among themselves implying availability of significant potential for growth of industries in the region. Simultaneously, a number of industry categories, particularly electrical and electronics, engineering and metal, and steel and iron industries have predominant horizontal linkages resulting in severe competition and mutual repulsion within and among each other. There is a necessity to limit horizontal linkages among and within the industry categories in order to avoid competition for the long term sustainability of industries in the region. Besides, exploring of complementary relations based on the vertical linkages is essential while deciding the location of industries in the region so that they could become self reinforcing and sustainable.

INTRODUCTION

Industrialization is a prerequisite for economic development; industrialization creates social overheads in order to provide goods and services to both individuals and businesses for consumption as well as offers employment opportunities. Moreover, in agrarian regions, where a large proportion of the population are unemployed or disguised employed whose marginal product is zero or negligible, industrial development becomes more of a necessity for the development of the regions. Besides, if the regions in addition to their agriculture potential have abundant mineral resources of economic value, then industrialisation becomes inevitable. Recognising this significance, emphasis has been laid on the creation of a process for development of industrial sector in different states and regions of India since the late 1950s'. Odisha state of India is one such state of the country, which has made significant efforts in this direction. It is one of the first states of the country, which has industry friendly policy, provide infrastructure, and allow financial incentives to the entrepreneurs to create an ambient environment for industrial development. In consequence, there was a spurt in the setting up of industries in different regions of the state: small, medium and large scale industries, particularly since early 1980s. However, the progress of industrial development in many regions of the state is observed to be not significant despite the availability of plentiful of mineral and agricultural resources, friendly industry development policy, advantages of provision of infrastructure and financial incentives. The industries including those are in large and medium scale categories are registered every year, however, many of them either fail to take off or do not

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become sustainable during their operation and ultimately languish to sickness (Alivelu, Samal, Chakravarty and Sen, 2011). A number of studies have been conducted to understand the reasons for such poor industrial development scenario on regional basis or in the state as a whole (Behera, 2012; Mohapatra, 2015). Most of these studies focussed on the issues relating to government policy, structural frameworks, infrastructure provisions, industrial and business relations, finance and role of bureaucracy. However, studies relating to understanding of the industrial development scenario based on cluster analysis, inter-linkages among the industry categories, demand and resource potential are observed to be scarce. The objective of the paper is to assess the industry development scenario through cluster analysis, observe the inter-linkage among the various categories of industries, and explore plausible perspectives for location of apposite industries in different areas in a region of Odisha State, India. A survey of research method and cluster analysis was used for conducting the study. Findings revealed that different clusters of industries are concentrated in different areas of the region. Small scale industries (SSI) sector are found to be ubiquitous. Majority of the industry categories available in the region have significant vertical (both back ward and forward) linkages among themselves implying availability of significant potential for growth of industries in the region. However, a number of industry categories, particularly electrical and electronics, engineering and metal, and steel and iron industries have predominant horizontal linkages resulting severe competition and mutual repulsion within and among each other. There is a necessity to limit horizontal linkages among and within the industry categories in order to avoid unwarranted competition and for long term sustainability of industries in the region.

THE STUDY AREA AND THE REGIONAL INDUSTRIAL SETTING

The region consisting of three administrative districts, such as, Cuttack, Dhenkanal and Angul district located in the river valleys and flood plains between the Brahmani and Mahanadi rivers at their pre deltaic course of Odisha State (Fig. 1) is considered for the case study. It lies between 20°20'N to 20°55'N latitude and 85°10'E to 85°57'E longitude at an altitude of 35m above the mean sea level. The major industrial centres include Chowdwar and Jagatpur in Cuttack district, Mahisiapat and Gundichapada in Dhenkanal district, Nalco, Talcher, and FCI in Angul district. The entire region is surrounded by the resource rich hinterland of Angul, Dhenkanal, Cuttack, Keonjhar and Sundargarh districts. In addition to a significant agricultural resource base, minerals, such as, iron ore, coal, and chromites in huge quantity are available in and around the region. The region is well connected by both rail and road. The National Highway (NH) 42 connecting Cuttack and Sambalpur passes through the region. The NH 23, which branches off from NH 42 at Baranpal at a distance 50 Kms from Dhenkanal town passes through Talcher town and connects Ranchi in Jharkhand. Besides, there is a moderate network of major district roads and other district roads in the area linking several settlements of importance. The region is also well connected to major cities of India through East Coast Railway. The East Coast Railway network also links the settlements of the region among themselves by Puri Sambalpur double track broad gauge railway line.

Odisha is one of the least industrialised States of India. The state has experienced an industrial growth rate of 1.5% in last decade (2004 to 2013). The contribution of industries to the State GDP is lowest compared to other States (Behera, 2012) as well as the share is declining from at 23% in 2004-05 to 20% in 2013-14 (Mohapatra, 2015). Most of the large scale industries in the State are mineral based. Recently the State has become a favourite destination for major steel and aluminium producers of the World because of the availability of adequate reserves of iron ore and bauxite in the State (Behera, 2012; Mohapatra, 2015). The share of metal based industries is quite high (63.9%) and has been increasing over time but the sector is facing challenges to sustain this high growth rate (Alivelu, et al., 2011).

The State is going through structural changes in terms of diversification from an agrarian economy to industrial and service oriented economy; as a result the Small and Medium scale enterprises (SMEs) perform marginally better than before. Still the growth of industrial sector is observed to be not up to the mark (Mohapatra, 2015).

As per the survey conducted by the Micro, Small, Medium enterprise (MSME, 2011), majority of the industries in the region belong to the small scale industries (SSI) in terms of number of units. However, large and medium scale industries are dominant in terms of investment and employment. In Angul, there are 3900 industries, which include 10 large and medium scale industries. These industries employ about 19,500 employees in SSI and about 12000 employees in large and medium scale industries (MSME, Angul, 2011). Dhenkanal has 5636 industries including 15 large and medium scale industries. They employ about 40,000 people including 32808 people in SSI (MSME, Dhenkanal, 2011). Cuttack has 13126 industrial units including 19 large and medium scale units and employ 72,215 in SSI and 2708 employees in large and medium scale industries (MSME, Cuttack, 2011). From the locational setting point of view, availability of agriculture and mineral resources, availability of land and accessibility are the most important advantages for all most all categories of industries in the region. Although, there are challenges with regards to the availability of skilled labour, processed raw material, water, technology and market; environmental conditions and Government policies; yet they do not pose impediments for industrial development in the region. However, inadequate availability of power and capital are the major problems (Das and Devadas, 2012).

METHODS

Industrial survey and cluster analysis are followed in the investigation. A survey research method was employed to collect primary data from the industries located in the region. A total of 101 industries belonging of different categories, nature and types have been surveyed in the year 2011. The industrial survey was conducted in the locations where a large concentration of industries is located. Industries belonging to industrial estates or industrial areas in Jagatpur and Chowdwar of Cuttack district; Mahisiapat and Gundichapada locations of Dhenkanal district; and Nalco, Angul town, Talcher, and FCI of Angul district are chosen for the survey. Industrial units in these locations were approached randomly to participate in the survey, and the survey was conducted among the willing industrial entrepreneurs by using semi structured interview method. A sample size varying between 10 and 15 numbers of industries were selected in each location based on the availability and concentration of industries. Parameters related to individual industrial units, which influence the industrial activities of the region such as, types of industry, installation capacity, production position, demand, supply, employment, investment, inter-linkage among industries, challenges and opportunities, opinion on future prospects, etc., were included in the survey schedule. Followed by, structured statistical data was collected from authentic organisations located in the state, such as, Directorate of Industries, Cuttack and Directorate of Economics and Statistics, Bhubaneswar.

Cluster analysis is applied to observe the concentration and dispersion of industries in the region. Cluster analysis is carried out by using location quotient and coefficient of localisation models based on location theory. Various linkages among the industries, such as vertical (forward, and backward), horizontal and complementary linkages are analysed to comprehend the suitability of industrial locations and sustainability of the industries.

Cluster Analysis and its Relevance in Industrial Development

Clusters in general are interdependent firms or units that are linked through the buyer-supplier relationship, share common resources and technologies, depend on similar labour pool and

institutions, and rely on special infrastructure. Industry clusters are geographical concentrations of industries that gain performance advantages through co-location (Doeringer and Terkla 1995, p. 225; Fraser, 1998). Gibbs and Bernat (1997) further clarified the definition by identifying shared input-needs and inter-relationships with suppliers and buyers. Rosenfeld (1997) enlarged the connections to those companies/ industries that also provide complementary services, including consultants, education and training providers, financial institutions, professional associations and government agencies. From the industry perspective, it creates quality jobs, export goods and services, and unite the public sectors of economic development, legislatures at all levels, universities, educational community, workforce development, support foundations, and all community economic stakeholders (The International Society for Optical Engineering, 2000, n.p.). Industries in the clusters draw a productive advantage in being geographically located near the resources as well as on each other because it can help develop innovative products, build knowledge, create and enhance cooperation and competition among the industries (CMAP, 2009). Cluster analysis is a tool of scientific inquiry used to make inductive generalizations for analysing industrial scenarios and industrial sustainability (Anderberg, 1973; Yang, Miao, 2014; Zeng, Liu, Tam, Shao, 2008), which is essential to understand the industrial scenario in a region.

Location Quotient and Coefficient of Localisation

The location quotient (Lw) measures both the degree of an area's specialization in an activity and the degree of concentration of the activity in the area. In cluster analysis it measures an industry's concentration in a locale relative to the nation, state or a region. While doing so it assumes uniform local consumption patterns and labour productivity across the nation or state (Munnich, 1999; Walker, 1980). The calculation results in a ratio that if equal to one means that the industry share of local employment is equal to the industry share of national employment. A Lw less than one may imply that a locale is not producing enough of the good or service requiring those goods and services to be imported from other areas (Munnich, 1999). A Lw greater than one suggests that the supply of goods or services is greater than the local demand. The industry has the capacity to generate additional income for the locale by exporting surplus goods or services. The Lw allows analysts to distinguish between non-basic (solely dependent on local conditions) and basic (influenced by non-local conditions) industries (Klosterman, 1990). The model is presented in Eq. (1).

$$Lw_{ij} = \frac{W_{ij}}{\sum_{j=1}^m} \bigg/ \frac{\sum_{j=1}^n W_{ij}}{\sum_{j=1}^n \sum_{i=1}^m W_{ij}} \quad (1)$$

where Lw_{ij} = Location quotient of the i th industry in j th location, W_{ij} = employment in i th industry j th settlement $i = 1, 2, 3, \dots, n$ industry categories and $j = 1, 2, 3, \dots, m$ industrial areas.

The coefficient of localisation shows the propensity of the industries to concentrate. Industries with low coefficient can thrive in different areas and are thus dispersed in nature. On the other hand higher coefficients show that the industries are centralised and concentrated in nature. The model is presented in Eq. (2).

$$Cw_i = \frac{1}{2} \sum_{j=1}^m \left[\left| \frac{W_{ij}}{\sum_{i=1}^n} - \frac{\sum_{i=1}^n W_{ij}}{\sum_{i=1}^n \sum_{j=1}^m W_{ij}} \right| \right] \quad (2)$$

where Cw_i = Coefficient of localisation of i th industry, W_{ij} = employment in i th industry j th settlement $i = 1, 2, 3, \dots, n$ industry categories and $j = 1, 2, 3, \dots, m$ industrial areas.

RESULTS AND DISCUSSION

The coefficient of localization and location quotient analyses are carried out under two groups (1) all industries (includes all large, medium and small scale) sector and (2) small scale industries (SSI). SSI sector is considered separately because of their predominant presence in the region and to avoid any sort of inconsistency in the analyses. The various industries are grouped into different clusters based on the guidelines of the Government of Odisha and Economics survey report (2014–15). Table 1 presents clusters of industries in the region and their coefficients of localisation. It is found that industries belonging to steel and iron, chemical and allied, electrical and electronics, power and energy, paper and paper based products, textile, and engineering and metal categories under all industries sectors have relatively higher coefficients of localization (> 0.5); therefore are concentrated and need specific locations in the region. Among these industry categories, steel and iron (0.863), engineering and metal industries (0.751) and power and energy (0.674) have shown relatively high concentration. This phenomenon occurs because of the presence of significant numbers of medium and large scale industries in the region. However, most of the industries in SSI sector have lower coefficients of localisation, which implies that these industries are not concentrated and thus are dispersed throughout the region.

Table 1: Coefficient of Localisation of Industries in the Region

Category of Industries	Coefficient of Localisation	
	All Industries	Small Scale (SSI)
Agro based	0.263	0.240
Chemical and allied	0.587	0.210
Electrical and Electronics	0.574	0.353
Engineering and metal	0.751	0.142
Steel and Iron	0.863	0.254
Forest and Wood based	0.255	0.222
Building materials	0.355	0.362
Cement and ceramic	0.396	0.211
Live stock and leather	0.534	0.434
Paper and paper products	0.574	0.229
Rubber and Plastic	0.354	0.291
Textile	0.572	0.171
Energy and power	0.674	0.052
Miscellaneous manufacturing	0.063	0.043
Repair and services	0.086	0.045

Coefficient of Localisation of Industries in the Region

The analyses of location quotients are also conducted under two sectors as discussed above (all industries and SSI) in four of the most important industrial areas of the region, such as, Angul (Angul town and Nalco), Talcher (Talcher town and FCI), Chowdwar (Jagatput and Chowdwar), and Dhenkanal (Gundichapara and Mahisiapat). The different industrial areas/estates, which are in close proximity of each other, are considered together in the respective major industrial areas

of the region. Table 2 and Table 3 present the location quotients of the industrial clusters in the above mentioned areas of the region. The analyses revealed that under all industry sectors particular industry categories are concentrated in specific areas of the region, although, several industry types are dispersed in the whole region. As observed, engineering and metal, power and energy, steel and iron, forest and wood industries are concentrated in Angul. Power and energy, building materials, forest and wood products, rubber and plastics, paper and paper based products are concentrated in Talcher. Chowdwar has seen the concentration of agro and food based, steel and iron, electrical and electronics, textile, cement and ceramic, rubber and plastic, and paper and paper based industries.

Table 2: Location Quotients of All Categories of Industries in the Region

Category of Industries	Location Quotients			
	Angul	Talcher	Chowdwar	Dhenkanal
Agro based	0.496	0.499	1.675	1.407
Chemical and allied	0.118	3.686	0.416	0.235
Electrical and Electronics	0.441	0.267	2.857	0.356
Engineering and metal	2.748	0.129	0.473	0.438
Steel and Iron	1.367	0.876	2.766	3.254
Forest and Wood based	1.252	1.634	0.	1.768
Building materials	0.307	2.155	0.558	0.609
Cement and ceramic	0.325	0.866	2.193	2.781
Live stock and leather	0.312	0	0	1.866
Paper and paper products	0.312	1.229	2.194	0.486
Rubber and Plastic	0.392	1.484	1.896	0.328
Textile	0.922	0.106	2.195	1.251
Power and Energy	1.897	2.542	0.467	1.053
Miscellaneous manufacturing	0.828	1.307	1.216	0.951
Repair and services	0.818	1.025	0.882	1.360

Table 3: Location Quotients of Small Scale Industries (SSI) in the Region

Category of Industries	Location Quotients			
	Angul	Talcher	Chowdwar	Dhenkanal
Agro based	1.073	1.083	0.944	0.899
Chemical and allied	0.474	1.013	1.940	0.628
Electrical and Electronics	0.431	0.715	2.587	0.454
Engineering and metal	1.104	0.868	1.540	0.621
Steel and Iron	1.235	0.743	1.464	1.745
Forest and Wood based	1.069	1.298	0.	1.442
Building materials	0.317	2.234	0.639	0.497
Cement and ceramic	1.420	0.531	0.639	1.449
Live stock and leather	0.312	0	0	0
Paper and paper products	0.503	0.580	1.978	1.042
Rubber and Plastic	2.189	0.580	1.178	0.082
Textile	0.791	0.624	1.028	1.601
Power and energy	—	—	—	—
Miscellaneous manufacturing	0.168	0.936	1.113	0.846
Repair and services	1.058	0.848	1.011	1.110

Dhenkanal has more concentration of iron and steel, agro and food based, forest and wood, cement and ceramic, livestock and leather, textile and power and energy industries. However, in SSI sector majority of industries have found to be dispersed and all the four industrial areas have shown similar trends. It is also found that steel and iron in all most all areas of the region, engineering and metal in Angul, forest and wood based industries in all areas except Chowdwar, cement and ceramics, and textile in Chowdwar and Dhebnkanal, live stock and leather industry in Dhenkanal, paper and paper based products, and rubber and plastic industries in Talcher and Chowdwar, power and energy industries in Angul, Talcher and Dhenakanal have location quotients higher than 1.0. This entails to two implications: (1) on the negative side these industries exceed the local demand and therefore, further growth will result in competition in the region, and (2) on the positive side, if they have the capacity, then can generate additional income from exports of their surplus products.

Furthermore, an analysis regarding the prospective industries in the region was conducted to observe the future scenario. The analysis is carried out from three different perspectives based on influential factors, such as, (1) based on resource availability, (2) local demand and (3) priorities given by the Government and is presented in Table 4. It is found that based on resource availability, agro and food based, and mineral based industries have the potential to grow in the region. Similarly,

Table 4: Prospective Industries based on Different Influential Factors in the Region

Industries based on Resource Availability	Industries based on Local Demand	Industries based on Government Priorities
Agro and food based Paddy processing, Cattle food, Edible oil extractor, Jute product and jute woven products, Fruit drinks, Cashew processing, Milk products	Agro and food based Canning and preservation of food, Processing and packing of cereals and pulses, Bakery and confectionaries	Agro and food based Sugar manufacturing
	Electrical and Electronics Domestic electrical appliances	Electrical and Electronic industries Television, Computer
	Chemicals and allied Candle manufacturing, Detergent and washing powder, Printing press and binding, Match and fire works	Chemicals and allied Synthetic fabric, Export oriented carpets
Engineering and metal Ferro alloys		Engineering and metal Ferro chrome, Aluminium rolled products
Mineral based Coal based such as coal briquettes and heat woven, Mineral calcinations, Mineral grinding, Power and energy		Rolled steel products
	Building materials Fly ash bricks	Building materials Fly ash bricks
	Textile Textile based handlooms and Khadi	Textile Polythene fibre yarn, Cotton fabric
Miscellaneous manufacturing	Paper based products Printing press and binding	
Repair and services	Repairing and services	

processing of agro and food based products, electrical and electronics, textile, chemical and paper based industries have local demand in the region. The Government, however, has given priorities to engineering and metal, steel and iron, electrical and electronics, sugar (agro and food based) and synthetic fibre industries in the region.

Inter-linkage among the various industry categories shows that each industry category has vertical (both backward and forward) linkage with several industry categories in the region (Table 5). Vertical linkages normally imply mutual attraction. Backward linkage means that the mutual attraction is important mainly to the supplying activity. In other words, a market-oriented activity is attracted by the presence of an activity to which it can sell. Backward linkage is extremely common because so much of the activity in any region is, in fact, producing for and oriented to the regional market. The larger the region (in terms of total area, population, or employment), the greater the relative importance of the internal market is likely to be. Forward linkage means that an impact of change is transmitted to an activity further along in the sequence of operations. The activity affected by a forward linkage must be locationally sensitive to the price or supply of its inputs (that is, input-oriented). In the regional context of the case study, this implies that all the industry categories have significant potential for growth in the region in all sectors. On the other hand, although, currently there seems to be mutual attraction among most of the industry categories, certain industry categories such as, steel and iron, engineering and metal, textile, rubber and plastic, and cement and ceramics industries may not be able to sustain the backward linkage scenario for longer terms because of their higher concentration in the region and limited extent and demand of the region and its hinterland including the whole State.

Table 5: Vertical (Backward and Forward) and Horizontal Linkages among the Industries in the Region

Category Number	Category of Industries	Inter-linkage		
		Backward Linkage	Forward Linkage	Horizontal Linkage
1	Agro based	1	1, 2, 12	Predominant
2	Chemical and allied	2, 3, 4, 11	2, 3, 4, 15	Not so Predominant
3	Electrical and Electronics	3, 10, 11	2, 4, 7, 12, 14, 15	Predominant
4	Engineering and metal	4, 11, 14	2, 4, 9, 12, 14, 15	Predominant
5	Steel and Iron	5	4, 7	Predominant
6	Forest and Wood based	6	1, 6, 9	Not predominant
7	Building materials	1, 7, 8, 10	7	Not so predominant
8	Cement and ceramic	8	2, 7, 14	Not so predominant
9	Live stock and leather	6	9, 11	Not predominant
10	Paper and paper products	1, 6	3, 7	Not so predominant
11	Rubber and Plastic	2	3, 4, 7	Not predominant
12	Textile	1, 3	—	Not so predominant
13	Power and energy	13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15	Not so predominant
14	Miscellaneous manufacturing	3, 4, 8	3, 4, 7, 8	Not so predominant
15	Repair and services	3, 13, 14	3, 4, 14, 15	Not predominant

Besides, many industry categories, such as, agro based, electrical and electronics, engineering and metal, and steel and iron industries are found to have predominant horizontal linkage within their

categories. Such horizontal inter-linkage involves competition of activities, or units of activities, for either markets or inputs. Consequently, the locational effect is basically one of mutual repulsion in contrast to the mutual attraction implied in vertical linkages (backward and forward) as seen in the region. The mutual repulsion among the industries in the region will dampen the growth of such industries, which could have strengthened the forward linkage otherwise. The entrance of new industries in these industry categories will hamper further development of industrial activities in the region. Particularly, the rivalry of different activities for example, procurement of resources, acquiring skilled labour, selling of the products, expenses in promotions, etc., could become a significant obstacle for regional industrial growth and could become a major cause of concern for industrial sickness.

It could be construed that although, there is significant potential for development of industries in the region in almost all categories, the limited extent and demand of the region and the state as a whole, mutual repulsion and competition exist in the market within industry categories because of high concentration and horizontal linkage in the industrial development in the region.

Further, since, there is not much variation in the infrastructure facilities in the region; a perspective distribution of industries has been attempted based on the cluster analysis, concentration of the industries in the region, vertical and horizontal linkages, complementary relations among industry categories, and potential of the region for appropriate industrial development in the region. As given in the Table 6, engineering and metal, forest and wood based products and electrical and electronics industries have high potential for growth in Angul. Talcher is suitable for chemical and allied industries, building materials, paper and paper based products and power and energy industries. Chowdwar has the potential for the growth of agro and food based, electrical and electronics, paper and paper products, rubber and plastic, and textile industries. Besides, agro and food based, engineering and metal, cement and ceramics, chemicals and allied, and textile based industries can grow significantly in Dhenkanal.

Table 6: Perspective Industries in Different Areas of the Region

Angul	Talcher	Chowdwar	Dhenkanal
Engineering and metal	Chemical and allied	Agro and food based	Agro and food based
Forest and wood	Building materials	Electrical and Electronics	Engineering and metal
Electrical and Electronics	Paper and paper based products	Paper and paper products	Cement and Ceramics
	Power and Energy	Rubber and plastic	Chemical and allied
		Textile	Textile

Evidently, there are several industries that are ubiquitous in nature particularly in SSI sector, which could thrive in any area of the region and need not be required to be concentrated. Simultaneously, care should be taken to avoid the increase in horizontal linkages among and within the industry categories in order to evade the un-warranted competition and mutual repulsion for the sustainability of the industrial development. Rather, complementary relations, such as, mutual attraction among suppliers of complementary products and mutual attraction among users of jointly supplied products need to be explored.

CONCLUSION

This study assessed the industry development scenario in a region of Odisha state of India. Concentration and dispersion of the industries are examined; inter-linkage among the various categories of industries are established; and plausible perspectives for location of appropriate

industries in different areas in the region are explored. A survey research method and cluster analysis was resorted to realise the aim of the study. The findings of the study revealed that particular categories of industries are concentrated in specific areas of the region. Evidently, engineering and metal, power and energy steel and iron, forest and wood industries are concentrated in Angul. Power and energy, building materials, forest and wood products, rubber and plastics, paper and paper based products are more concentrated in Talcher. Chowdwar has seen concentration of agro based, steel and iron, electrical and electronics, textile, cement and ceramic, rubber and plastic, and paper and paper based industries. Dhenkanal has concentration of iron and steel, agro and food based, forest and wood, cement and ceramic, live stock and leather, textile and power and energy industries. However, most of the industries in SSI sector are ubiquitous in nature and are not spatially concentrated. It is also seen that majority of the industry categories have significant vertical (both backward and forward) linkages among themselves, which implies that there is significant potential for growth of industries in the region. Simultaneously, it is found that a number of industry categories have predominant horizontal linkages within and among themselves. This implies that there is severe competition and mutual repulsion within and among these industry categories, which include electrical and electronics, engineering and metal, and steel and iron industries.

It is found that different areas of the region have potential for the location and growth of specific industry categories as perceived from the various inter-linkages, cluster analysis, resource potential of the region, demand for products and government priorities. Consequently, a number of prospective industry categories have been explored to be located in different areas of the region. Concurrently, it is also proffered that complementary relations, such as, mutual attraction among suppliers of complementary products and mutual attraction among users of jointly supplied products need to be explored based on the vertical linkages while deciding the location of industries in the region so that the industries could become self reinforcing. There is a necessity to limit horizontal linkages among and within the industry categories in order to avoid unwarranted competition for the long term sustainability of industries in the region. The findings of the study provide an insight to the current scenario and future industrial development perspectives, which shall assist the entrepreneurs and policy makers regarding the choice and location of industries in the region.

REFERENCES

- Anderberg, M. (1973): *Cluster Analysis for Applications*, Academic Press, New York.
- Alivelu, G., et al (2011): *A Thousand Industries in a Thousand Days? State Business Relations and The Puzzle of Orissa's Industrial Performance*, Centre for Economic and Social Studies, Working Paper No. 97, 3–36.
- Behera, D. K. (2012): *Economic growth and sectoral linkages: empirical evidence from Odisha*, *Journal of Regional Development and Planning*, Vol. 1 (.2), 91–102.
- CMAA (2009): *Industry Cluster Analysis: Regional Economic Base Analysis*, Technical Document, Chicago metropolitan agency for planning, pp. 19, June 2009.
- Doeringer, P. B. and Terkla, D. G. (1995): *Business strategy and cross-industry clusters*. *Economic Development Quarterly*, 9, 225–37.
- Das, D., Devadas, V. (2012): *Planning for Regional Tourism development*, LAP LAMBERT Academic Publishing, Germany. ISBN-10: 3659245704, ISBN-13: 978-3659245701.
- Economic survey Report (2014–15): Directorate of Economics and Statistics, Govt. of Odisha.
- Feser, E. (1998): *Old and New Theories of Industry Clusters*. In *Clusters and Regional Specialisation*: by M. Steiner (Ed.) Pion Ltd., (www.pion.co.uk/ep/errs/errs1st.html)

- Gibbs, R. M. and Bernat Jr., G. A. (1997): Rural industry clusters raise local earnings. *Rural Development Perspectives*, 12(3), 18–25.
- Klosterman, R. E. (1990): *Community and Analysis Planning Techniques* (Chapter 10). Savage, Maryland: Rowmand and Littlefield Publishers, Inc.
- Mohapatra, D. R. (2015): An Empirical Analysis of Progress and Prospects of the Economy of Odisha State of India, *European Academic Research*, Vol. 2(2), 14620–14635.
- Munnich, L. W. (January 1999): *Industry Clusters: An Economic Development Strategy for Minnesota, Preliminary Report*. [Electronic Version]. Retrieved July 12, 2000 from <http://www.hhh.umn.edu/centers/slp/projects/edweb/ic-rep.htm>.
- MSME (2011): Annual report, Ministry of Micro, Small and Medium enterprises, Govt. of Odisha.
- MSME (2011): Brief Industrial Profile of Angul Cuttack and Dhenkanal district Ministry of Micro, Small and Medium enterprises, Govt. of Odisha.
- Rosenfeld, S. A. (1997): Bringing business clusters into the mainstream of economic development. *European Planning Studies*, 5(1), 3–23.
- The International Society for Optical Engineering (2000): What is a cluster? [Electronic Version]. Retrieved March 24, 2003 from [http://www.photonicsclusters.org/whatisa cluster.html](http://www.photonicsclusters.org/whatisa%20cluster.html).
- Walker, F. David (1980): *Planning for Industrial Development*, John Wiely and Sons.
- Yang, Weiwei and Miao, Ran (2014): The Application of Cluster Analysis in the Classification of Chinas Modern Service Industries, *Journal of Service Science and Management*, 7, 377–389, Published Online December 2014 in SciRes.
- Zeng, S. X., Liu, H. C., Tam, C. M. and Shao, Y. K. (2008): Cluster analysis for studying industrial sustainability: an empirical study in Shanghai, *Journal of Cleaner Production*, 16, 1090–1097.