Study on Spatio- Economic Relationship of Industries in Greater Nagpur Area

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Abstract--- *This paper is an attempt to address the spatio-economic relationship of the industries and the general theory and challenges relating to the industrial location. The existing industrial performance of the region, the top performing and lagging industries of the region along with the spatial analysis were ascertained, using tools like shift share analysis, location quotients and delineation tools such as land and economic suitability matrix. Nagpur is becoming one of the major nuclei for Industrial Growth in the State of Maharashtra and the country in a larger perspective. Thus, this paper tries to represents the regional industrial environment through proper industrial mix where the enterprises can make profit by determining spatial margin to profitability. It can be used as the foundation for enterprises to select locations and type of industries in the overall scope of industry allocation.*

Keywords--- *Industry Allocation, Inter Industrial Linkages, Location Quotients, Shift and Share Analysis, Spatio-Economic Relationship*

PREAMBLE - "WHAT ARE THE REASONS FOR THE LOCATION OF A PARTICULAR ENTERPRISES OR INDUSTRY IN A SPECIFIC AREA? IS IT JUST A SNAP DECISION OR IS THERE MORE OF A SCIENCE TO THE DECISION?"

BY ALFRED WEBER [1]

I. INTRODUCTION

AMONGST the policies for overall economic development industries plays an important role. Industrialization is one of the major solutions for raising the level of economy and providing employment opportunities. It focuses both on the region and the people's creativity, skill and talent (Issard, 1960). Economic factors play a vital role in the growth of the industries such as availability of land, raw materials, labour, transport and infrastructure. The industrial development is primarily linked with increasing investment, generating employment and socio-economic development of the region. For the sustainable industrial growth, there is a need to develop the industries in all the three aspects (i.e. economic, environment and social) and positioned in a spatial location allocation framework.

Nagpur remains a city with tremendous economic potential. Today, due to the combination of changed political will and history of cordial industrial relations Nagpur is on the brink of rapid economic development. Being uniquely situated at the geographical centre of India, it is becoming one of the

major nuclei for Industrial Growth in the State of Maharashtra and the country in a larger perspective. Currently, industrial growth is more concentrated to the Butibori industrial zone which lies close to the NH-7. Butibori industrial area is serving as one of the major venues for a large number of industries and is getting itself established as a five star industrial zone.

A group of constantly developing industries located around the Nagpur urban areas has induced the further concentration of industries and thus affecting the surroundings. Hence, there is a need to avoid excessive concentration and haphazard development of industries for the sustainable industrial growth. Thus, this paper puts up the study on the spatio-economic relationship of the industries in Greater Nagpur area to identify the constantly developing industries in and around Nagpur region, thereby enhancing inter-industrial linkages, spatial distribution of industries and hence developing the investment scenario by representing the regional industrial environment for the sustainable industrial growth.

II. IDENTIFICATION OF MAJOR ISSUES

Industrial progress cannot be achieved easily as it is preconditioned by several factors. The important ones being availability of land, capital, industrial enterprises, labour, availability of raw materials and good markets, speedy and efficient means of transportation. To understand the present scenario of the industrial development in Nagpur region certain studies were done. Based on the study some of the major issues are identified both at the regional and local level (Table 1).

Table 1: Issues of Concern

Issues	Description
Sectoral issue	Contribution of per capita income to Gross Domestic Product (GDP) in Maharashtra state is more in service sector as compared to manufacturing sector. [2]
Category mix/ Imbalance issue	In the Nagpur region almost all industrial area fall under the D or D+ category which reflects a very low level of industrial development. [3]
Environment issue	From the pollution control board report it is found out that maximum Large Scale industries are red in nature in the Nagpur Region. [4]
Composition Issue	Nagpur region has mainly SSI (Small Scale Industries) which constitutes 96% of total industries, while MSI (Medium Scale Industries) and LSI (Large Scale Industries) contribute only 2% each. [4]
Location issue	Impact of the newly proposed industrial belt

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	<p>in Butibori area.</p> <p>The distance from Butibori industrial area to the Nagpur city which is the major urban center with 20.52 Lakhs population (i.e 50% of Nagpur district) is approx. 30 Km and hence, it results in increased trip length for the major commuter.</p>
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So, in a bid to build a competitive environment; industries & their ancillaries have to be promoted in clusters, based on the availability of raw materials, skilled labour, and market potential and through proper industrial mix.

III. INDUSTRIAL LOCATION IN AND AROUND NAGPUR REGION

Maharashtra Industrial Development Corporation (MIDC) classifies industrial areas into 4 types. They are five star industrial area, Major industrial area, and Mini industrial area and Growth centers. Amongst all the industrial areas in and around Nagpur region, four major industrial zones are identified as these nodes attain special significance in terms of their proximity to the highly urbanized region (mainly Nagpur urban area) and adjoining industrial clusters. These areas are Butibori industrial area, Kalmeshwar industrial area, Hingna industrial area and Wardha industrial area as shown in Figure 1. Proposed project of MIHAN SEZ area is also taken into consideration as it will create huge impact on the Nagpur regional economic development in the years ahead.

From the primary survey and expert opinion survey it was found that the factors that make Nagpur an ideal investment destination are: i) availability of affordable land; ii) availability of qualified manpower at competitive prices; iii) well connectivity to the rest of the country; iv) upcoming international airport; v) history of cordial industrial relations; vi) easily available abundant natural resources like forest and minerals.

IV. LITERATURE STUDY

The study on spatial distribution of industries can be traced back to the Industrial Location Theory [5] of Weber, a German economist. Alfred Weber formulated a theory of industrial location in which an industry is located where the transportation costs of raw materials and final product is a minimum. However, Weber's model is a supply side model, and assumes static demand in either a single market or to a single distribution point to multiple markets. Further, David Smith's (1981) extended the Weber's model by assuming equal production costs across producers. This model is called the Weberian Least Cost Model. However, this is clearly not the case in the real world. Variations in scale of production and technology (how land, labour, capital, natural resource, and managerial inputs are transformed into output) can lead to variations in production costs. Hence, scale and technology factors can influence optimal location.

In August Losch's (1954) location theory [6], the main focus is on the economic aspect of the region. He proposed that each product has a specific demand curve, which varies according to the demographic density and the cost of transportation to the production centre brought upon the consumer. This approach was ignored by the Weber's least cost theory. Losch concludes that demand is more elastic in an industrial economy than in an agricultural economy, and supply is more elastic in an agricultural economy. Local differences in transport rates are considered in this theory.

Various location theories and economic models [7] helped to identify factors to establish the suitable locations for the new industries. Factors that influence where an industry/firm will choose to locate were determined. This can be classified under

Figure 1: Location of Industries in and Around Nagpur City [3]

two levels. One is spatial level and other is strategic level as shown in table 2. The following could all be considered as important but for some industry/firm, some of the factors will be more important than others.

Table 2: Factors Affecting Location Decisions

At spatial level	At strategic level
<ul style="list-style-type: none"> • Nearness to a Supply of Raw Materials • Nearness to Market • Nearness to a Supply of Labour • Nearness to Power • Proximity of Other Businesses - External Economies of Scale • Transport and Communication Services 	<ul style="list-style-type: none"> • The Reputation of an Area • Incentives • Competition • Opportunities for Expansion

V. SCENARIO ANALYSES

In order to emphasize on the scenario analysis of the Nagpur region, models were used like shift and share analysis, location Quotients and land and economic suitability matrix. The aim of this approach is to know the potential location for the industrial setup, sectoral and spatial share of the industries and competitiveness of industries within the region. The spacio- economic relationship of the industrial area in the Greater Nagpur area is also determined. The two major criteria for analysis are taken as the total no. of establishment and total no. of employment.

5.1 At District Level

The quotients for industrial location of the 6 districts in Nagpur region were obtained by determining the relationship between the employments and establishments with the population of the district. Location quotient indicates the concentration of employments or industries in a particular zone or location. Graph shows (Fig. 2) Nagpur, Bhandara and Gondia have high concentration of establishment and employment in accordance with its share at the region.

Figure 2: Graph Showing Location Quotients for Employment

When these three districts were compared (Table 3) with respect to population, no. of employment & no. of

establishment over the Nagpur region, it is observed that Nagpur District contributes the highest percentage of population along with the highest percentage share of employment and establishment.

Table 3: Table Showing the Total Population, Employment and Establishment in 3 Districts

Districts	% over Nagpur Region					
	Population		Employment		Establishment	
Nagpur	4346000	39%	545338	46%	211049	44%
Bhandara	1154000	10%	133924	11%	59050	12%
Gondia	1218000	11%	126700	11%	55162	11%

Under shift and share analysis, the data from fourth and fifth economic Census, Maharashtra State were analyzed [8]. From these data a distinction between the top performing and lagging industries were made. Shift-share analysis is one way to account for the competitiveness of a region's industries and to analyze the local economic base. It shows how well the region's current industries are performing by systematically examining the national, regional and local industrial components [9]. The formula used for the calculation of shift and share [10] is as follows:

Differential Shift

$$D_j = \{[\Delta X_{ij} / X_{ij}(t)] - [\Delta X_N / X_N(t)]\} * X_{ij}(t)$$

Proportional Shift

$$P_j = \{[\Delta X_{iN} / X_{iN}(t)] - [\Delta X_N / X_N(t)]\} * X_{ij}(t)$$

Total Shift

$$S_{ij} = [\Delta X_{ij} - \Delta / X_N(t)] * X_{ij}(t)$$

Where,

$X_{ij}(t)$ - Employment or no of establishment in 1998 at District level

$X_{iN}(t)$ - Employment or no of establishment in 1998 at Regional level

$X_N(t)$ - Employment or no of establishment in 1998 at State level

$\Delta X_{ij} = X_{ij}(t+r) - X_{ij}(t)$ Where, ΔX_{ij} is change in the no. of employment or in no. of establishment from year 1998 to 2005 at district level.

The shift and share analysis (Fig. 3) yields that, at district level there was a positive share of number of manufacturing industry while its regional share is negative from year 1998 to 2005. It means there is more increase in manufacturing industries at the Nagpur district compared to the overall Nagpur region. But there is negative share of employment in manufacturing industry at the district level. It means even if numbers of manufacturing industries have increased, employment in the manufacturing sector has decreased.

Figure 3: Economic Census Results- Industry Employment Mix at District Level (1998-2005) [11]

Hence, to understand the increase or decrease in number of various manufacturing industries and its employment generation the data from year 2006 to 2009 has been studied. All the manufacturing industries are classified under three heads-

- Consumer goods industries
- Intermediate goods industries
- Capital goods industries

Consumer goods industries are mainly resource based downstream industries (like textile industry), intermediate industries are mainly upstream industries (like steel rolled industry) and capital goods industries are mainly capital intensive industries (like automobile industry and heavy industries).

By considering percentage share of employment and establishment to the total value of respective criteria, Consumer goods industries and capital goods industries has shown the positive growth while the intermediate goods industries has shown declined trend both in terms of number and employment generation. Even if there was increase in consumer goods industries, the employment engaged in these industries were reduced. It indicates that employment generation is shifted towards the capital goods industries thus, affecting the local talent.

5.2 Spatial Analysis at District Level

Spatial analysis has been done combining the two matrixes [12]. One is the land suitability matrix and other is economic viability matrix to understand the spacio- economic relationship of industries in Nagpur district.

5.2.1 Land Suitability Matrix

Land suitability matrix is prepared by overlapping of Air pollution sensitivity matrix, Surface water sensitivity matrix and Ground water sensitivity matrix. After overlapping all these grid maps, a land suitability matrix (Fig. 3) was prepared. It is found that eastern and north eastern part of Nagpur district is more suitable for the agricultural activities as it has high water availability and has high fertile soil. While western and south western part is more suitable for non-agricultural activities. This area has plateau type of morphology and has shallow type of soil which is not suitable for agricultural activities. Even the concentration of waste land is high in this part which makes it more suitable for industrial development.

Figure 4: Percentage Total of Establishment and Employment as per the Classification of Industries

Figure 5a: Air Pollution Sensitivity Matrix

Figure 5d: Resultant of Fig. 5a, 5b and 5c

Figure 5b: Surface water pollution sensitivity matrix

Figure 5c: Ground water sensitivity matrix

5.2.2 Economic Suitability Matrix

An economic suitability matrix is prepared by overlapping terrain map, resource map and transportation map. The multi-criteria analysis was used to arrive at the economic suitability zones. After overlapping these three maps, economic suitability matrix (Fig. 4) was prepared. It is observed that the availability of minerals are more towards the northern part of Nagpur district but due to the higher concentration of settlements towards the northern part it results in higher land value near the more urbanized area. So southern part of Nagpur district is more suitable for industrial location. Even the rail linkages towards the southern part are well laid which will help to establish strong inter-industrial relationship between the industries.

Figure 6: Resultant of Resource Map, Transportation Map and Terrain Map

5.3 At local Level

Again, shift and share analyses was performed to understand the performance of the identified industrial area i.e. Kalmeshwar industrial area, Hingna industrial area,

Butibori industrial area and Wardha industrial area. The visible result for the local level (Fig. 5) shows that the Butibori industrial area has positive share at local level as well as at regional level, both in the case of establishment and employment. Though the rest of industrial areas have shown an increase in employment generation, the total increase in establishment is less.

Establishment Criteria			
Areas	Local share (D)	District share (P)	Regional share (S)
Kalmeshwar	-10%	9%	-12%
Hingna	-87%	74%	-118%
Butibori	5%	10%	39%
Wardha	-8%	7%	-9%

Employment Criteria			
Areas	Local share (D)	District share (P)	Regional share (S)
Kalmeshwar	8%	-11%	-2%
Hingna	46%	-62%	-11%
Butibori	42%	-24%	108%
Wardha	3%	-3%	5%

Figure 7: Best Industrial Location through Shift and Share Analysis by Considering Establishment Criteria (above) and Employment Criteria (below)

The data obtained from the secondary source, from the statistical department for each major industrial zone of study area, was analyzed. Table 4 shows that there is an increase in almost all types of manufacturing units in the Butibori industrial area from year 2005-06 to 2008-09 [13] except capital based industries, while in Kalmeshwar, Hingna and

Wardha capital-based industries have been coming up in the past 2-3 years.

Table 4: Increased or Decreased of Industries Based on the Classification of Industries

	Kalmeshwar	Hingna	Butibori	Wardha
Consumer goods industries	0%	0%	43%	0%
Intermediate goods industries	0%	0%	88%	0%
Capital goods industries	6%	1%	-49%	19%
Others(power supply industries, telecommunication, import export trading and machinery servicing)	11%	-15%	886%	0%
Service industries	50%	0%	36%	0%

Also, Table 4 indicates that there is decrease in the manufacturing units in Hingna industrial area. The reason might be the higher number of the closed units, which was found during the primary survey.

5.4 Spatial Analysis at Local Level

Based upon the secondary data for the year 2008-09, the location preferences for the above mentioned four areas were worked out by the two methods. One is weighted-factor scoring model and other is dimensional analysis technique. The weightage for each criterion was decided based on some basic study through literature and by understanding through primary survey and expert opinion survey.

Table 5: Weighted Factor Scoring Model

STATISTICAL DATA	L1	L2	L3	L4	Weightage (Wi)	Wi*L1	Wi*L2	Wi*L3	Wi*L4
Items	Kalmeshwar	Hingna	Butibori	Wardha					
No of plots allotted	153	1525	1636	343	0.10	15.30	152.50	163.60	34.30
Unit under production	147	1208	460	128	0.10	14.70	120.80	46.00	12.80
Unit under construction	2	36	232	17	0.10	0.20	3.60	23.20	1.70
Total no. of sick units	0	198	90	30	0.05	0.00	9.90	4.50	1.50
Annual turnover in Crs)	1007.73	2542.5	3960	20	0.30	302.32	762.75	1188.00	6.00
Total investment in Crs))	71.68	1715.4	5060	235	0.15	10.75	257.31	759.00	35.25
total employment	5236	29200	18645	1800	0.20	1047.20	5840.00	3729.00	360.00
					1.00	1390.47	7146.86	5913.30	451.55
Rank	3	1	2	4					
Result : L4< L1 < L3 <L2									

Above method showed the variant result with respect to location preference. Hence, considering the two factors i.e. employment and annual turnover, GIS contour map has been created for both the factors. After overlapping the two contour maps Fig 8 shows the resultant map. Here, the result shows that Butibori has high potential for industrial development followed by Hingna. Even though Hingna has shown negative growth at district and regional level, it has the potential at the local level with respect to employment generation.

Table 6: Dimensional Analysis Technique

STATISTICAL DATA	L1	L2	L3	L4	Weig htage (Wi)	(L1/L2) ^Wi	L1/L 3^Wi	L1/L4 ^Wi	(L2/L3) ^Wi	L2/L 4 ^Wi	L3/L 4^Wi
Items	Kalmeshwa r	Hingn a	Butibor i	Wardha							
No of plots allotted	153	1525	1636	343	0.10	0.79	0.79	0.92	0.99	1.16	1.17
Unit under production	147	1208	460	128	0.10	0.81	0.89	1.01	1.10	1.25	1.14
Unit under construction	2	36	232	17	0.10	0.75	0.62	0.81	0.83	1.08	1.30
Total no. of sick units	0	198	90	30	0.05	0.0	0.0		1.04	1.10	1.06
Annual turnover (in Crs)	1007.73	2542.5	3960	20	0.30	0.76	0.66	3.24	0.88	4.28	4.89
Total investment (in Crs)	71.68	1715.4	5060	235	0.15	0.62	0.53	0.84	0.85	1.35	1.58
total employment	5236	29200	18645	1800	0.20	0.71	0.78	1.24	1.09	1.75	1.60
						0.16	0.12	2.54	0.77	17.32	22.53
						L2 > L1	L3 > L1	L1 > L4	L3 > L4	L2 > L4	L3 > L4
						if A/B < 1, B is preferred	1	4	2	4	4
						if A/B > 1, A is preferred	Result : L4 < L1 < L2 < L3

Figure 8: Resultant GIS Contour Map of Two Factors-Employment and Annual Turnover

VI. PROPOSALS

The analysis helped to understand the entire existing industrial scenario in and around greater Nagpur area. Based on this study, an inter-industrial linkages flow chart (Figure 9) for the upstream, downstream and service industries supporting the manufacturing industries were worked out. It shows the link between various types of the downstream

industries with the upstream industries which helped to establish the right industrial mix. Then, industries present in the different industrial locations were identified to understand the interdependency of types of industries within the industrial zone in the Nagpur region, for proper industrial clustering. Thus, the spatial distribution of the industries around the greater Nagpur area is denoted as shown in Figure 10 below.

Figure 9: Inter – Industrial Linkages

Kalmeshwar

Figure 10: Flowchart Showing the Interdependency of Different Industrial Areas

CONCLUSIONS

Various factors help to determine the concentration of the new industries in the region. It's not only the availability of raw material, nearness to market and availability of employment in the region but the performance of the existing industries, local economic base and spatial distribution of surrounding industries also have a great influence on the decision of setting up any industrial zone in the city. Based on the above analysis, this paper concludes that the Major industrial areas in the Greater Nagpur region have great potential to enhance the Nagpur's local and regional economy

and to provide high employment opportunity, thus improving the overall lifestyle. The shift –share analysis and location quotient has provided a simple, straightforward approach in separating out the state and industrial contributions from local growth and hence, proved useful for targeting industries that might offer significant future growth opportunities. Also, the land and economic suitability matrix has provided easy way in identifying the suitable spatial location for the industrial zone. Thus, the spatio-economic relationship of industries through proper industrial mix will not only foster the regional

economic growth but also foster the progress of region into a domain of desired urbanization.

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