Socio-economic impact on Nivedita Setu, Kolkata, West Bengal – An insight through Exploratory Factor Analysis

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Abstract

Infrastructure, according to economists, is the backbone of each and every economy. Facts and figures plainly reveal that when given the option, investors prefer to invest in countries with more developed infrastructure. As a result, rapid infrastructure development is one of the most fundamental ways for a country to capitalise on diverse economic prospects. It is therefore unsurprising that countries all around the world place a high priority on infrastructure development. The current research was conducted on Nivedita Setu and was separated into several sub-sections using a structured questionnaire. The current study will attempt to assess socio-economic progress by examining potential for increased economic productivity, socio-economic competence to improve a long and healthy life, and equitable economic distribution. Exploratory Factor Analysis with Principal Component Analysis and the Varimax Method of Rotation are the key tools employed here.

Key words :- Nivedita Setu, Economic productivity, Structured questionnaire, Exploratory Factor Analysis, Principal Component Analysis

I. Introduction

Developing countries such as India have echoed this view, announcing plans to invest billions of dollars to create and enhance their infrastructure in order to keep up with the rest of the globe. As a result, infrastructure and its finance are critical issues worldwide, regardless of whether a country is developing or developed. Because infrastructure is such a high priority issue around the world, funding infrastructure projects is also seen as a huge concern. As a result, an entire field of study known as infrastructure financing has emerged.

Nivedita Setu (also known as Second Vivekananda Setu) is a multi-span extradosed bridge that connects Howrah and Kolkata in West Bengal. It was completed in 2007. It runs parallel to the ancient Vivekananda Setu, which opened in 1932 and is about 50 metres downstream. Sister Nivedita, Swami Vivekananda's social worker-disciple, is honoured with the bridge's name. The Belghoria Expressway connects the junction of NH 16 and NH 19 at Dankuni to NH 12, NH 112, Dumdum/Kolkata Airport, and the northern sections of Kolkata. The bridge has a capacity of 48,000 vehicles per day.

II. Brief Review of Literatures

According to **Klingebiel (2001)**, governments have offered grants, loans, and guarantees to investors as part of an overarching strategy to encourage private finance and provision of infrastructure services. This assistance has frequently been supplied through the use of institutionalized specialty financial facilities. Governments around the world are attempting to boost private capital flows into a variety of infrastructure sectors. However, private sector participation has been restricted, particularly in emerging nations, due to investor aversion to many of the commercial, financial, and political risks associated with large-scale projects.

Land sales as an infrastructure finance strategy were investigated by **Peterson (2006)**. The first section examines the land leasing procedure and its implementation in China, which has committed to transforming land assets into infrastructure on the largest scale. Many Chinese towns have financed half or more of their very high urban infrastructure investment levels directly through land leasing, with the rest financed through borrowing against the value of land on their financial sheets.

Green infrastructure, according to **Dunn (2010)**, is a cost-effective and ecologically friendly solution to water management and natural resource conservation in metropolitan environments. Green infrastructure, according to this article, has unique and exceptional benefits for the urban poor that are rarely acknowledged or discussed. Green infrastructure can improve urban water quality, reduce urban air pollution, improve public health, increase urban aesthetics and safety, produce green collar jobs, and assist urban food security when focused in impoverished neighbourhoods, which it often isn't.

Broadhurst et al. (2017) identified the fundamental trends and problems posed by the combination of the Internet's unparalleled reach, speed, and scale with violent extremists' political objectives. Cyber weapons, vital infrastructure, attribution, the Internet of Things, recruitment and propaganda, financing, legislation and countermeasures, and cyberwar are among the topics covered in the book. Each one includes a concise overview of a crucial facet of the cyber terror issue, a study of developing trends or views, and additional pertinent material or instances discovered during the investigation.

Morris (2019) claims that optimal approaches to infrastructure policy and design that detect specific types of market failures minimise financing costs and improve the ability to attract funding in the private provisioning of infrastructure. When state systems are poor organizationally it is first desirable to enhance the state capacity so that it can minimally undertake the responsibilities of design, regulation, development of frameworks, and of monitoring, for the private delivery of infrastructure. This is especially true when there are dual market failures resulting from both the natural monopoly and the appropriability failing.

III. Objectives of the study

- To highlight on the social as well as sociological impact of the Nivedita Setu.
- To focus on the economic impact of the select infrastructure.

IV. Research Methodology

The data collected for the study is primary in nature. The data has been collected with the help of a structured questionnaire. Random Sampling method has been used to select the respondents before interviewing.

At first a pilot survey has been conducted here within 30 respondents to gather a basic knowledge about the customers' perception regarding the selected bridges. Then on the basis of the factors identified a structured questionnaire in 5-point Likert scale has been prepared to conduct the market survey **amongst 130 respondents**. The Bridge is chosen on Judgemental Sampling Basis amongst the prominent bridges in Kolkata and its surroundings. Appropriate statistical tools and techniques including descriptive statistics, Exploratory Factor Analysis and multivariate analytical techniques will be used depending on the nature of data.

V. Results & Discussions

Gender of the Respondents: Out of the total respondents of 130, for this particular bridge, 84.6% are males and 15.4% are females.

Educational qualification of the Respondents: Majority of the respondents were below 10^{th} standard.

Monthly Incomes of the Respondents: Majority of the respondents were having monthly earnings below INR 5000.

Residential Area of the Respondents: Out of those 130 respondents, 38.5% belongs to the City areas, 30.8% belongs to the Town areas and only 30.8% belongs to the Village areas.

Climatic Conditions of the Study Area: Due to the formation & usage of the Nivedita Setu, no major changes came out in the climatic conditions of the nearby areas of the bridge and it remains to be natural.

Land Use of the Study Area: Due to the formation & usage of the Setu, Land usages are proper for maximum of the respondents.

Perception of Pollution in the Study Area: After the formation & usage of the Nivedita Setu, the maximum respondents said that the nearby areas of the bridge became unhealthy due to pollution.

Perception of Health & Hygiene in the related Study Area: As 57.7% of the respondents responded that the nearby areas of the bridge became highly unhygienic, so it can be concluded that, after the formation & usage of the Setu, the nearby areas of the bridge became highly unhygienic.

Perception of Changed Noise Level in the Study Area: After the formation & usage of the Nivedita Setu, the Noise Levels remained gone beyond tolerance limit according to the responses of the maximum respondents.

Perception of Changed Vibration in the Study Area: After the formation & usage of the Setu, majority of the respondents said that Vibration Levels are within their tolerance limits.

Past Emanation in the Study Area: After the formation & usage of the Setu, majority of the respondents said that Past Emanations are intolerable for them.

Traffic Jam in the Study Area: After the formation & usage of the Setu, majority of the respondents said that the traffic jams are normal for them in that area.

Solid Waste Disposal in the Study Area: After the formation & usage of the Setu, majority of the respondents said that the solid waste disposal are normal.

Drainage in the Study Area: After the formation & usage of the Nivedita Setu, majority of the respondents said that the drainage systems are within their tolerance limits.

Conveyance in the Study Area: After the formation & usage of the Setu, majority of the respondents are happy with the conveyance facilities they are receiving from the bridge.

Findings of Exploratory Factor Analysis

The responses of the questionnaire are measured on a Likert scale; hence they are continuous in nature. In the exploratory phase to find out the constructs from the dataset, Exploratory Factor Analysis has been conducted. The following sections represents the results: -

Table 1: KMO & Barlett's Test

Table 11.4.1.: KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.792
Bartlett's Test of Sphericity	Approx. Chi-Square	742.161
	df	210
	Sig.	.000

(**Source:** Primary Data compiled through SPSS)

The value of KMO is **0.792** which is much higher than 0.5 that indicates the sample is adequate for carrying out factor analysis. On the other hand, the control of Sphericity (Barlett's sig < 0.001) proves that EFA can be carried out.

Principal Component Analysis for Exploratory Factor Analysis

Principal component analysis (PCA) is a technique for lowering the dimensionality of such datasets, boosting interpretability while minimising information loss, according to **Ian T. Jolliffe & Jorge Cadima (2016)**. It accomplishes this by generating new uncorrelated variables that optimise variance in a sequential manner. PCA is an adaptive data analysis technique because it simplifies finding new variables, the principal components, to solving an eigenvalue/eigenvector problem, and the new variables are specified by the dataset at hand, not a priori. In order to carry

out Principal component analysis (PCA), and to identify the factors which have socio-economic impact on the respondents, there are twenty-one (21) variables which are extracted into eight (8) factors which **68.350% of the total variance.** The rotated component matrix has been developed with Principal component analysis as extraction method and Varimax with Kaiser normalisation.

Table 2: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.926	18.696	18.696	3.926	18.696	18.696	3.772	17.964	17.964
2	2.324	11.068	29.764	2.324	11.068	29.764	2.124	10.112	28.076
3	1.840	8.760	38.524	1.840	8.760	38.524	2.016	9.601	37.677
4	1.519	7.231	45.755	1.519	7.231	45.755	1.442	6.865	44.542
5	1.328	6.326	52.081	1.328	6.326	52.081	1.307	6.224	50.766
6	1.248	5.944	58.025	1.248	5.944	58.025	1.265	6.025	56.791
7	1.138	5.419	63.444	1.138	5.419	63.444	1.215	5.785	62.576
8	1.030	4.906	68.350	1.030	4.906	68.350	1.213	5.774	68.350
9	.923	4.397	72.748						
10	.865	4.121	76.869						
11	.736	3.505	80.374						
12	.667	3.178	83.552						
13	.548	2.608	86.160						
14	.534	2.543	88.704						
15	.481	2.289	90.992						

16	.473	2.253	93.245						
17	.364	1.733	94.979						
18	.325	1.548	96.527						
19	.265	1.264	97.791						
20	.236	1.124	98.914						
21	.228	1.086	100.000						
Extraction Method: Principal Component Analysis.									

(**Source:** Primary Data compiled through SPSS)

Table 3: Rotated Component Matrix

	Component							
	1	2	3	4	5	6	7	8
x1	.825							
x2	.800							
x3	.798							
x4	.793							
x5	.763							
x6	.727							
x7		.866						
x8		.814						
x9		.772						
x10			.883					
x11			.862					
x12								
x13				.824				
x14				.725				
x15					.805			
x16								
x17						-.847		

x18								
x19							.822	
x20								-.774
x21								

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 11 iterations.

(**Source:** Primary Data compiled through SPSS)

(**Source:** Primary Data compiled through SPSS)

Interpretation of the Factors as per Exploratory Factor Analysis

All the related variables were merged into eight Exploratory Factors like:

(i) **Exploratory Factor–1:** From the above table, it is seen that the first Factor (Factor 1) consists of variables X1, X2, X3, X4, X5 and X6. Thus, the first exploratory factor with six variables is named as **"Facilities and Increased Standard of Living".** The multiple regression equation for this variable **"Facilities and Increased Standard of Living"** is greater than 1 and is explained by the following formula:

$$B_1 = 0.825x1 + 0.800x2 + 0.798x3 + 0.793x4 + 0.763x5 + 0.727x6 \text{ ..... [i]}$$

(ii) **Exploratory Factor–2:** From the above table, it is seen that the second Factor (Factor-2) consists of variables X7, X8 and X9. Thus, the second exploratory factor with three variables is named as **"Adverse Effect on Climate and Illegal Logging".** The multiple regression equation for this variable **"Adverse Effect on Climate and Illegal Logging".** is greater than 1 and is explained by the following formula:

$$B_2 = 0.844x8 + 0.866x7 + 0.772x9 \text{..... [ii]}$$

(iii) **Exploratory Factor–3:** From the above table, it is seen that the third Factor (Factor-3) consists of variables X10 & X11. Thus, the third exploratory factor with two variables is named as **"Life Danger and Social Variations".** The multiple regression equation for this variable **"Life Danger and Social Variations" is** greater than 1 and is explained by the following formula:

$$B_3 = 0.883x10 + 0.862x11 \text{ ..... [iii]}$$

(iv)Exploratory Factor–4: From the above table, it is seen that the fourth Factor (Factor-4) consists of variables X13 & X14. Thus, the fourth exploratory factor with two variables is named as **"Urban Movement and Higher Education".** The multiple regression equation for this variable **"Urban Movement and Higher Education(B_{19})"** is greater than 1 and is explained by the following formula:

$B_4 = 0.824x13 + 0.725x14$ ..... [iv]

(v) Exploratory Factor–5: From the above table, it is seen that the fifth Factor (Factor-5) consists of variable X15. Thus, the fifth exploratory factor with two variables is named as **"Change in Livelihood Pattern".** The multiple regression equation for this variable **"Change in Livelihood Pattern(B_{20})"** is greater than 1 and is explained by the following formula:

$B_5 = 0.805x15 + 0.728x13$ ..... [v]

(vi)Exploratory Factor–6: From the above table, it is seen that the Sixth Factor (Factor-6) consists of variable X17. Thus, the sixth exploratory factor with one variable is named as **"Time and Cost-Effective Occupation".** The multiple regression equation for this variable **"Time and Cost-Effective Occupation"** is greater than 1 and is explained by the following formula:

$B_6 = 0.847x17$ ..... [vi]

(vii)Exploratory Factor–7: From the above table, it is seen that the seventh Factor (Factor-7) consists of variable X19. Thus, the seventh exploratory factor with one variable is named as **"Increased Cost of Living".** The multiple regression equation for this variable **"Increased Cost of Living"** is greater than 1 and is explained by the following formula:

$B_7 = 0.822x19$ ..... [vii]

(viii) Exploratory Factor–8: From the above table, it is seen that the eighth Factor (Factor-8) consists of variable X20. Thus, the eighth exploratory factor with one variable is named as **"Cultural Exchange".** The multiple regression equation for this variable **"Cultural Exchange"** is greater than 1 and is explained by the following formula:

$B_8 = 0.774x20$ ..... [viii]

VI. Conclusion

According to the EFA, it can be said that decision making in relation to the socio-economic impact of the **Nivedita Setu** on the respondents **(D_{SEIN})** depends on **seven** factors namely, **"Facilities and Increased Standard of Living", "Adverse Effect on Climate and Illegal Logging", "Life Danger and Social Variations", "Urban Movement and Higher Education", "Change in Livelihood Pattern", "Time and Cost-Effective Occupation", "Increased Cost of Living" & "Cultural Exchange" i.e.**

$$D_{SEIN} = \beta 1 + \beta 2 + \beta 3 + \beta 4 + \beta 5 + \beta 6 + \beta 7 + \beta 8$$

Furthermore, it may be stated that Vivekananda Setu had grown weakened as a result of its age, rising utility costs, and excessive traffic, making even repairs impossible. A second bridge was desperately required. As a result, Nivedita Setu was built parallel to it, about 50 metres (165 feet) downstream. Upstream traffic movement (Bally to Kolkata) is facilitated by Vivekananda Setu, whereas downstream traffic is facilitated by Nivedita Setu (from Kolkata to Bally). The main challenge was to design and build a new bridge that did not obstruct the view of the old Vivekananda Setu, did not dwarf the historically significant Dakshineswar Kali Temple, which is located well within visible distance, and could carry significantly higher levels of fast traffic for around half a century while also resolving all social and economic issues.

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