Research Paper

Socio-Economic Contributions of Living Industrial Heritage

A Correspondence Analysis of the Industrial Community in West Bengal, India

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Abstract

Living industrial heritage emphasizes the continuity of function, community engagement, and evolving cultural practices, making it a suitable framework for studying operating industrial heritage sites. Taking the case example of jute mills in West Bengal, India as living industrial heritage, this paper explores the impacts of five social and economic attributes. The paper uses correspondence analysis to evaluate the disparities in perception amongst the different occupational groups within the industrial community, including industrial workers, non-industrial employees, self-employed individuals, students, and retired or unemployed individuals. Data was collected from surveys conducted in six jute mill neighbourhoods along the Hooghly River. The study highlights the dual role of jute mills as both living industrial heritage and contemporary economic assets, using five socio-economic factors, which are, employability, community pride, willingness to pay, accessibility and tourism potential. The key findings include the level of agreement amongst the occupation groups and the inter-relationship of the socio-economic attributes with the occupation groups. The results indicate a higher level of agreement amongst the industrial workers for their willingness to pay for industrial skills development. Whilst the non-industrial works and self-employed individuals have higher agreement towards accessibility and tourism in living industrial heritage sites, indicating their interest in developing social infrastructure. With a focus on inclusivity, the study concludes with recommendations for future management of jute mill as living industrial heritage.

Keywords

Living industrial heritage, Jute mill, Socio-economic contribution, Industrial community, Correspondence analysis

1. Introduction

Living heritage sites comprise a distinct resident community that actively engages with the site and contributes to the local socio-economic landscape (Pham, 2015; Haselberger and Krist, 2022a; Raevskikh, Di Mauro and Jaffré, 2024). Historically significant industrial sites that are partially or fully operating, with complex layers of actively engaged stakeholders, require management as living heritage sites. However, most of the recognized industrial heritage sites, often reflect post-industrial or brownfield contexts. 4% of the total UNESCO World Heritage sites constitute industrial heritage, majority of which are post-industrial

landscapes (Falser and Yang, 2001). In India, however, their socio-economic value of UNESCO World Heritage Sites such as the Chhatrapati Shivaji Maharaj Terminus (formerly Victoria Terminus) and the Darjeeling Himalayan Railway is largely impacted by their continuous utility and ability to support local livelihoods. The jute industry in India, particularly along the Hooghly River in West Bengal, serves as one such example of how industrial heritage can be both a symbol of historical significance and a driver of contemporary economic growth (Rai, 1978; Stewart, 2017). The jute industry of West Bengal grew significantly in the early 20th century, employing over 300,000 workers, allowing migrants to settle and creating a cosmopolitan industrial society. (Palit and Kajaria, 2007; Bharadwaj and Fenske, 2012; Stewart, 2017). The social and economic fabric of this industrial landscape has been shaped by both the direct employment within the mills and the ancillary industries that developed around them, including transportation, trade, and services. Despite a decline in the global demand for jute products, most of these mills continue to operate (Rai, 1978), evolving into a form of living industrial heritage, functioning as historical landmarks and significant economic contributors. This research investigates how these dual roles impact the socio-economic well-being of the communities that continue to depend on the jute industry.

The paper commences with a literature review to establish the theoretical frameworks of living industrial heritage, from which the socio-economic components were determined. The subsequent section presents an overview of the topic area and delineates the research methodology. The results and debates are developed based on the methodology, followed by conclusions and recommendations for future research.

2. Literature review

2.1. Industrial heritage as living heritage

Living heritage is often characterized by active community engagement, and involves continuous evolution of cultural practices (Pham, 2015; Nugroho, Yuliastuti and Rukayah, 2021) which contributes to its dynamic nature (Haselberger and Krist, 2022b; Raevskikh, Di Mauro and Jaffré, 2024). The community participation for economic and social sustainability is further emphasized in studies referring to intangible cultural heritage as living heritage (Abdul Aziz *et al.*, 2023). In the context of industrial heritage, most studies have traditionally focused on post-industrial landscapes or brownfield sites, often addressing the challenges of conservation in abandoned or underutilized industrial spaces (Navratil *et al.*, 2018; Mostadi and Biara, 2019; Konior and Pokojska, 2020; Jóźwiak and Sieg, 2021; Kuzior *et al.*, 2021). These studies primarily investigate the repurposing of deindustrialized sites, with a focus on regeneration, adaptive reuse, and cultural heritage tourism. However, there is a notable gap in research on continuing industrial sites that maintain active production while simultaneously serving as heritage assets. These sites, hereby referred to as living industrial heritage, still function within their original industrial purpose but are increasingly recognized for their cultural and historical significance. While significant research has been devoted to post-industrial sites, there is a gap in the study of living industrial heritage and its association towards the engaged community.

2.2. Industrial community and socio-economic attributes

An industrial community is a socio-economic entity who are directly or indirectly involved in industrial operations, sharing a common culture related to industrialization (Hornborg, 2015; Zhang, Xu and Aoki, 2023). Studies examining how these sites serve both as heritage assets and active economic contributors have drawn attention to the socio-economic impacts on the community (Xu and Aoki, 2018; Claver, García-Domínguez and Sebastián, 2020; Zhang *et al.*, 2021; Yang, 2023; Mousavinia, 2024). Study of these literature led to the identification of the key socio-economic attributes which have been elaborated in this section.

Sense of pride, often linked to the collective memory, is a critical attribute in reinforcing social cohesion of industrial communities constituting the workers, residents, and other stakeholders (Coscia, Lazzari and Rubino, 2018; Rek-Wozniak and Wozniak, 2020). The willingness to pay for the ongoing usage, accessibility, and maintenance of live industrial historic sites reflects users' perceptions as significant economic contributors (Somoza-Medina and Monteserín-Abella, 2021; Kuzior *et al.*, 2022). Tourism as a regeneration strategy for declining industrial heritage is a well-researched area (Pawlikowska-Piechotka, 2010; Andrade-Suárez and Caamaño-Franco, 2020; Zhao and Liu, 2021; Berkenbosch, Groote and Stoffelen, 2022) and aims to identify if tourism is also perceived as a potential for living industrial heritage. Employability is crucial for economic sustainability (Canevaro *et al.*, 2019; Pardo Abad, 2020), whilst accessibility to the industrial landscapes may provide opportunity for enhancing social infrastructure (Heesche, Braae and Jørgensen, 2022). Studies discuss how living industrial heritage sites maintain local employment opportunities, while accessibility to these sites ensures inclusivity, promoting economic diversification and social engagement (Loures, 2015; Štrbíková, Vdolečková and Vitková, 2020). This study examines the impact of the five socio-economic attributes, which are, sense of pride, willingness to pay, tourism potential, employability, and accessibility, through a survey on the perceptions of the industrial communities.

3. Research methodology

The research aims to evaluate how different occupational groups within the industrial community perceive the socio-economic contributions of living industrial heritage. The study is conducted in four stages. The first stage involved a literature review for living industrial heritage studies which led to the establishment of the connection between the industrial neighbourhood and identification of the industrial community groups. Next, five socio-economic attributes were identified. Following this, the study area and demographic composition was identified, based on which the questionnaire was designed. Finally, the data was analysed using appropriate statistical technique for the collected data type.

3.1. Study area

The jute mills situated along the Hooghly River in West Bengal, India, founded in the mid-19th century, were instrumental in converting the region into an industrial centre. By the 1920s, more than 50 mills flanked both riverbanks, forming a continuous industrial landscape (Ali, 2012; Dey, 2018). This development stimulated urbanization and significant in-migration, leading to the formation of cohesive worker communities (Palit and Kajaria, 2007; Bharadwaj and Fenske, 2012; Ghosh, 2016). The forward and backward linkages of the jute mills influenced livelihoods through practices of cultivation, transport, and marketing (Sethia, 1996). Despite setbacks in the industrial growth due to partition of Bengal after independence, the mills remain key to the historic industrial identity of the region (Bharadwaj and Fenske, 2012), thus serving as an appropriate case example of living industrial heritage. The study identified six of the operating jute mills (refer Figure 1) located along the Hooghly River: Hukumchand Jute Mill, Gondalpara Jute Mill, India Jute Mill, Hastings Jute Mill, Hooghly Jute Mill, and Bauria Jute Mill, with existing industrial community in the respective neighbourhoods.

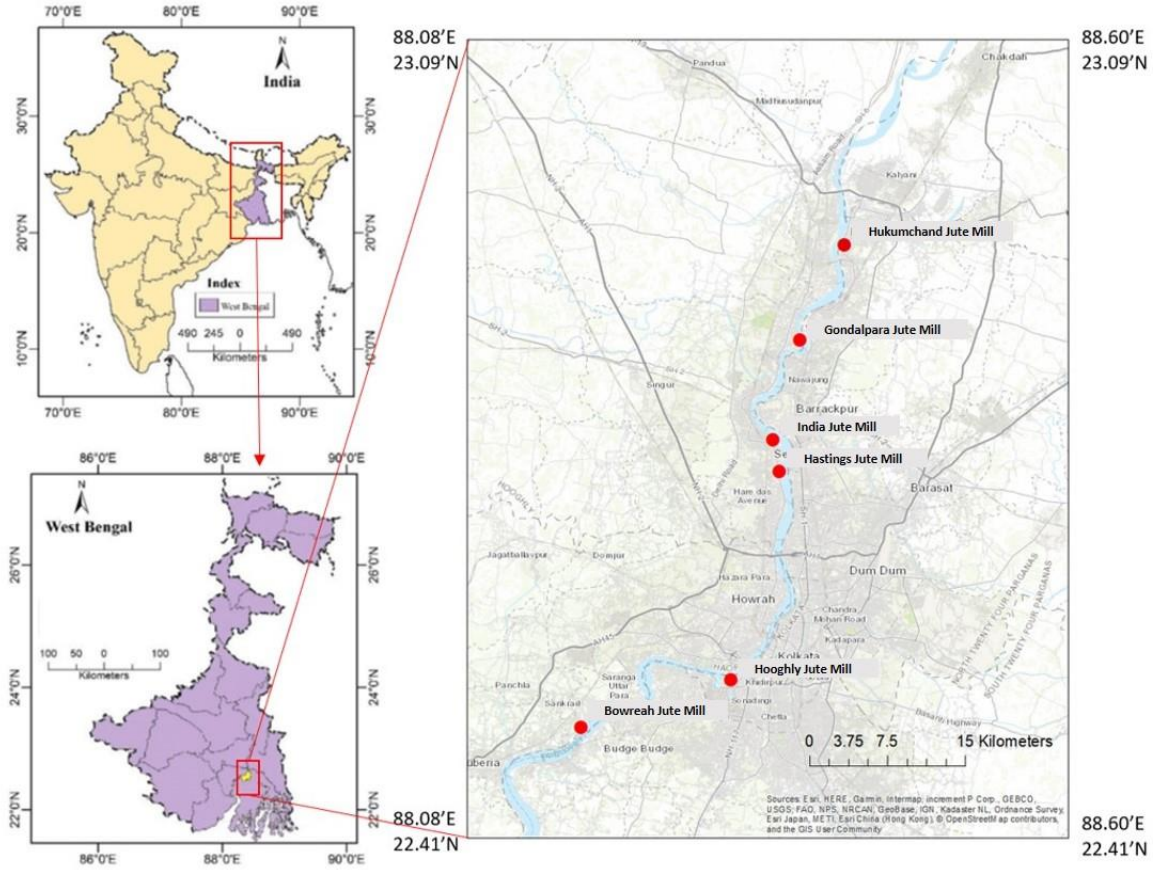

Figure 1 Map of study area showing location of six jute mills in West Bengal, India. Source: Author.

The mills have been identified based on their historic significance, present operation status, availability of secondary data and accessibility for survey of the industrial community. For identifying the industrial community, the neighbourhood for each of the jute mills (refer Figure 2) were delineated having a 15 minutes walking distance from the mills.

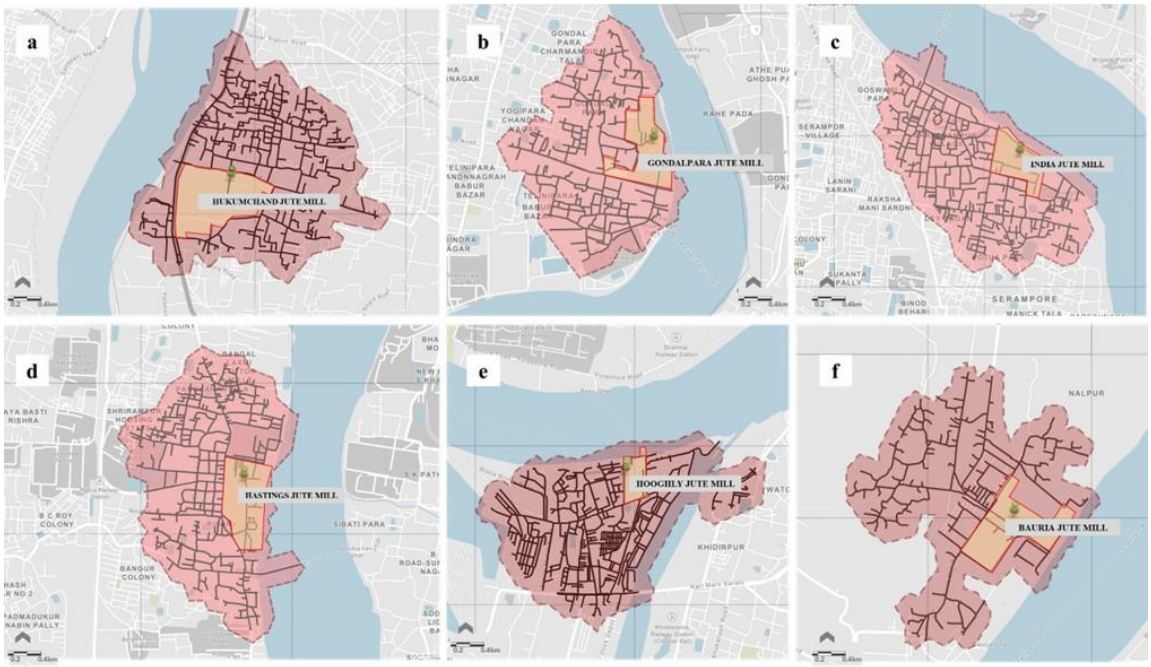

Figure 2 Neighbourhood delineation of six jute mills along Hooghly River in West Bengal, India. a. Hukumchand Jute Mill, b. Gondalpara Jute Mill, c. India Jute Mill, d. Hastings Jute Mill, e. Hooghly Jute Mill, f. Bauria Jute Mill. Source: Author.

After a reconnaissance survey of the delineated neighbourhood, the industrial community was identified, having appropriate acquaintance with respective jute mills.

3.2. Questionnaire survey

The questionnaire survey aimed to identify how the community perceives the socio-economic contributions of the jute mills in terms of employability, community pride, tourism potential, accessibility, and willingness to pay for industrial training programs or continuing industrial activities. For each of the six delineated neighbourhoods, the required sample size was calculated by assuming a finite population size, using the population density as the unit. A stratified purposive sampling approach was adopted to identify samples across the five occupational groups. This stratified sampling helps ensure a broad representation without requiring a larger overall sample size. After removing the missing data, a total of 273 responses were used across five occupational groups: industrial workers, non-industrial employees, self-employed individuals, students, and retired/unemployed individuals (refer Table 1).

Table 1 Table showing demographic profile of sample. Source: Author.

Demographic parameters	Description	N	Percentage
Gender	Male	219	80.2
	Female	54	19.8
Occupation	Employed-industrial	48	17.6
	Employed-others	38	13.9
	Self-employed	81	29.7

	Student	48	17.6
	Retired/ unemployed/ others	58	21.2

Although the proportions of different occupation groups have been attempted to be similar, the ratio of female to male respondents are skewed, which is considered as one of the limitations of this study.

3.3. Data analysis

Correspondence analysis is a multivariate statistical technique applied on categorical variables (Iwasaki and Pederzoli, 2023). In heritage studies, it has been often used to identify patterns and correlations between heritage attributes or indicators (refer Table 2).

Table 2 Literature review of correspondence analysis in heritage studies. Source: Author.

Source	Subject area	Data Type	Findings
(Iwasaki and Pederzoli, 2023)	Heritage collections	Survey questionnaire	Levels of impacts in different regions and age-groups
(Patru-Stupariu, Pascu and Bürgi, 2019)	Resilience of cultural landscapes	Structured and semi-structured interviews	Resilience levels of tangible and intangible heritage in cultural landscape
(Pujol-Tost, 2017)	Virtual archaeology	Survey questionnaire	Associations between topics and experimental conditions
(Tureckova *et al.*, 2019)	Brownfield regeneration	Observation data from case study	factors impacting decision-making on brownfield regeneration

This study employs correspondence analysis (CA) to evaluate the relationship between the variables, which are the occupational groups and the socio-economic attributes related to the six jute mills.

4. Results and discussion

The results of this study highlight the varied socio-economic contributions attributed to jute mills as living industrial heritage. The Likert-scale data, the respective median scores for the five attributes, and the correspondence graphs helped identify the strength of agreement amongst the industrial communities.

4.1. Agreement to socio-economic attributes

The varying levels of agreement (refer Figure 3) for socio-economic attributes reflect different expectations based on occupational responsibilities.

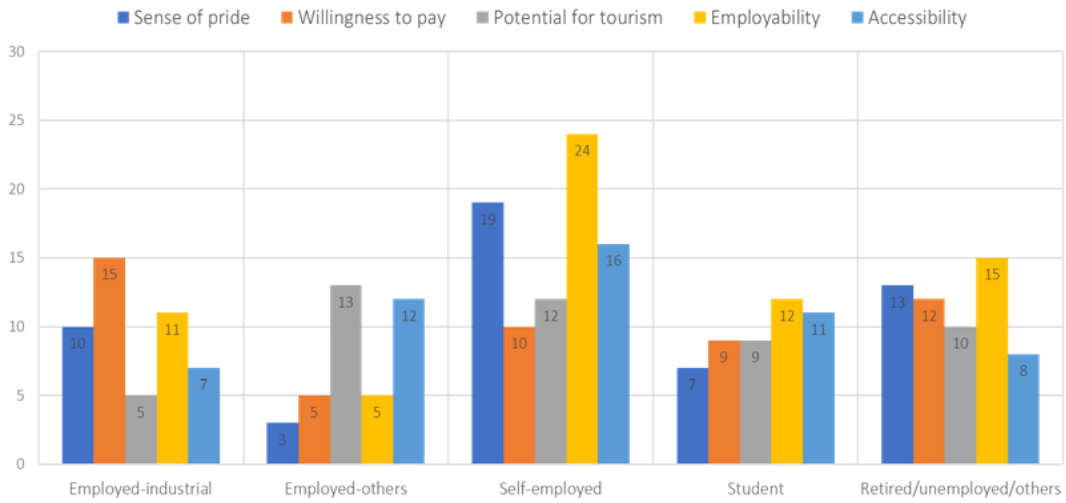

Figure 3 Bar diagram showing level of agreement to the various socio-economic contributions. Source: Author.

Industrial workers exhibited a high level of agreement on the *willingness to pay* for the learning of industrial skills linked to jute mills, suggesting that these skills hold both cultural and economic significance for this group. The workers, thus, are more interested in continued usage of the jute industry. In contrast, the median scores on *potential for tourism* and *accessibility* are higher as given by the employees of other sectors. This corresponds to their necessity of social infrastructure or blue-green infrastructure, especially in the high-density areas around the jute mills in West Bengal. Among self-employed individuals, whose businesses rely on the forward and backward linkages of jute production, there is a higher appreciation for the roles of jute mills in providing *employability* and promoting a *sense of pride* for the community. Additionally, the students and employees of other sectors rated the *sense of pride* attribute as a relatively low, potentially due to limited exposure to these heritage sites and a regular access to with other institutional spaces outside the neighbourhood. The highest agreement on *employability* attribute came from self-employed and retired individuals. The differences in agreement on the contributions the of jute mills as living industrial heritage underscores the need for community participation for interventions in these living heritage sites. Employability and physical accessibility of the riverine jute mills landscapes are identified as the main requirements, especially in the context of West Bengal, which should be utilised in future adaptive reuse strategies. A comparison with similar studies in other industrial landscapes would help identify the region-specific requirements of industrial communities.

4.2. Inter-relation of socio-economic attributes

The dimensions of the correspondence analysis, for analysing the closely linked attributes to the occupation groups, were limited to two, with a cumulative percentage explained exceeding 60%. The dominance of the first dimension indicates that major divergences among occupational groups or attributes might be understood by examining the factors associated with this dimension.

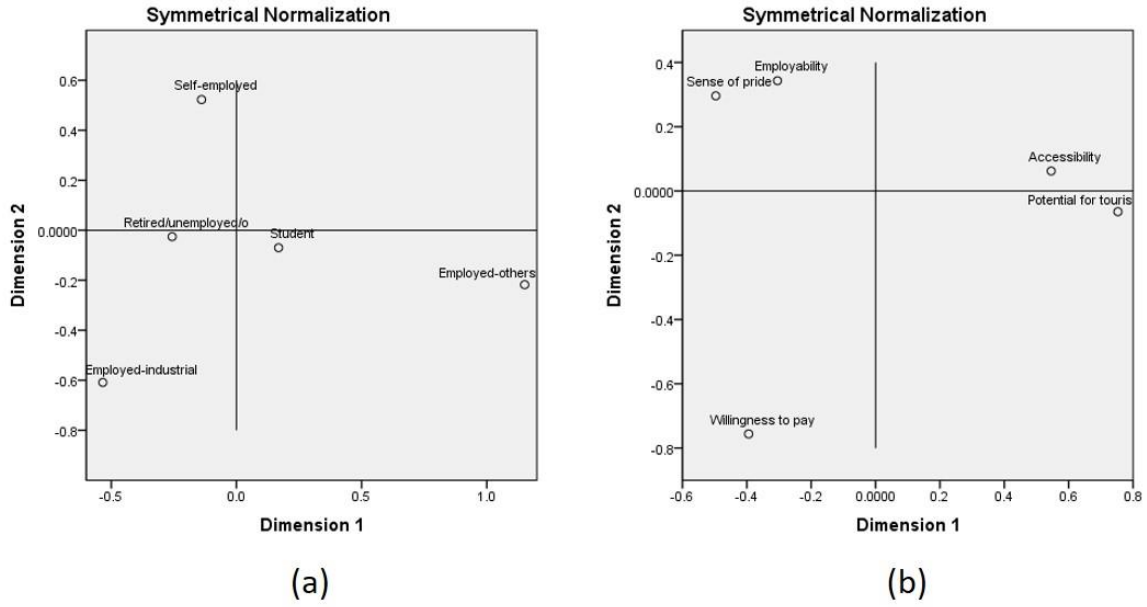

Figure 4 Correspondence analysis (a) Row profile for occupation and (b) column profile for socio-economic attributes. Source: Author.

The row profiles analysis shows how the respondents from the different occupation groups vary in their opinion. On the Dimension 1 of the row profile analysis (refer Figure 4a), *employed-industrial* workers are positioned on the negative side of the axis, whereas *student* and *employed-others* groups occupy the positive side. On the Dimension 2 of the row profile analysis (refer Figure 4a), the *self-employed* are positioned on the positive side, while all other occupation groups are positioned on the negative side. Thus, it may be observed that the opinions of the industrial workers and the self-employed individuals has the largest variation in opinion. The row profile analysis seems to differentiate between those who see industrial heritage primarily as a source of entrepreneurial opportunity (self-employed) and those who view it through the lens of direct employment (industrial workers). The column profiles analysis (refer Figure 4b) shows how the opinions about the socio-economic attributes are correlated. Attributes like *employability* and *sense of pride* cluster closely together in the upper quadrant of the correspondence map. This proximity suggests that these attributes are highly valued across the community and may be viewed as interconnected. On the other hand, *willingness to pay* is positioned in the second quadrant, and not clustered with any of the other four attributes, indicating that the opinions about the industrial continuity is largely varying amongst the industrial community.

In the total correspondence analysis (refer Table 3), Dimension 1 accounts for 70.8% of the total inertia, with a singular value of 0.259, while Dimension 2 explains an additional 24.9% with a singular value of 0.154.

Table 3 Summary table of correspondence analysis

Dimension	Singular Value	Inertia	Proportion of Inertia		Confidence Singular Value	
			Accounted for	Cumulative	Standard Deviation	Correlation 2
1	.259	.067	.708	.708	.060	.042

2	.154	.024	.249	.957	.061
3	.058	.003	.036	.992	
4	.027	.001	.008	1.000	
Total		.095	1.000	1.000	

Together, these two dimensions capture over 95% of the variance, justifying their importance in explaining the relationships between occupational groups and the socio-economic attributes of the jute mills.

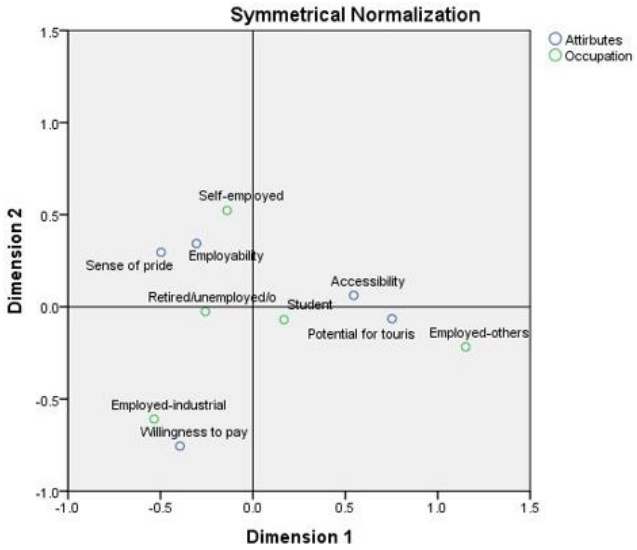

Figure 5 Summary chart of correspondence analysis. Source: Author.

The attributes of *employability* and *sense of pride* were closely linked in the upper quadrant of the correspondence map (refer Figure 5), indicating a similarity in perception across the entire industrial community. *Self-employed* individuals displayed a strong association with *employability* and *sense of pride*, indicating that they perceive the jute mills as both historical landmarks and sources of entrepreneurial opportunities. Though positioned on the negative quadrant, the opinions of the *retired/unemployed* group are also closely clustered with *employability* and *sense of pride*. Figure 5 clearly depicts that only the *employed-industrial* group has a strong and unified opinion about the *willingness to pay* for continued usage of the jute mills. Despite limited direct interaction, the *employed-others*, i.e., the non-industrial employees and the *students* were closely associated with the *potential for tourism* and *accessibility*, demonstrating their acknowledgement of the cultural and economic contributions of the jute mills. Overall, *accessibility* is the only attribute positioned in the fourth quadrant, whose opinion in this case may be biased as the industrial workers are the only group having physical accessibility to the jute mills. Similarly, there might be a bias on opinions towards *willingness to pay*, which is positioned furthest with respect to all occupation groups except the industrial workers. These findings reveal that accessibility is a key determining factor for altering the perceptions about a living industrial heritage. Future scope should involve surveying of occupation groups having direct or indirect accessibility to living industrial heritage sites. The findings also indicate that community pride is closely associated with the functioning status or economic opportunities provided by the industrial heritage sites. Finally, the students and the retired or unemployed groups within the industrial community have some similarity in opinion about a living

industrial heritage, especially in the case of jute mills. Whilst, the industrial workers, the employees from non-industrial sectors and the self-employed groups widely differ in their opinions about a living industrial heritage.

5. Conclusions and recommendations

The disparities in perceptions across occupational groups of the industrial community highlight the importance of inclusive approaches for management of living industrial heritage.

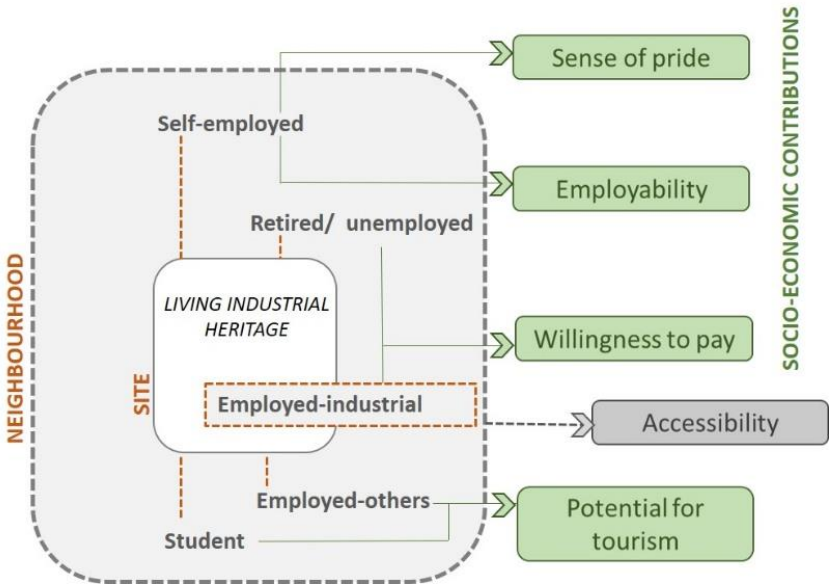

Figure 6 Socio-economic contributions according to industrial community

The study takes forward the argument of how the different stakeholders, based on their level of connection, perceive the contributions of a living industrial heritage. For the case of jute mills in West Bengal, India, the industrial workers are the only group having both inside access and outside perspective, who have expressed a strong opinion in continuing the "livingness" of the sites. Figure 6 summarises the findings from the correspondence analysis, emphasizing that the industrial workers are the most significant occupation group while accessibility serves as the principal socio-economic attribute that influences overall perception of industrial heritage. Future scope may analyse the region-specific mediating factors for each of the five attributes.

5.1. Recommendations for future prospect of jute mills as living industrial heritage

Jute industry in west Bengal had a major economic impact, which employed over 300,000 workers during the earliest stage of industrial revolution in India (Palit and Kajaria, 2007). Heritage management policies for jute mills should focus on offering skill development programs and entrepreneurship support for the jute industrial community. Similar approaches have been employed in former industrial regions of European and Asian countries where heritage sites have been linked to job creation through adaptive reuse and skill training programs (Rizzo *et al.*, 2015; Lu, Liu and Wang, 2020; Chen, 2021; Somoza-Medina and Monteserín-Abella, 2021). The continued presence of industrial communities along the heritage jute mills, create a potential to serve as hubs for community-based tourism. Studies have shown that industrial heritage tourism not only contributes to local economies but also promotes a sense of ownership within communities (Pawlikowska-Piechotka, 2010; Đurkin and Perić, 2017). This approach of participatory

planning is advocated for intangible cultural heritage (UNESCO, 2003; Petronela, 2016). Further, policies should prioritize both physical accessibility and inclusivity, making the sites interpretable for a wide demographic.

5.2. Way forward

This study underlines the extent to which the jute mills as living industrial heritage contribute to community pride, employment, and tourism for their respective industrial community. This research may be taken forward to analyse the differences in this contribution for a larger community, outside the demarcated industrial neighbourhoods. This, added with a proximity analysis of the social infrastructure facilities around the site, will lead to the understanding of the regional impact of the sites. Overall, the study highlights the multiplicity of stakeholders constituting an industrial community and proposes a way forward for perceptions study on living industrial heritage.

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