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Review Article

Analysis of Challenges of Post-earthquake Reconstruction of Health Sector Building Projects in Rural Nepal: A SEM Approach

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Abstract

Nepal's health sector vulnerabilities were exposed during the 2015 Gorkha earthquake, which prompted immediate reconstruction efforts. This disaster underscored the need for enhanced healthcare infrastructure throughout the country but encountered numerous challenges. This study aims to investigate the challenges faced during the post-earthquake reconstruction of health sector building projects in rural Nepal. Five major challenges were identified through a literature review, namely "resource challenges", "legal challenges", "physical and territorial challenges", "management and coordination challenges" and "social and cultural challenges". Perceptions on identified challenges were collected from 137 clients, consultants, and contractors working on 106 ongoing building construction projects in 9 districts across 3 provinces funded by the Government of India. Structural equation modeling (SEM) using the partial least squares (PLS) method was conducted with SmartPLS version 3 to identify the major challenges. All five challenges were found to be significant, with "resource challenges" being the most significant (β= 0.613), followed by "legal challenges", "physical and territorial challenges", "management and coordination challenges" and "social and cultural challenges". Based on these findings, it is suggested that Nepal should adopt a comprehensive strategy that includes proper resource management, improved legal frameworks, effective coordination between stakeholders, and an understanding of social and cultural dynamics to overcome these challenges. Therefore, all project stakeholders must collaborate to address these challenges, which will ensure a resilient and sustainable healthcare infrastructure in earthquake-prone regions like Nepal.

Keywords: Rural Nepal, Gorkha Earthquake, Challenges of Post-earthquake Reconstruction, Health Sector Building Projects, Structural Equation Modeling

INTRODUCTION

On April 25, 2015, an earthquake of 7.8 M_w struck Nepal, affecting 31 of 75 districts. Another earthquake that struck Nepal on May 12, 2015, inflicted more devastation. These two earthquakes killed nearly 9,000 lives, wounded over 23,000 people, and displaced over 2 million people. Moreover, 500,000 homes and 1,000 health facilities were damaged (Adhikari et al., 2016). The earthquakes caused widespread damage to Nepal's healthcare system, including the destruction of hospitals and health clinics, and the displacement of healthcare workers.

The Government of India (GOI) has provided substantial funding for the reconstruction of Nepal's healthcare system, including the construction of new hospitals and health clinics (Goicbrinepal,2020). The Embassy of India in Nepal signed memorandums of understanding (MoUs) with the Central Level Project Implementation Unit (Building) of the National Reconstruction Authority (NRA) for the reconstruction of 147 health sector buildings in Nepal, though the tender was only awarded for 132 projects in 27 packages in 10 different districts: Dhading, Gorkha, Sindhupalchowk, Gulmi, Kavrepalanchowk, Dolakha, Ramechhap, Rasuwa, Lalitpur, and Nuwakot (Goicbrinepal, 2020).

Post-earthquake reconstruction is a complex and challenging endeavor that requires meticulous orchestration of various interconnected actions. Managing uncertainties and intricacies in these projects is a formidable task, acknowledged as one of the most demanding responsibilities in rebuilding earthquake-affected regions. To navigate this, it's crucial to break down the reconstruction into defined stages and utilize adapted or existing tools. Yet, hasty or poorly executed reconstruction can inadvertently introduce further vulnerabilities to the community. Hence, planning for post-earthquake reconstruction should be both practical and reflective (Ismail et al., 2014). Reconstruction after an earthquake is complex, and it's important to identify the challenges and recovery needs of affected communities. Studying the challenges faced during specific post-earthquake recovery phases is crucial for evaluating previous actions and guiding ongoing recovery efforts. The reconstruction process is filled with challenges, including the lack of financial resources, shortage of skilled labor and expertise, and the need to balance the urgency of reconstruction with community engagement and participation (Comerio, 2014).

Years after the 2015 Gorkha earthquake in Nepal, especially in rural areas, the sluggish progress in post-earthquake reconstruction of health sector buildings funded by the GOI raises significant concerns. To date, there have been few studies conducted on this topic, and none have comprehensively identified the in-depth challenges faced during the post-earthquake reconstruction of health sector building projects in rural Nepal. This study aims to address this research gap by investigating the challenges encountered during the reconstruction process using the Partial Least Squares (PLS) path modeling technique. This robust statistical method helps to identify the major challenges by analyzing various factors and their interrelationships, providing valuable insights into the obstacles hindering reconstruction efforts. By leveraging the PLS path modeling technique, this study seeks to uncover critical challenges and offer recommendations for more effective reconstruction strategies. This approach will contribute to a deeper understanding of the specific issues faced in rural areas and support the development of targeted solutions to accelerate the rebuilding of essential health infrastructure.

LITERATURE REVIEW

Natural earthquakes can cause significant destruction, particularly when they are powerful. However, the extent of damage can be exacerbated by human factors, such as inadequate planning, infrastructure, and management of natural resources, which can increase vulnerability to earthquake hazards (Achmad, 2023; Liu *et al.*, 2017). In general, typical earthquake consequences and effects are:

- Fatalities of individuals.
- Physical harm or injuries sustained by people.
- Destruction or harm to property and assets.
- Interruptions or stoppages in economic and industrial operations.
- Interference or disturbance to daily routines and habits.
- Loss of income and job opportunities for affected individuals.
- Interference or disruptions in necessary services and utilities.
- Damage to infrastructure and interference with administrative and organizational systems.
- Psychological and sociological effects or consequences following the event.

Disaster Risk Reduction

Disaster risk reduction (DRR) involves identifying, analyzing, and preventing new risks, reducing existing risks, and managing residual risks to enhance disaster resilience. It encompasses strategies aimed at mitigating socio-economic susceptibilities and environmental perils, while enhancing communal aptitude and fortitude. Risk reduction integrates structural (e.g., building codes, strengthening structures) and non-structural measures (e.g., vulnerability analysis, land use planning, training) into the reconstruction process. This integration lessens vulnerabilities, enhances resilience, and promotes safer communities.

Sendai Framework for Disaster Risk Reduction 2015-2030

The Sendai Framework for Disaster Risk Reduction 2015-2030 is an international agreement adopted by United Nations member states in March 2015. It outlines a set of priorities and actions aimed at reducing disaster risk and building resilience to disasters over 15 years, from 2015 to 2030. The framework was named after the city of Sendai in Japan, which was severely affected by the Great East Japan Earthquake and Tsunami in 2011.

The Sendai Framework emphasizes a shift from focusing solely on disaster response and recovery to a more proactive approach that centers on disaster risk reduction (DRR) and the prevention of new disaster risks. It sets out four priority areas, often referred to as the "Four Priorities for Action," which serve as the foundation for its implementation:

Understanding Disaster Risk:

This priority focuses on improving the understanding of disaster risk, including the identification, assessment, and monitoring of risks. It emphasizes the importance of collecting and sharing accurate data, conducting risk assessments, and promoting scientific research to better comprehend the nature of disasters and their impacts.

Strengthening Disaster Risk Governance to Manage Disaster Risk:

This priority highlights the significance of strong governance and institutional frameworks for disaster risk reduction. It calls for the integration of disaster risk reduction into policies, plans, and programs at all levels of government, as well as enhanced cooperation and coordination between relevant stakeholders.

Investing in Disaster Risk Reduction for Resilience:

This priority underscores the need for financial investment in disaster risk reduction activities and initiatives. It encourages the allocation of resources to activities that enhance resilience, such as infrastructure development, early warning systems, and community-based disaster risk reduction efforts.

Enhancing Disaster Preparedness for Effective Response and Recovery:

This priority emphasizes the importance of preparedness measures to ensure an effective response and recovery when disasters occur. It advocates for the development of comprehensive disaster response plans, the enhancement of community resilience, and the establishment of early warning systems to minimize the impact of disasters.

Post-Disaster Need Assessment and Recovery Plan

In 2015, the National Planning Commission (NPC) performed a quick evaluation of the needs following the Gorkha earthquake to determine the necessary resources and expenses for reconstruction. The Ministry of Health and Population (MoHP) contributed to this process by providing the following information:

- analysis of the situation before and after the disaster
- assessment of damage to healthcare facilities and losses
- plans for Recovery and Reconstruction
- strategy for implementing the recovery plan

Table 1: Major Challenges Associated with Post-earthquake Building Reconstruction

S. N	Items	Key Challenges	Relevant Literature
		Resources Challenges	
1	RC1	Inaccessibility to public facilities	(Chang-Richards *et al*., 2013; Coşgun, 2011; Haigh *et al*., 2016a)
2	RC2	Low-quality construction materials	(Demirli *et al*., 2015; Özerdem & Rufini, 2013)
3	RC3	Unavailability of necessary resources	(Pamidimukkala *et al*., 2020)
4	RC4	Lack of experienced managers	(Özerdem & Rufini, 2013)
5	RC5	Lack of institutional capacity for planning	(Pamidimukkala *et al*., 2020)
		Management and Coordination Challenges	
1	MCC1	Inadequate community mobilization	(Raju, 2013; Shafique, 2022; Sharma *et al*., 2018; Zhou *et al*., 2013)
2	MCC2	Health and safety management issues	(Bilau *et al*., 2016; Ranghieri & Ishiwatari, 2014b)
3	MCC3	Ineffective coordination and management	(Haimes, 2012; Patel & Hastak, 2013)
4	MCC4	Cost and time overrun	(Choudhary & Mehmood, 2013; Sun & Xu, 2011)
5	MCC5	Delays in the reconstruction process	(Pamidimukkala *et al*., 2020)
		Social and Cultural Challenges	
1	SCC1	High level of expectations	(Barenstein, 2012)
2	SCC2	Unavailability of social services	(Erinsel Önder *et al*., 2010)
3	SCC3	Relocation affects	(Hidayat & Egbu, 2011)
4	SCC4	Inadequate public awareness	(Pamidimukkala *et al*., 2020)
5	SCC5	Cultural disparities	(Safapour & Kermanshachi, 2020)
		Legal Challenges	
1	LC1	Lack of pre-existing reconstruction policies	(Safapour *et al*., 2021)
2	LC2	Lack of legal documents	(Bilau *et al*., 2016)
3	LC3	Complexity of design	(Gök, 2011; Ranghieri & Ishiwatari, 2014b)
4	LC4	The limited scope of local government	(Pamidimukkala *et al*., 2020)
5	LC5	Lack of institutional capacity for regulation	(Safapour *et al*., 2021)
		Physical and Territorial Challenges	
1	PTC1	Geological nature of the resettlement site	(Maly & Ishikawa, 2014a)
2	PTC2	Complex landscape remoteness	(Kwok, 2016)
3	PTC3	Shortage of land for relocation	(Safapour *et al*., 2021)
4	PTC4	Unavailability of transportation services	(Pamidimukkala *et al*., 2020)
5	PTC5	Environmental risk	(Safapour *et al*., 2021)
		Challenges of Post-Earthquake Reconstruction	
1	CPR1	Post-earthquake reconstruction is a challenging and complicated process.	(Ismail *et al*., 2014)
2	CPR2	Management of construction firms should prioritize developing strategies to reduce the	(Khorshidian & Fayazi, 2023)

S. N	Items	Key Challenges	Relevant Literature
		challenges associated with post-earthquake reconstruction.	
3	CPR3	Assessing post-earthquake recovery phases is crucial for evaluating past actions and guiding ongoing efforts.	(Li *et al*., 2019)

MATERIALS AND METHODS

Research Framework

The research framework outlines a comprehensive plan to investigate the challenges related to post-earthquake reconstruction in health sector building projects in rural Nepal. The process commences with an extensive literature review and proceeds to the development of a conceptual model. A cross sectional research study with a quantitative approach was subsequently utilized to guide data collection, facilitating the construction and evaluation of a SmartPLS (PLS-SEM) model. The ultimate goal is to accurately interpret the analyzed data, yielding valid findings and recommendations that align with the research objective and deepen the comprehension of the difficulties encountered in the post-earthquake reconstruction of health sector building projects in rural Nepal.

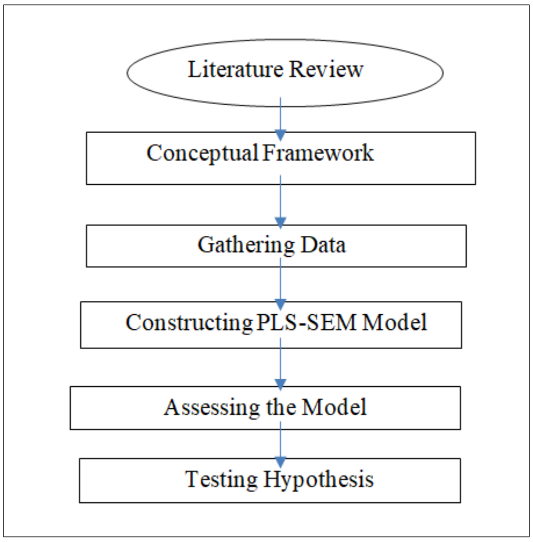

Figure 1: Flow Chart for the Development of PLS-SEM Model

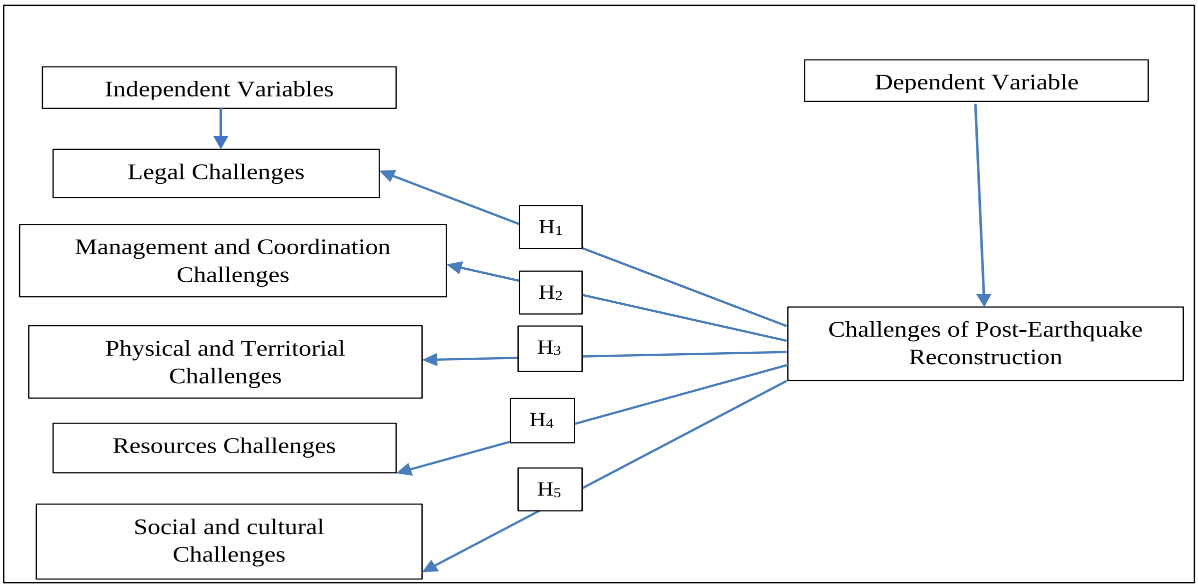

Figure 2: Conceptual Framework for the Evaluation of Challenges of Post-Earthqauke Reconstruction

Study Population and Data Collection

The targeted population of this study consists of the client, consultant, and contractor officer-level technical staff who are actively involved in the post-earthquake reconstruction of health sector building projects following the 2015 Gorkha earthquake, funded by the Government of India. The total study population size was 151. Questionnaires designed using Google Forms were sent to all participants. Out of these, 137 valid responses were received, resulting in a non-response rate of 9.3%.

Questionnaire Preparation

A set of structured questionnaires was prepared, based on an extensive literature review, to identify the challenges of post-earthquake reconstruction of health sector building projects in rural Nepal after the 2015 Gorkha earthquake. The questionnaires used a 5-point Likert scale, ranging from 1 ("strongly agree") to 5 ("strongly disagree"). There were five distinct groups of exogenous variables, consisting of a total of 25 factors that influenced the challenges associated with post-earthquake reconstruction. In addition, there was an endogenous latent variable group that encompassed three challenges related to post-earthquake reconstruction. The exogenous latent variable included Resource Challenges (RC), Management and Coordination Challenges (MCC), Legal Challenges (LC), Social and Cultural Challenges (SCC), and Physical and Territorial Challenges (PTC). These groups collectively comprised 25 indicators. Respondents were asked to rate their perspectives on these challenges.

Data Analysis

The data collected using Google Form was prepared in Microsoft Excel and saved in CSV format. Afterward, the data was imported into the Smart PLS version 3 application for structural equation modeling (SEM). The partial least square method was used to perform the structural equation modeling, which includes two models: the measurement model and the structural model.

The measurement model, also referred to as the outer model, evaluates the relationships between latent variables (constructs) and their associated observed indicators. This process ensures that the constructs are accurately represented by the indicators, with a focus on the reliability and validity of the measurement instruments. Conversely, the structural model, or inner model, assesses the relationships between the latent variables themselves. It investigates the direct and indirect effects among the constructs, enabling the testing of hypotheses regarding the relationships between various challenges and their impacts on post-earthquake reconstruction efforts.

By employing the PLS-SEM method, the study aimed to identify the primary challenges and their interrelationships, thereby providing a comprehensive understanding of the factors influencing the reconstruction of health sector building projects in rural Nepal.

RESULTS AND DISCUSSION

Demographic and Professional Information of Respondents

Table 2: Demographic and Professional Information of Respondents

Variables	Responses	Percentage (%)
Work Experience (in Year)	1-5	38
	6-10	53
	11-15	7
	16 or above	2
Education Level	Diploma	4
	Bachelor’s	70
	Master’s	26
Stakeholder	Client	29
	Consultant	45
	Contractor	26
Professionals	Project Manager	19
	Office Engineer	32
	Site Engineer	38
	Construction Supervision Expert	4
	Overseer	2
	Others	5

Table 2 provides a comprehensive overview of the demographic and professional information of the respondents. In terms of work experience, more than half (53%) have 6-10 years of experience, followed by 1-5 years (38%), 11-15 years of experience (7%), and 16 or more years (2%). Regarding education, the largest group holds a bachelor's degree (70%), followed by a master's degree (26%) and a diploma (4%). When looking at stakeholder roles, consultants make up 45%, followed by clients (29%) and contractors (26%). In terms of professional roles, site engineers account for 38% of the respondents, followed by office engineers (32%) and project managers (19%), while construction supervision experts (4%), overseers (2%), and others (5%).

Analysis and Validity of Measurement Model

The initial step in the PLS analysis involves assessing the reliability and validity of the measurement model(Hair Jr *et al*., 2020). This was accomplished by estimating various parameters such as indicator loading, Average Variance Extracted (AVE), Composite Reliability (CR), and Cronbach's alpha (CA). For indicator loading, values higher than 0.7 indicated good reliability for each respective construct (Hulland, 1999). Similarly, CR and CA values above 0.7 for all constructs demonstrated satisfactory internal consistency reliability (Laksmita *et al*., 2020). Additionally, all constructs exhibited AVE values above the cutoff level of 0.5, which signifies convergent validity(Franke & Sarstedt, 2019). To evaluate discriminant validity, Fornell and Larcker criteria, Heterotrait Monotrait Ratio (HTMT), and cross-loadings were employed (Ab Hamid *et al*., 2017; Rasoolimanesh, 2022).

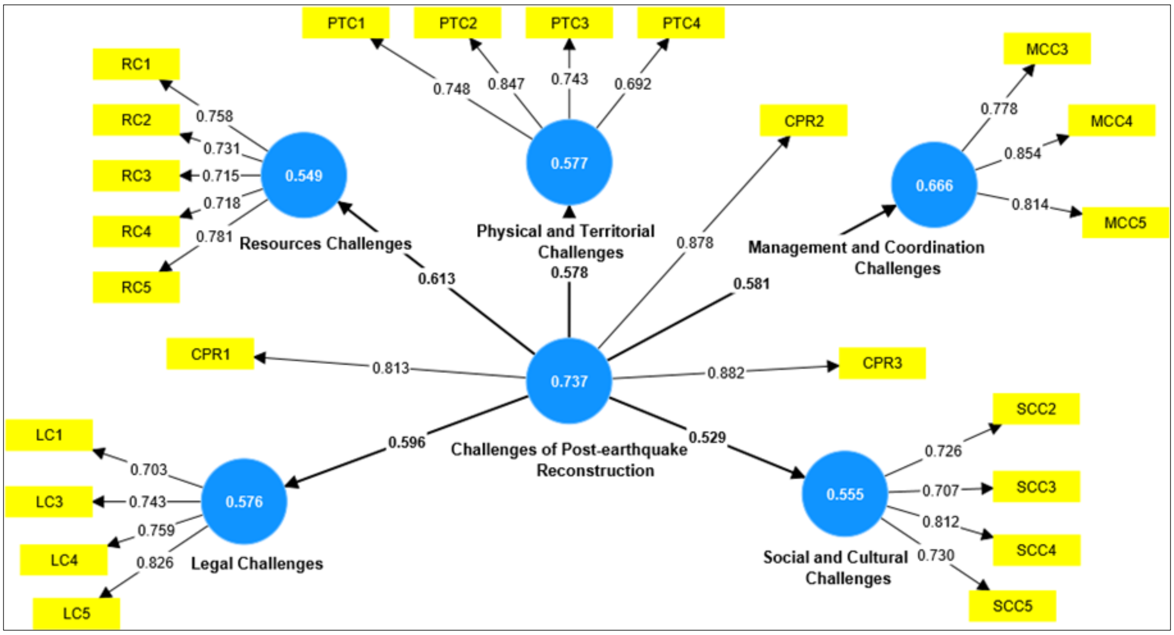

Figure 3: Measurement Model Showing Average Variance Extracted (AVE) of each Construct

Table 3: Construct Reliability and Validity Overview

Construct	CA	CR	AVE
Challenges of Post-Earthquake Reconstruction	0.822	0.833	0.737
Legal Challenges	0.757	0.784	0.576
Management and Coordination Challenges	0.749	0.761	0.666
Physical and Territorial Challenges	0.756	0.784	0.577
Resource Challenges	0.795	0.802	0.549
Social and Cultural Challenges	0.733	0.744	0.555

Table 3 shows CA, CR, and AVE values for evaluating the measurement value of the construct's indicator in the model. CR and CA values larger than 0.7 show internal consistency reliability (Laksmita et al., 2020). The AVE value greater than 0.5 signifies convergent validity (Franke & Sarstedt, 2019).

Table 4: Discriminant Validity; Indicator Items Cross loading

Factors	CPR	LC	MCC	PTC	RC	SCC
CPR1	**0.813**	0.471	0.362	0.514	0.398	0.384
CPR2	**0.878**	0.5	0.59	0.483	0.563	0.532
CPR3	**0.882**	0.561	0.52	0.499	0.597	0.435
LC1	0.394	**0.703**	0.482	0.444	0.576	0.533
LC3	0.385	**0.743**	0.274	0.503	0.46	0.455
LC4	0.407	**0.759**	0.428	0.475	0.405	0.394
LC5	0.58	**0.826**	0.476	0.569	0.618	0.518
MCC3	0.426	0.475	**0.778**	0.38	0.554	0.452
MCC4	0.534	0.477	**0.854**	0.46	0.538	0.527
MCC5	0.452	0.399	**0.814**	0.463	0.448	0.489
PTC1	0.41	0.537	0.445	**0.748**	0.444	0.417
PTC2	0.552	0.568	0.511	**0.847**	0.417	0.486
PTC3	0.411	0.48	0.336	**0.743**	0.292	0.537
PTC4	0.35	0.407	0.294	**0.692**	0.264	0.468
RC1	0.487	0.57	0.564	0.528	**0.758**	0.59
RC2	0.37	0.498	0.32	0.24	**0.731**	0.396
RC3	0.41	0.514	0.43	0.332	**0.715**	0.52

Factors	CPR	LC	MCC	PTC	RC	SCC
RC4	0.452	0.39	0.529	0.274	**0.718**	0.342
RC5	0.525	0.563	0.454	0.346	**0.781**	0.379
SCC2	0.359	0.46	0.465	0.417	0.453	**0.726**
SCC3	0.398	0.469	0.514	0.576	0.384	**0.707**
SCC4	0.465	0.521	0.447	0.488	0.522	**0.812**
SCC5	0.336	0.403	0.36	0.358	0.418	**0.73**

Similarly, Table 4 displays the cross-loading of all consistent apparent variables has a higher value compared to their linked latent variable with other cross-loadings (Henseler et al., 2015). The bold element in the diagonal indicators item cross-loading on its construct.

Table 5: Discriminant Validity: Heterotrait-Monotrait Ratio (HTMT)

	CPR	LC	MCC	PTC	RC	SCC
CPR						
LC	0.734					
MCC	0.723	0.725				
PTC	0.723	0.86	0.691			
RC	0.738	0.87	0.804	0.59		
SCC	0.668	0.834	0.807	0.834	0.782	

The Heterotrait-Monotrait Ratio (HTMT) value is under the threshold of 0.9 which assures the discriminant validity (Henseler et al., 2009) as displayed in Table 5.

Table 6: Discriminant Validity (Fornell and Larker Criteria)

	CPR	LC	MCC	PTC	RC	SCC
CPR	**0.858**					
LC	0.596	**0.759**				
MCC	0.581	0.552	**0.816**			
PTC	0.578	0.66	0.534	**0.76**		
RC	0.613	0.686	0.628	0.472	**0.741**	
SCC	0.529	0.626	0.602	0.623	0.6	**0.745**

Similarly, Table 6 illustrates the square root of AVE values for each construct and its correlation with other constructs. The bold values are square root AVE values which met the discriminant validity as it is greater than its correlation coefficient with other constructs (Yusoff *et al*., 2020).

Analysis and Validity of Structural Model

The analysis and validity of the structural model, include; the collinearity test, structural model path coefficient, evaluating the level of R^2, and predictive relevance Q^2. A good model fit indicates that the relationships between the observed variables and the latent variables are well-defined (Schok *et al*., 2010).

Table 7: Result of Collinearity Assessment and Predictive Relevance (Q^2)

Predictor construct (Exogenous variable)	Dependent variable (Endogenous Variable)	Variance Inflation Factors (VIF)	Q^2
LC	CPR	1.49	.336
MCC	CPR	1.51	.322
PTC	CPR	1.51	.313
RC	CPR	1.56	.361
SCC	CPR	1.40	.252

The result of the collinearity assessment is shown in Table 7, where the Variance Inflation Factor (VIF) was below threshold value 5, which specifies that data were free from multi-collinearity problems (Henseler *et al*., 2009). Similarly, Q^2 is the predictive relevance of the structural model by implementation of Stone-Geisser's factor which was calculated by using the blindfolding process (Tenenhaus *et al*., 2005). The Q^2 value should be greater than zero for the relevance of the corresponding construct (Hair *et al*., 2019). Table 7 shows that during calculation, all predictive relevance Q^2 values were in a good cut-off range.

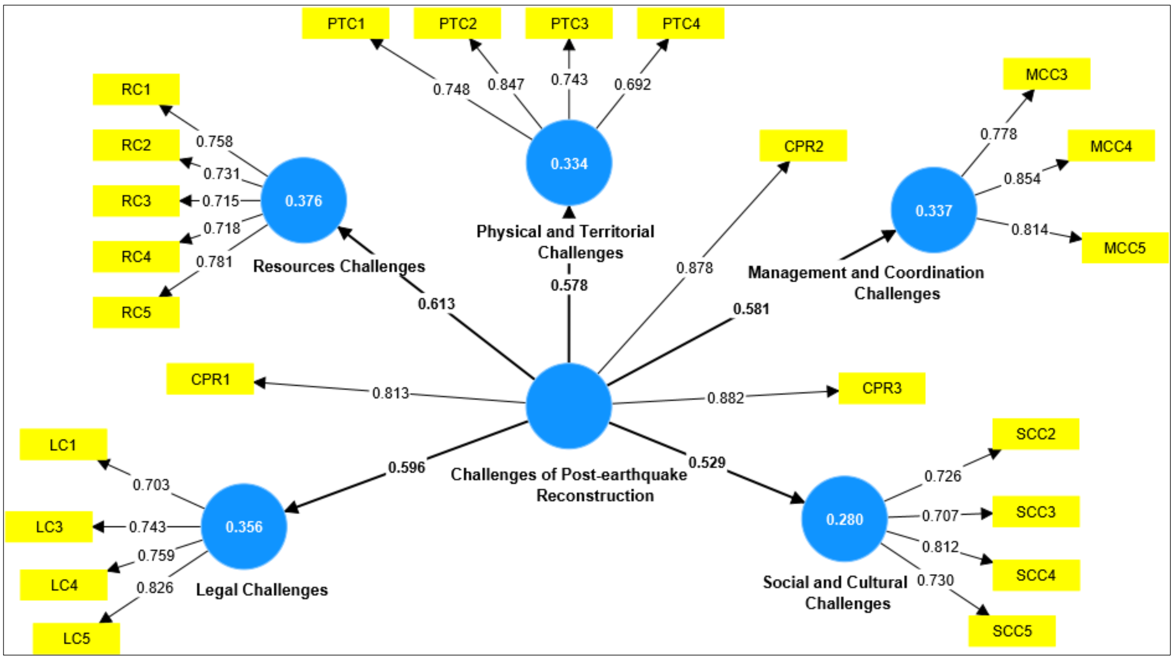

Figure 4: Coefficient of Determination (R^2) Value of Independent Construct

The coefficient of determination (R^2) is widely employed to evaluate structural models and is considered a primary indicator of the model's predictive capability. R^2 values, ranging from 0 to 1, signify the extent of predictive accuracy, with larger values indicating greater accuracy in predictions (Hair Jr *et al*., 2021). Regarding this, values such as 0.67, 0.33, and 0.19 are categorized as substantial, moderate, and weak, respectively (Chin, 1998).

Table 8: Testing the Hypothesis in the Structural Model

Hypothesis	Relation	Beta (O)	LL (5%)	UL (95%)	Standard Deviation (SD)	T statistics (O/SD)	P value	Decision
H1 (a)	CPR -> LC	.596	.430	.723	0.075	7.937	0.000***	Supported
H2 (b)	CPR -> MCC	.581	.374	.726	0.090	6.461	0.000***	Supported
H3 (c)	CPR -> PTC	.578	.400	.719	0.081	7.117	0.000***	Supported
H4 (d)	CPR -> RC	.613	.460	.739	0.073	8.382	0.000***	Supported
H5 (e)	CPR -> SCC	.529	.329	.694	0.093	5.685	0.000***	Supported

Note: t-value >= 1.96 at p = 0.05 level*, t-value >= 2.58 at p = 0.01 level**, t-value >= 3.29 at p = 0.001 level***

The path coefficient delineates the customary alteration in the endogenous construct when subjected to a unit modification in the predictor construct. The beta value serves as an assessment of the interrelations among all latent variables; a higher beta value indicates a more pronounced or substantial impact of the exogenous (predictor) variable on the endogenous (dependent) variable (Aibinu & Al-Lawati, 2010; Ramayah et al., 2018). The beta value is derived from the t-test value, with non-parametric bootstrapping employed to acquire the t-value. This technique involves generating a predetermined number of samples to compute the t-value, with 5000 samples specifically generated through bootstrapping for this calculation (Henseler et al., 2009). Some literature suggests that for a two-tail test, the threshold for significance is a t-value of 1.96 or higher at the 0.05 level of significance, a t-value of 2.58 or higher at the 0.01 level of significance, and a t-value of 3.29 or higher at the 0.001 level of significance (Hair et al., 2011; Sukamani & Wang, 2020). Table 8 indicates that all pathways attained t-values exceeding the critical value of 1.96 at a significance level of 5%.

Furthermore, the reliability and validity of both the outer measurement model and the inner structural model were found to be significant. The outcomes of all five hypothetical paths (H1-H5) outlined in Table 8 underscore the significance of the SEM model. All five hypotheses were supported at a significance level of less than 1%, as depicted in Table 8. The analysis and determination of the path coefficient within the inner structural model revealed that the correlation between resource challenges and the challenges associated with post-earthquake reconstruction in health sector building projects in rural Nepal was notably significant compared to other constructs, evidenced by the highest t-value of 8.382 and a beta value of 0.613. This finding is consistent with research conducted by (Safapour et al., 2021), the lack of appropriate financial resources was highlighted as a key hurdle in the literature that seriously impedes health sector building restoration following a natural catastrophe. The availability of enough funds is critical to the recovery of all devastated regions, including health sector buildings. Inadequate funding causes significant time delays in delivering critical resources such as materials, machines, and human resources, significantly impacting the health sector building restoration process. Additionally, the results of this study were in line with the research conducted by (Pamidimukkala et al., 2020), the post-disaster rehabilitation of health sector structures in rural and urban locations involves unique problems. The issues in the resource category were the most frequently encountered and ranked first. (Haigh et al., 2016b) also state that inaccessibility to public facilities is one of the key challenges associated with post-disaster reconstruction.

Similarly, with a t-value of 7.937 and a beta value of 0.596, the legal challenges showed the second highest significance to the challenges of post-earthquake reconstruction in health sector building reconstruction projects in rural Nepal. The past research conducted by (Safapour et al., 2021), shows that the lack of pre-existing reconstruction policies was one of the key challenges associated with post-disaster reconstruction. Insufficient pre-existing reconstruction policies contribute to a multitude of discrepancies and clashes during the reconstruction process, leading to a heightened occurrence of errors and culminating in a significant escalation of both the cost and duration of health sector building reconstruction. Also, according to (Ranghieri & Ishiwatari, 2014a) complexity of design is one of the key challenges associated with post-earthquake reconstruction.

Moreover, with a t-value of 7.117 and a beta value of 0.578, the physical and territorial challenges show the third most significant challenges of post-earthquake reconstruction in the health sector building reconstruction projects in rural Nepal. According to (Maly & Ishikawa, 2014b; Safapour et al., 2021) geological nature of the resettlement site is one of the key challenges associated with post-disaster reconstruction. Also, (Kwok, 2016) states that complex landscape remoteness is one of the major challenges associated with post-disaster reconstruction. (Safapour et al., 2021) classified shortage of land for relocation and environmental risk in physical and territorial categories. According to (Pamidimukkala et al., 2020) unavailability of transportation services is categorized into a physical category.

Similarly, with a t-value of 6.461 and a beta value of 0.581, the management and coordination challenges show the fourth significant challenge to post-earthquake reconstruction in health sector building reconstruction projects in rural Nepal. According to past research conducted by (Safapour et al., 2021) management and coordination category was the most significant barrier to post-earthquake reconstruction of buildings in urban and rural areas. In the analyzed literature, inadequate coordination and management is a major obstacle to the post-disaster housing reconstruction process in both urban and rural areas. This issue was identified as the foremost challenge within the management and coordination aspect. Following natural disasters, various organizations engage in reconstruction efforts, creating complexities for local governments in orchestrating these activities effectively. Furthermore, substantial time delays from project initiation throughout the reconstruction phase, leading to project extensions beyond stipulated deadlines, also emerged as a notable hindrance that should be minimized whenever feasible (Haigh & Sutton, 2012; Rouhanizadeh & Kermanshachi, 2020).

Moreover, with a t-value of 5.685 and a beta value of 0.529, the social and cultural challenges showed the fifth significance to challenges of post-earthquake reconstruction in health sector building reconstruction projects in rural Nepal. According to (Pamidimukkala et al., 2020) unavailability of social services is one of the key challenges in the post-disaster reconstruction of buildings in urban and rural areas which falls under the category of social challenges. Also, (Barenstein, 2012) found that the relocation effect also affects post-disaster reconstruction. As per (Ophiyandri et al., 2016) inadequate public awareness which falls under the social category was one of the key challenges in the post-earthquake reconstruction of buildings. Similarly, (Erinsel Önder et al., 2010; Hidayat & Egbu, 2011; Zhou et al., 2013) state that cultural disparities after the relocation is also one of the key challenges in post-earthquake reconstruction of buildings in rural and urban areas.

CONCLUSION

This study aims to find out the challenges of post-earthquake reconstruction of health sector building projects in rural Nepal using the structural equation modeling technique. Factors were identified using an extensive literature review, and based on this structured questionnaire was prepared. Responses from clients, consultants, and contractors were gathered and analyzed. All the constructs namely resource, legal, physical and territorial, management and coordination, and social and cultural aspects were found significant. The study underscores that resource challenges play a pivotal role and have a significant and strong impact on the challenges encountered during post-earthquake reconstruction in health sector building projects in rural Nepal with beta value of 0.613 The availability and allocation of financial resources, materials, and human resources are crucial factors that significantly affect the pace and effectiveness of the reconstruction efforts. Legal challenges also emerge as a critical factor with a beta value of 0.596, highlighting the need for clear and supportive reconstruction policies to streamline the process and reduce discrepancies. Physical and territorial challenges, management and coordination challenges, and social and cultural challenges also significantly contribute to the complexities faced during reconstruction. Addressing these challenges necessitates a holistic approach, considering not only physical aspects but also legal, social, and managerial dimensions.

Achieving a successful and efficient post-earthquake reconstruction of health sector buildings in Nepal requires a comprehensive strategy that tackles the identified challenges. Adequate resource management, improved legal frameworks, effective coordination and management, and an understanding of social and cultural dynamics are vital for overcoming these challenges and ensuring a resilient and sustainable healthcare infrastructure in earthquake-prone regions. Policymakers, stakeholders, and practitioners must collaborate to devise and implement strategies that holistically address these challenges, ultimately nurturing a robust and resilient health sector in the face of seismic events.

Furthermore, this study focused on health building projects funded by GOI after the 2015 Gorkha earthquake, addressing five key challenge dimensions. Future research could broaden the scope to the entire construction industry and include environmental, technological, and economic challenges with a more extensive literature review.

Conflict of Interest:

The authors declare no potential conflicts of interest concerning this article's research, authorship, and publication.

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