Quest Journals
Journal of Architecture and Civil Engineering
Volume 11 ~ Issue 8 (August 2026) pp: 78-84
ISSN(Online): 2321-8193
www.questjournals.org

Research Paper

Risk Management Analysis of a Type 45 m² Housing Assistance Project in an Archipelagic Region: A Case Study of Teluk Wondama, West Papua, Indonesia

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ABSTRACT : *Government-supported housing construction in archipelagic regions is exposed to logistics, weather, infrastructure, and occupational-safety risks that can directly affect cost, schedule, quality, and project continuity. This study analyzes risk management for a Type 45 m² housing assistance project in Teluk Wondama Regency, West Papua, Indonesia.*
A sequential explanatory mixed-methods design was applied. Quantitative data were collected through a questionnaire completed by five purposively selected stakeholders representing the contractor, the relevant government agency, and the beneficiary community. Fifty-nine risk indicators in twelve risk-source groups were assessed using likelihood and consequence scores and classified through the AS/NZS 4360:2004 risk matrix. Qualitative interviews, field observation, and document review were then used to explain the quantitative priorities and validate practicable mitigation measures.
The analysis identified two very-high risks and three high risks. The five priority risks were high sea waves (R=20.00), delayed material delivery (R=16.72), accidents during unloading from boats (R=13.20), limited water and electricity supply (R=11.20), and material damage during sea transportation (R=10.40). The qualitative findings confirmed that dependence on marine transport, remote-site conditions, and limited supporting utilities intensify these risks. Recommended controls include weather-based delivery scheduling, buffer time and buffer stock, alternative suppliers, transport-safe packaging, temporary water and power systems, and strengthened unloading safety procedures. Projected residual-risk values fall in the medium category; however, these values are targets rather than post-mitigation measurements. The study shows that integrating risk ranking with contextual qualitative evidence provides a practical basis for managing small public housing projects in remote archipelagic environments.

KEYWORDS: *Archipelago construction, housing assistance, mixed methods, risk management, risk matrix, AS/NZS 4360:2004.*

*Received 14 Aug., 2026; **R**evised 27 Aug., 2026; **A**ccepted 30 Aug., 2026*
P**ublished with open access at **www.questjournals.org

I. INTRODUCTION

Adequate housing is a basic component of social welfare and a central objective of government housing-assistance programs. For low-income communities, public housing support is intended not only to provide physical shelter but also to improve health, safety, and quality of life. Indonesian housing policies and technical guidance place particular emphasis on appropriate targeting, construction quality, and accountable implementation of assistance programs [6,8,9].

Project implementation in remote and archipelagic environments is substantially more complex than in well-connected urban locations. Construction materials may depend on marine transport, travel windows may be constrained by weather and sea conditions, and basic utilities can be limited at the site. These uncertainties can interrupt procurement, reduce labor productivity, damage materials, increase safety exposure, and ultimately threaten the achievement of project cost, time, quality, and occupational-safety objectives. Risk management is therefore required as a systematic process for recognizing, evaluating, prioritizing, and treating uncertain events before they become critical project disruptions [1,5].

The Type 45 m² Housing Assistance Project in Teluk Wondama Regency represents this problem clearly. The project examined in this study is located in Kampung Sariay, Roon District, and comprises three Type 45 housing units with a contract value of IDR 649.05 million and a planned construction period of 120 calendar days. The island setting means that a substantial share of construction materials and project movement relies on sea access, while water, electricity, equipment, and skilled labor cannot always be assumed to be continuously available.

Previous risk studies have addressed construction projects using the AS/NZS 4360:2004 framework, and housing-project studies have also applied other prioritization approaches such as the House of Risk. These studies demonstrate the usefulness of structured risk identification and ranking [4,7]. However, the thesis on which this article is based identifies a more specific research gap: risk research on government-supported, small-scale housing in an archipelagic and access-constrained setting remains limited, and technical, logistical, institutional, social, environmental, and safety factors are rarely examined together within one integrated analysis.

Accordingly, the contribution of this study is the integration of a likelihood-consequence risk matrix with qualitative field evidence to analyze a government housing-assistance project in a remote island context. The study has three objectives: (1) to identify risks from planning through construction; (2) to determine the priority level of those risks using AS/NZS 4360:2004; and (3) to formulate practical mitigation strategies that fit the local conditions of Teluk Wondama.

II. LITERATURE REVIEW

2.1. Construction Project Risk Management

Construction risk management is concerned with uncertainties that may influence the achievement of project objectives. Risk sources can arise from planning, resources, finance, contract administration, site conditions, technology, natural conditions, logistics, and occupational health and safety. A systematic process allows project actors to recognize risk events, assess their significance, select responses, and monitor whether the selected controls remain effective [1,5].

Housing projects require particular attention because apparently small individual buildings may still be exposed to supply, coordination, quality, labor, and access risks. In publicly supported housing, implementation performance also affects the timeliness and usefulness of assistance for beneficiaries. Research on housing construction has therefore emphasized the need to identify dominant risk sources early and to align mitigation with project context [2,7,11].

2.2. AS/NZS 4360:2004 Risk Assessment

The AS/NZS 4360:2004 framework organizes risk management around context establishment, risk identification, risk analysis, risk evaluation, risk treatment, communication, and monitoring. In this study, the analytical core is the combination of likelihood (L) and consequence (C), expressed as $R = L \times C$. The resulting score is located in a five-level matrix ranging from very low to very high risk. This structure provides a transparent basis for comparing a large number of heterogeneous risk indicators and selecting the risks that require immediate or priority treatment [14].

A matrix-based assessment is particularly useful in settings where detailed probabilistic data are unavailable but knowledgeable stakeholders can still judge the relative likelihood and impact of specific risk events. Nevertheless, the interpretation of matrix scores should remain connected to field evidence, especially when the number of respondents is limited. For this reason, the present research combines quantitative ranking with qualitative interviews, observation, and documentation rather than treating the risk score as a stand-alone statistical estimate.

2.3. Research Gap and Analytical Position

The source thesis reviewed prior studies of construction risk, residential construction, occupational safety, risk matrices, and AS/NZS 4360:2004. It found that much of the existing work concerns larger building, bridge, infrastructure, or general housing projects, whereas small government housing assistance in a remote archipelagic setting has received less integrated attention. The present study therefore positions geography and marine logistics not as background variables, but as central conditions that interact with material supply, utilities, equipment, labor, safety, and project management. The sequential explanatory mixed-methods design is used to connect numerical priority with the local mechanisms that create each risk.

III. RESEARCH METHOD

3.1. Study Area and Project Characteristics

The research was conducted in Teluk Wondama Regency, West Papua Province, with the case project located in Kampung Sariay, Roon District. Fieldwork was carried out during 2026 over approximately six months, covering preparation, data collection, analysis, and reporting. The project consists of three Type 45 m² housing units and includes foundation work, timber structural columns, architectural work, plumbing, electrical work, and finishing.

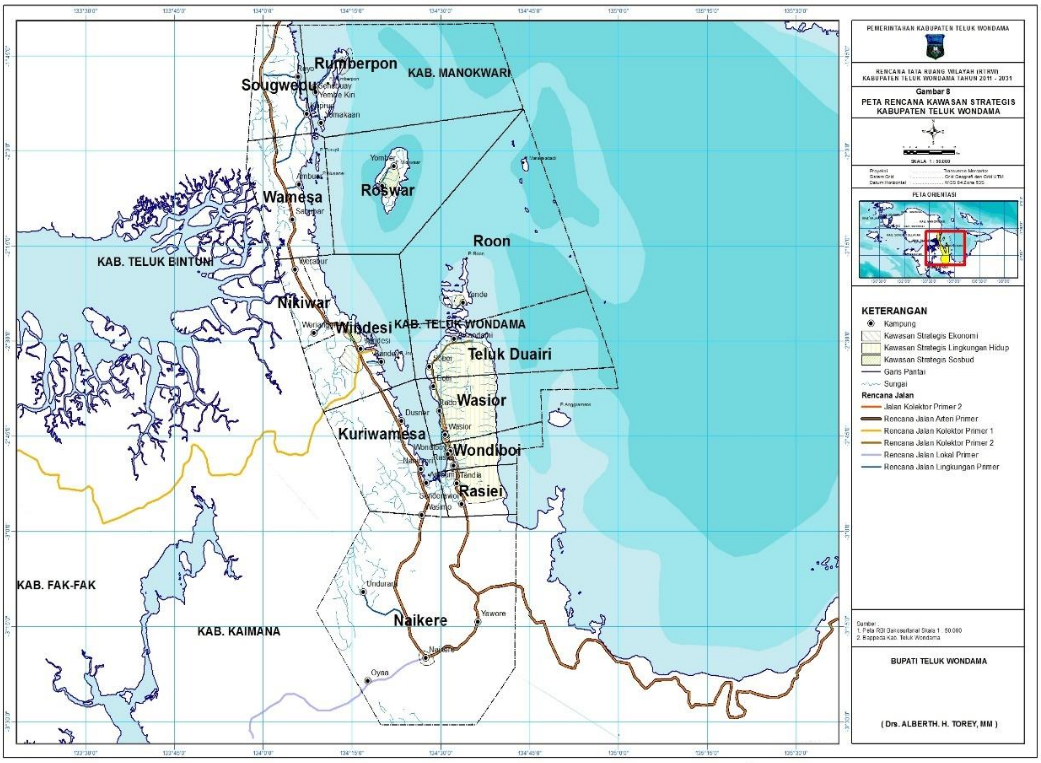

Figure 1. Study location in Teluk Wondama Regency.

Table 1. General characteristics of the case project

Item	Description
Project	Type 45 m² Public Housing Construction
Location	Kampung Sariay, Roon District, Teluk Wondama Regency
Contract value	IDR 649,050,000
Number of units	3 units
Planned duration	120 calendar days
Maintenance period	60 calendar days
Contractor	CV. Faizal Putra
Planning consultant	CV. AK Architecth

3.2. Research Design, Respondents, and Data Collection

A mixed-methods approach with a sequential explanatory orientation was employed. The quantitative phase was used to score and rank risk indicators, while the qualitative phase was used to explain why the risks occurred, how they affected implementation, and which mitigation actions were feasible in local conditions. The study is descriptive and was not designed for inferential testing of causal relationships.

Five respondents were selected purposively because of their direct involvement or knowledge of the project: one contractor representative, one representative of the relevant government agency, and three community representatives. The small sample was intended to provide project-specific expert and user perspectives rather than statistical generalization. Data were collected through questionnaires, in-depth interviews, field observation, project documentation, and literature review.

The questionnaire covered 59 risk indicators grouped into twelve risk-source categories. Respondents assessed the likelihood and consequence of each indicator using the study's five-point scales. Qualitative evidence was subsequently compared with the quantitative ranking through triangulation. This combination reflects the methodological logic that quantitative data indicate how large a risk priority is, while qualitative data explain why the risk arises and how it may be controlled [12,13].

3.3. Risk Analysis Procedure

For each indicator, average likelihood and consequence values were calculated from respondent assessments. The risk score was then obtained using $R = L \times C$. Scores were mapped to the AS/NZS-based risk matrix used in the thesis and classified as very low, low, medium, high, or very high. The analysis then proceeded through four stages: risk identification, risk analysis, risk evaluation, and risk treatment. Priority mitigation focused on the two very-high and three high risks identified by the detailed results table.

Mitigation alternatives were developed from field conditions, interviews, and literature, then validated for practical applicability by project-related respondents. The thesis also estimated target residual-risk values after proposed controls. Because no second round of post-mitigation likelihood and consequence scoring was conducted, those residual values are treated in this article as projected targets rather than empirically observed post-treatment outcomes.

Figure 2. Marine access and material movement context associated with the project area.

IV. RESULT AND DISCUSSION

4.1. Risk Identification and Risk-Source Ranking

The identification stage produced 59 indicators across twelve risk-source groups: planning, social conditions, natural conditions, equipment, materials, labor, construction methods and technology, finance, contract, contractor management, physical site conditions, and occupational health and safety. This broad distribution confirms that the project risk profile cannot be reduced to construction technique alone; it emerges from the interaction between remote geography, logistics, resources, administration, and field operations.

Table 2. Ranking of the twelve risk-source groups

Rank	Risk-Source Group	Risk Weight	Share (%)	Thesis Rank
1	Equipment	9.30	11.13	1
2	Natural conditions	9.28	11.11	2
3	Materials	8.60	10.29	3
4	Physical site conditions	8.24	9.86	4
5	Occupational health and safety	7.88	9.43	5

Rank	Risk-Source Group	Risk Weight	Share (%)	Thesis Rank
6	Financial	7.17	8.58	6
7	Construction methods and technology	6.18	7.40	7
8	Labor	5.97	7.14	8
9	Planning	6.00	7.18	9
10	Contractor management	5.34	6.39	10
11	Social conditions	5.16	6.18	11
12	Contract	4.43	5.30	12

At group level, equipment received the highest aggregated weight, closely followed by natural conditions and materials. However, aggregate group ranking and individual-indicator priority are not identical. The most critical individual risks were concentrated in natural conditions, material logistics, utilities, and unloading safety. This distinction is important: a group may contain several moderate risks and therefore accumulate a high overall weight, while a different group may contain a single risk with an exceptionally high score.

4.2. Priority Individual Risks

The detailed risk matrix classified two indicators as very high and three as high. These five risks form the practical core of the project's mitigation strategy. They are strongly related to the project's island geography and dependence on waterborne material movement.

Table 3. Five priority risks from the AS/NZS 4360:2004 matrix

Rank	Risk	L	C	R = L×C	Category
1	High sea waves	4.00	5.00	20.00	Very high
2	Delayed material delivery	3.80	4.40	16.72	Very high
3	Accident during unloading materials from boats	3.00	4.40	13.20	High
4	Limited water and electricity supply	2.80	4.00	11.20	High
5	Material damage during sea transportation	2.60	4.00	10.40	High

High sea waves produced the maximum risk score (R=20). The qualitative data explain this result by showing that marine conditions directly determine whether boats carrying personnel and materials can travel safely. Unsafe sea conditions can therefore suspend transport, delay work, and expose both people and cargo to significant consequences. The risk is not merely meteorological; it acts as a trigger for schedule, logistics, cost, and safety effects.

Delayed material delivery ranked second (R=16.72). Because many construction inputs must be brought to the island, procurement performance depends on supplier readiness, transport availability, and favorable travel conditions. Delays can halt dependent activities and create knock-on effects across the schedule. Material damage during sea transportation (R=10.40) is linked to the same logistics chain, especially exposure to movement, water, and handling during loading and unloading.

The unloading process itself generated a high occupational-safety risk (R=13.20). Material transfer between a boat and the shore can involve unstable surfaces, manual handling, heavy items, weather exposure, and limited lifting support. The risk therefore requires both operational controls and decisions about when unloading should or should not proceed.

Limited water and electricity supply (R=11.20) reflects the remote-site infrastructure constraint. Water is required for several construction operations and worker needs, while electricity supports tools and site activities. Unreliable utility availability can reduce productivity and cause avoidable work stoppages. Together, the five priority risks demonstrate that project performance is shaped by the coupling of natural conditions, logistics, utilities, and safety rather than by any single technical construction factor.

4.3. Risk Mitigation Strategies

Risk treatment was directed toward reducing likelihood, reducing consequences, avoiding unsafe exposure where necessary, and providing operational buffers. The proposed actions were validated against the actual project context. Table 4 summarizes the principal controls derived from the thesis.

Table 4. Validated mitigation measures for the priority risks

Priority Risk	Validated Mitigation Measures	Primary Objective
High sea waves	Use official weather and wave forecasts; schedule deliveries within safe windows; provide buffer time; use seaworthy transport; postpone sailing when conditions are unsafe.	Reduce transport interruption and safety exposure.
Delayed material delivery	Order long-lead materials earlier; monitor deliveries; use alternative suppliers; maintain buffer stock; shift work to activities not dependent on delayed materials.	Maintain material availability and schedule continuity.
Accident during unloading from boats	Apply unloading SOPs; require appropriate PPE; conduct safety briefings; use lifting aids; provide supervision; unload only under safe sea/weather conditions; prepare emergency response.	Reduce injury likelihood and consequences.
Limited water and electricity	Survey water sources; provide storage tanks and scheduled supply; use alternative water delivery; provide generators and fuel reserves; sequence electrical-equipment use.	Prevent stoppage caused by basic-utility shortages.
Material damage during sea transportation	Use robust and water-resistant packaging; secure loads against movement; match vessel capacity to cargo; inspect before and after transport; maintain reserve materials.	Reduce material loss, rework, quality deterioration, and delay.

4.4. Projected Residual Risk and Mixed-Methods Integration

The thesis developed target residual-risk values to indicate the intended effect of implementing the validated controls. These values should be interpreted cautiously because they were not derived from a second, post-mitigation respondent survey. In other words, they are management targets or projections rather than measured evidence of realized risk reduction.

Table 5. Target/projected residual risk after mitigation

Risk	Initial R	Target L	Target C	Residual R	Target category
High sea waves	20.00	3.0	3.0	9.0	Medium
Delayed material delivery	16.72	2.5	3.0	7.5	Medium
Accident during unloading from boats	13.20	2.5	3.2	8.0	Medium
Limited water and electricity	11.20	2.0	4.0	8.0	Medium
Material damage during sea transportation	10.40	2.0	3.0	6.0	Medium

The target values indicate that the proposed controls are intended to move all five priority risks into the medium category. The strongest implication is managerial: risk treatment should be planned before logistics and site operations begin rather than added only after disruptions occur. Buffer stock, buffer time, alternative suppliers, temporary utilities, packaging standards, and unloading SOPs are relatively practical interventions that can be incorporated into project planning and procurement.

The qualitative and quantitative results were convergent. The questionnaire identified the highest numerical priorities, while interviews, observation, and project documentation confirmed the mechanisms behind those scores. This convergence strengthens the practical credibility of the ranking within the case project. At the same time, the small respondent group means the results should be interpreted as a context-specific risk assessment rather than a statistically generalizable estimate for all housing projects in Papua or Indonesia.

From a construction-management perspective, the findings also show that an island project's supply chain should be treated as part of the core production system. Marine weather, vessel availability, unloading safety, storage, and utility continuity are not peripheral logistical issues; they directly determine work-package readiness. This insight is the main practical contribution of the study and explains why conventional project controls need to be adapted to archipelagic conditions.

V. CONCLUSION

The project risk profile comprised 59 indicators across twelve risk-source groups, confirming that small public housing projects in remote island settings are affected by interacting natural, logistical, resource, administrative, and safety risks. Detailed analysis using the AS/NZS 4360:2004 standard identified two very-high risks. High sea waves (R=20.00) and delayed material delivery (R=16.72) alongside three high risks: boat unloading accidents (R=13.20), limited water and electricity (R=11.20), and material damage during sea transit

(R=10.40). To address these issues, stakeholder-supported mitigation strategies emphasize weather-based logistics planning, buffer time and buffer stock, alternative suppliers, secure packaging of materials, temporary utility systems, and enhanced occupational safety controls during unloading. Although the mixed-methods design effectively links quantitative risk scores with field observations, the findings remain case-specific due to the small purposively selected sample size (n=5) and the fact that residual risk values represent projected targets rather than post-mitigation measurements; consequently, future studies should broaden the sample base and evaluate actual post-implementation residual risks.

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