

Community-Based Assessment of Environmental, Social, and Economic Impacts of Hill Land Development in Bentong, Malaysia

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ABSTRACT

Hill land development has grown in importance as a component of urban expansion in nations like Malaysia, where flat land is in short supply. While such development has several benefits, including economic growth, infrastructural expansion, and greater land utilisation, it also poses significant sustainability difficulties. Major environmental issues include deforestation, soil erosion, landslides, and biodiversity loss. Social issues like as community dislocation and the deterioration of cultural assets complicate development outcomes, while economic advantages are frequently unevenly distributed, adding to higher living expenses and social inequality. This research assesses hill land development's environmental, social, economic, and infrastructural implications. A mixed-methods strategy was implemented, which included literature reviews, questionnaire surveys, and data analysis. The findings emphasise the vital need for long-term infrastructure design, such as robust road networks, effective water management systems, and enough public services, to reduce environmental deterioration and assist local people. The study indicates that effective integration of excellent engineering methods, community engagement, and strong regulatory frameworks is required to handle the complex issues of hill land development. The findings help policymakers, developers, and academics promote sustainable and inclusive development approaches.

Keywords: Sustainable Infrastructure, Socioeconomic Impacts, Urban Development Challenges

INTRODUCTION

Land change has traditionally played an important part in human progress, ranging from agricultural expansion in earlier ages to rapid urbanisation in modern cultures. Population expansion is driving increasing the demand for land to sustain food production, housing, transportation, and economic activities [Peng et al., 2024]. Hilly places are important for the ecosystem because they help to regulate water, save soil, and protect biodiversity. However, rising development pressures have exposed these places and their populations to increased environmental and socioeconomic dangers [Guo et al., 2024].

Hill land development in Malaysia became formally approved in 1998, resulting in large-scale developments in areas such as Genting Highlands. Although these improvements have brought economic benefits, they have also highlighted questions about environmental sustainability and community well-being [Abdullah, 2016]. Public opposition to projects on Penang Hill and Cameron Highlands highlights the persistent issue of combining development needs with environmental protection.

Hill land development is the conversion of steep or high terrain into residential, commercial, or agricultural use. While such initiatives generate economic possibilities, they are usually linked to negative consequences such as soil erosion, landslides, deforestation, and environmental degradation [Weng Chan, 1998]. Understanding the linkages between development activities, environmental systems, and local populations is therefore critical for obtaining sustainable outcomes [Shoyama et al., 2020].

Bentong, a district in Pahang, Malaysia, demonstrates these issues. Bentong, known for its mountainous topography and abundant biodiversity, has seen increased development pressure due to population expansion and land demand. By 2023, the district's population had grown to almost 119,500, increasing the need for housing and infrastructure development in ecologically vulnerable regions. This expansion has resulted to deforestation, soil erosion, and increased landslip and flooding threats, especially during strong rainy seasons [Mohamed et al., 2022].

Infrastructure development in mountainous places provides particular challenges, since creating and maintaining roads, utilities, and buildings on steep slopes necessitates greater expenditures and specialised engineering solutions. Without proper planning, development may lead to congestion, insufficient services, and a strain on local resources. Furthermore, hill land development frequently has a negative impact on local populations, including relocation, loss of livelihoods, and destruction of cultural assets [Mastura Jaafar et al., 2021]. Although growth may provide jobs and enhance infrastructure, the advantages are not always distributed equally.

This study examines the environmental, social, economic, and infrastructure implications of hill land development in Bentong to identify difficulties. The goal is to identify significant concerns and provide ways for attaining sustainable development while balancing economic growth, environmental conservation, and social equality. The study's goal is to provide practical suggestions for responsible hill land development by considering community viewpoints and stakeholder feedback.

METHOD

The study implemented a planned and methodical technique to fulfil its research aims, which were to identify the obstacles and possibilities connected with hill land development. Figure 1 shows the entire research structure in accordance with the study goals.

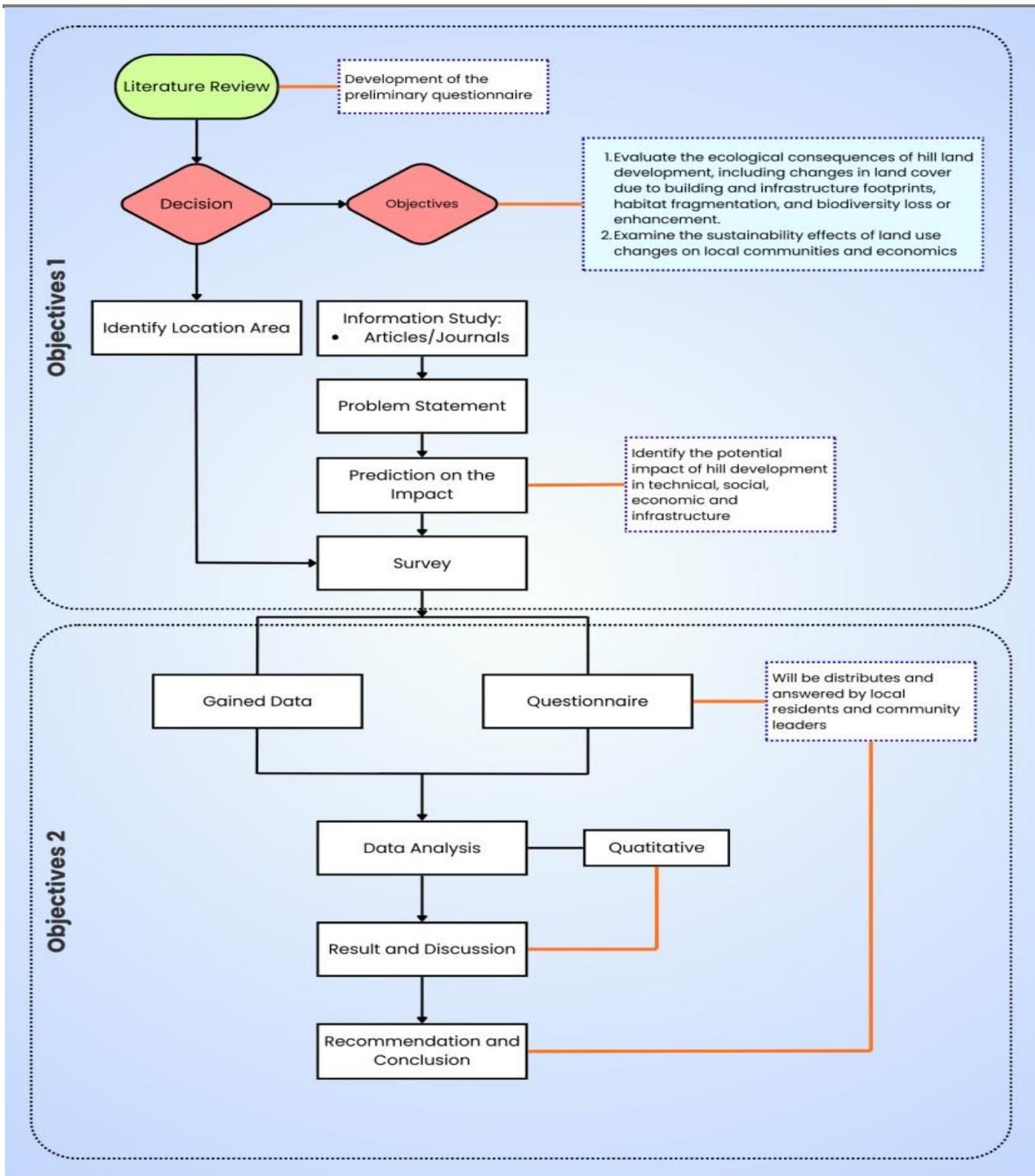


Figure 1: Methodology Flowchart

The technique consisted of three major components which are literature review, data collecting, and data analysis. Each component helped to create a complete assessment of the effects of hill land development. The literature evaluation provided the theoretical and contextual underpinning for the study by reviewing existing research on environmental deterioration, social displacement, economic inequality, and infrastructure constraints in steep terrains. Previous research stressed the necessity of geotechnical investigations, slope stability assessments, and erosion management techniques in reducing the hazards associated with hill land development [Mohd Zulkifli Mohd Yunus, 2019]. Other studies have identified ecological implications such as

deforestation and biodiversity loss, as well as socioeconomic repercussions such as community displacement and livelihood disruption [Wong & Wai, 2020].

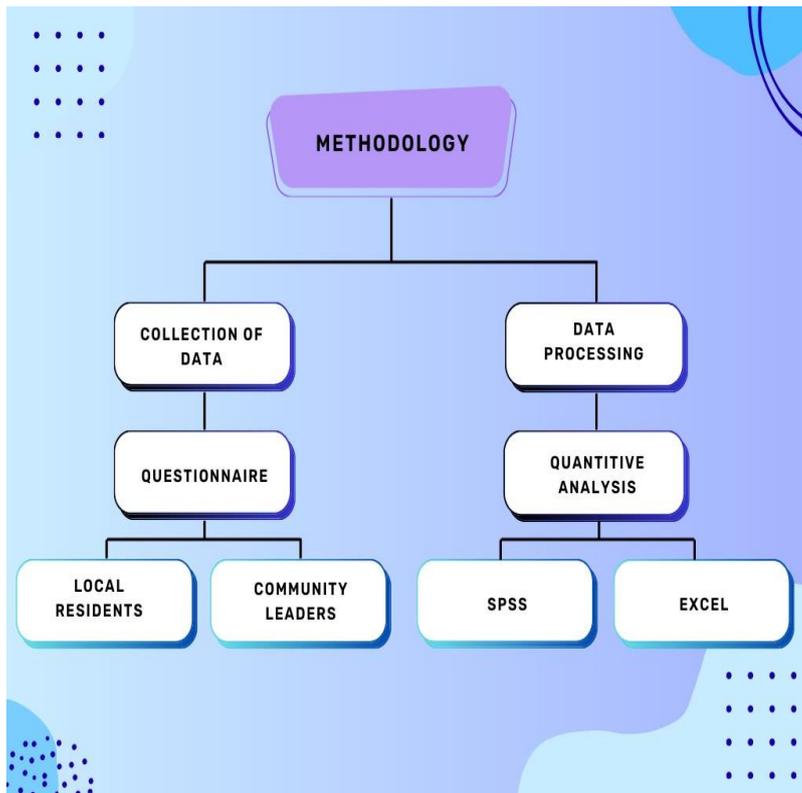


Figure 2: Collection and Evaluation of Data Breakdown

Figure 2 shows the division for collecting data and analysis. During the data collection phase, organised questionnaires were sent to local inhabitants, community leaders, and subject matter experts. The study was aimed to collect respondents' perspectives on environmental change, social repercussions, economic constraints, and infrastructural conditions caused by hill land development. The key concerns investigated were community displacement, changes in property prices, infrastructural adequacy, and general quality of life. SPSS software was utilised for assessing quantitative data, producing descriptive statistics, frequency distributions, and correlations that allowed relevant patterns and relationships to be identified. To discover repeating themes and deeper insights into community problems, thematic coding was applied to qualitative data collected from open-ended replies. The use of both quantitative and qualitative methodologies resulted in a comprehensive understanding of the sustainability difficulties connected with hill land development.

RESULTS AND DISCUSSION

This section shows and analyses the survey findings performed in Bentong, Pahang, with an emphasis on infrastructural, economic, social, and environmental issues. The findings raise a number of sustainability concerns, including increasing demand on existing infrastructure, higher living expenses, community dislocation, and environmental damage. Tables 1 and 2 highlight the significant issues found and the mitigating methods offered.

Infrastructure Challenges

Overloaded Infrastructure

One of the biggest concerns raised is the potential of infrastructure overload as a result of fast population increase. A total of 68.3% of respondents expressed concern about the ability of current infrastructure, such as roads, water supply, and energy systems, to meet rising demand. Inadequate infrastructure renovations may cause traffic congestion, water shortages, and power outages. These findings show the critical need of proactive infrastructure planning and investment to maintain long-term service dependability.

Road Improvements

Increased traffic from new projects has highlighted the need for upgraded road infrastructure. While 34.8% of respondents strongly agreed that upgraded road networks would increase accessibility, 44.9% were concerned about the present road conditions. The mountainous terrain increases the risk of erosion and landslides, necessitating the use of slope stabilisation and erosion-resistant building techniques to assure road safety and durability.

Sustainable Water Management

Water supply has arisen as a major problem, particularly during drought periods. Approximately 60.8% of respondents supported the use of sustainable water management measures including rainwater collection. These systems can minimise reliance on external water supplies, improve water security, and boost resistance to climatic variability, especially in mountainous areas where traditional water infrastructure may be ineffective.

Economic Challenges

Increased Cost of Living

More over half of respondents (56.5%) expressed worry about growing living costs caused by population expansion and increased demand for housing and services. Rising property prices and living expenditures disproportionately affect low-income households, emphasising the need of affordable housing policies and price regulatory mechanisms in promoting equitable economic growth.

Loss of Traditional Jobs

The conversion of agricultural property to residential or commercial usage has raised worries about employment displacement, especially in traditional farming industries. A total of 57.9% of respondents expressed concern about the loss of agricultural livelihoods. Job retraining programs, alternative work options, and the maintenance of specific agricultural zones are critical for ensuring economic variety and resilience.

Social Challenges

Displacement of Communities

Community displacement was highlighted as a key social issue, with 63.6% of respondents worried about possible relocation due to development. Displacement frequently causes social instability, loss of cultural identity, and decreased economic security. Fair compensation schemes, open relocation plans, and genuine community participation are critical for mitigating negative social repercussions.

Overcrowding and Pressure on Services

Population expansion has raised demand for public services such as education and healthcare. More over half of the respondents (55.3%) stated that current offerings will be insufficient to satisfy future demand. To sustain quality of life, it is vital to expand public facilities strategically and prepare for long-term service needs.

Environmental Challenges

Environmental Damage from Construction

The damage to the environment from building operations is still a big issue, with 56.1% of respondents citing hazards such as soil erosion, water pollution, and biodiversity loss. The steep topography of hill locations makes them more vulnerable to landslides and ecosystem damage, underlining the significance of environmentally friendly construction techniques and erosion control methods.

Loss of Agricultural Land

The conversion of agricultural land for development was seen as a serious environmental and economic problem, with 68.7% of respondents being concerned. Protecting agricultural zones and encouraging sustainable farming techniques are critical for ensuring food security and bolstering local economies.

Table 1. Issues or Challenges in Hill Land Development.

Issue	Strongly Agree (%) / Raw	Agree (%) / Raw	Neutral (%) / Raw	Disagree (%) / Raw	Strongly Disagree (%) / Raw	Total Responses
Limited road access to hill areas	19.40% (13)	34.80% (24)	35.90% (25)	8.70% (6)	1.40% (1)	69
Poor condition of roads leading to high villages	23.20% (16)	35.90% (25)	30.40% (21)	10.10% (7)	0% (0)	69
Difficulty supplying utilities (water, electricity) in isolated hill locations	19.40% (13)	36.20% (25)	33.30% (23)	8.70% (6)	2.90% (2)	69
High building costs in steep terrain	22.50% (16)	43.50% (30)	27.50% (19)	6.70% (5)	0% (0)	69
Soil erosion and landslides while constructing	30.40% (21)	41.90% (29)	21.70% (15)	5.80% (4)	0% (0)	69
Construction's effects on the area's biodiversity (plants and animals)	22.50% (16)	37.70% (26)	30.40% (21)	9.00% (6)	0% (0)	69
Water quality degradation caused by building runoff	26.10% (18)	37.70% (26)	29.00% (20)	7.20% (5)	0% (0)	69
Deforestation for building and land development	24.60% (17)	27.50% (19)	38.00% (26)	9.00% (6)	1.40% (1)	69
Social disputes between indigenous groups and	16.10% (11)	39.10% (27)	37.70% (26)	6.70% (5)	0% (0)	69

developers						
Displacement of Local Communities caused by Development	18.80% (13)	44.90% (31)	30.40% (21)	5.80% (4)	0% (0)	69
Rising development demand has led to an increase in the cost of living	24.60% (17)	31.90% (22)	35.90% (25)	7.20% (5)	0% (0)	69
Local traditional economies are declining as a result of landuse changes	33.30% (23)	36.20% (25)	27.50% (19)	2.90% (2)	0% (0)	69

Mitigation Measures

Respondents overwhelmingly endorsed numerous mitigation initiatives aimed at encouraging sustainable hill land development. These include road stabilisation and erosion control, reforestation with native species, sustainable water management systems, equitable compensation and resettlement methods, and community involvement in decision-making processes. The widespread popular support for these policies emphasises the necessity of integrated planning approaches that balance growth goals with environmental conservation and social equality.

Table 2. Mitigation Measures for Hill Land Development.

Mitigation Measure	Strongly Agree (%) / Raw	Agree (%) / Raw	Neutral (%) / Raw	Disagree (%) / Raw	Strongly Disagree (%) / Raw	Total Responses
Implementing road stabilisation procedures to minimise erosion and landslides	32.80% (23)	28.80% (20)	31.90% (22)	6.70% (5)	0% (0)	69
Planting indigenous plants for reforestation and soil conservation	33.30% (23)	36.20% (25)	27.50% (19)	2.90% (2)	0% (0)	69
Creation of Rainwater Harvesting and Other Sustainable	30.40% (21)	30.40% (21)	32.80% (23)	6.70% (5)	0% (0)	69

Water Management Systems						
Provide equitable compensation and resettlement opportunities for displaced communities	36.20% (25)	32.80% (23)	29.00% (20)	2.90% (2)	0% (0)	69
Collaborative decision-making procedures that include local communities in planning and implementation	26.10% (18)	37.70% (26)	33.30% (23)	2.90% (2)	0% (0)	69

CONCLUSION

Hill land development in Bentong brings both potential and problems in terms of economic, social, environmental, and infrastructure development. While development has the ability to boost economic growth and improve infrastructure, it also carries serious concerns such as environmental deterioration, social dislocation, and infrastructural pressure. Sustainable development necessitates a balanced strategy that incorporates environmental conservation, social equality, and economic viability.

This study suggests promoting eco-tourism and agro-tourism to sustain traditional livelihoods, putting in place affordable housing legislation, actively including communities in planning processes, and employing ecologically responsible construction techniques. Infrastructure development should emphasise erosion resistant architecture and long-term utility systems capable of supporting future demand. Hill land development in Bentong may move forward to a resilient and sustainable future that benefits both current and future generations with thorough planning and participatory governance.

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