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An anthropogenic factor contributing to the forest land use changes and its socio-economic impact on the Temiar community in Lojing, Kelantan, Malaysia

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ABSTRACT

This study investigates human-induced factors influencing changes in forest land use and assesses the socio-economic impacts of the Temiar community in Lojing Highland. The assessment investigates perceptions of forest change, scrutinizing both negative impacts and positive aspects. A cross-sectional household survey involving 550 households, coupled with questionnaires and field observations, utilized descriptive and correlation analysis. Findings reveal that deforestation is influenced by accessibility, land use, government policies, human activities, ecological factors, and population dynamics. While highlighting severe threats to biodiversity, respondents also perceive Land Use and Land Cover Change (LULC) as an emerging economic opportunity, recognizing its role in income generation and job creation. Infrastructure developments have remarkably improved the overall quality of life, especially job prospects. These new opportunities reduce reliance on forest sales, promoting economic diversity. Results highlight the threats of human-induced change while emphasizing the potential for economic growth and improved living standards for the Temiar community. In order to ensure the continuity of common life, there is a need for an improved focus on implementing sustainable practices that balance conservation and economic advancement in the Lojing Highland.

Contribution/ Originality: This study provides both the negative and positive perceptions on the impacts of land use and land cover change in Lojing Highland of the Temiar community. The factor causing deforestation was useful to government agencies in planning the development of this community and balancing economic development and ecosystem sustainability.

1. INTRODUCTION

Land use and land cover change (LULC) have emerged as critical areas of study, with Gidey et al. (2023) emphasizing their complexity. The drivers behind LULC span biophysical and socio-economic factors, encompassing climate change, landform variations, population shifts, technological advancements, governmental policies, and community norms. These diverse influences contribute to the evolving landscape globally and regionally. Xu, Chi, Rao, and Zhang (2022) highlight the increasing importance of understanding land usage, especially with rising

demands for accurate data for strategic planning. Categorizing land-use variability becomes crucial for sustainable land management, preventing overuse, and environmental damage. LULC changes, stemming from both natural and human activities, significantly impact global and regional patterns, necessitating thorough analysis for optimized resource management and local well-being. The implications of LULC alterations extend to various domains. For instance, reforestation efforts offer localized cooling benefits, counteracting the warming trends in urban environments like urban heat islands. However, in nations heavily reliant on natural resource exploitation for livelihoods, the competition for sustainable land usage presents a growing concern. As a result, LULC changes have acquired substantial attention due to their far-reaching effects on socio-economic, environmental, and political aspects, highlighting the need for comprehensive understanding and management.

The connection between socio-economic factors and deforestation is complicated and multifaceted. While poverty is frequently identified as a significant driver of deforestation, it's crucial to recognize the influence of various variables like population growth, urbanization, and economic development on this phenomenon. The transformation of land use can lead to increased food production, greater resource availability, and economic growth. For instance, converting forested areas into agricultural land has the potential to strengthen local food supplies and generate economic advantages. Similarly, transforming natural grasslands into urban centres can address the housing and infrastructure demands of an expanding population (Wang, Liu, Peng, & Liu, 2021). The complex relationship between human activity and its impact on forested areas remains a focal point of environmental concern and socio-economic analysis. In particular, the exploration of anthropogenic factors influencing changes in forest land use and their subsequent effects on indigenous communities has garnered significant attention in recent research activities.

Kelantan is a state in Malaysia that has experienced a high rate of forest loss in the past decades. Determining the precise extent of this loss is challenging due to variations in methods and definitions used across different sources to gauge changes in forest cover. Nonetheless, estimates suggest that Kelantan may have lost approximately 200,000 to 300,000 hectares of forest between 2000 and 2020 (Forestry Department of Peninsular Malaysia, 2021). The Temiar community in Lojing, Kelantan, faces significant socio-economic impacts that stem from various factors, including deforestation, land encroachment, and changes in traditional livelihoods. This indigenous group has a unique cultural identity and strong ties to the land, making them particularly vulnerable to the effects of socio-economic changes (Mohd, 2018).

Widespread deforestation, driven by logging and development projects, directly impacts their traditional lands, disrupting their way of life and access to essential resources like medicinal plants, hunting grounds, and clean water. This not only jeopardizes their cultural heritage but also leads to a decline in traditional livelihoods. The Temiar people, who traditionally rely on subsistence farming, gathering forest produce, and hunting, find their practices unsustainable due to limited access to ancestral lands. As a result, some community members are forced to seek alternative sources of income, introducing economic instability and contributing to a loss of cultural identity. The encroachment on their lands exacerbates socio-economic challenges, causing displacement and economic disparities within the community (Siti & Saad, 2019; Wang et al., 2021). This study aims to examine the anthropogenic factors contributing to forest land use changes and socio-economic impact on the Temiar community, a distinct indigenous group residing in Lojing, Kelantan.

2. METHODOLOGY

2.1. Study Area

The study area is situated in the Lojing Highlands within Gua Musang, Kelantan, Peninsular Malaysia (Figure 1). Over recent years, this area has witnessed significant development, raising concerns about the environmental impact of agricultural activities and the socio-economic implications for the Temiar tribe, a subgroup of the Senoi tribe, residing in settlements within the region. Various land use modifications have occurred here, encompassing logging areas, timber and oil palm plantations, large-scale agricultural farms, and other land uses, leading to

substantial alterations in land utilization. These operations have not only affected the environment but also had repercussions on the local communities nearby.

The selection to focus primarily on the Temiar community in this study was influenced by their demographic prominence as the predominant ethnic group in the Lojing Highlands. The infrastructural development of Temiar hereditary community settlements is crucial due to their remote, dispersed, and secluded nature. Villages in the Lojing Highlands region are widely acknowledged to be experiencing significant socio-economic consequences as a result of changes in land utilization. A considerable portion of the population relies solely on forest resources as their primary source of income.

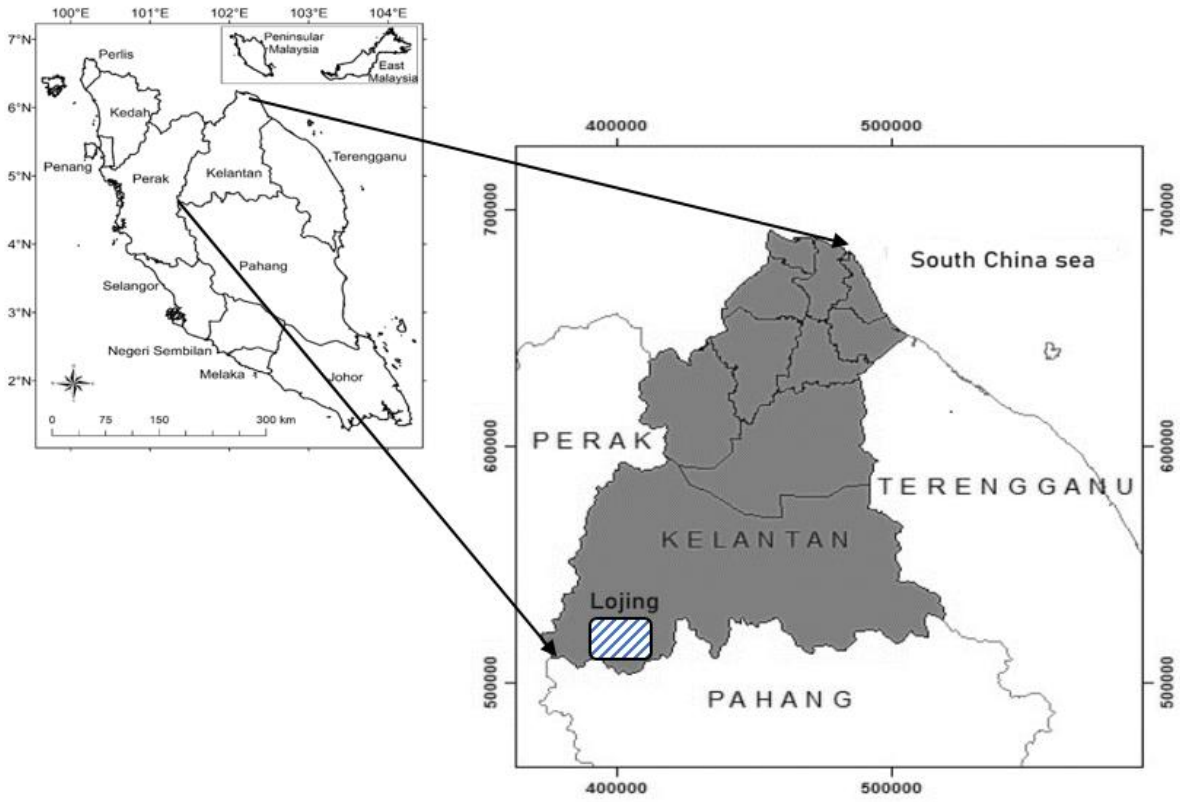

Figure 1. A map of Peninsular Malaysia and Kelantan showing the location of the Lojing Highlands in the state of Kelantan.

2.2. Methods

The methodology carried out for this study involved employing a quantitative approach utilizing a structured questionnaire distributed through a cross-sectional survey. This questionnaire was utilized to investigate and evaluate the socio-economic impacts of indigenous populations on changes in land use within the Lojing Highlands region. The survey campaign was conducted from March 2022 until August 2022. The study population consisted of the Temiar residing in the Lojing Highlands area. The research encompassed four Temiar hereditary settlements and two settlements under the Orang Asli Resettlement Program (OARP) initiated by The Department of Indigenous Persons Development (DIPD). The estimated population in this study area during the research period in 2019 was approximately 8,982 individuals. The determination of the total number of households per village was based on estimates provided by the district office, community leaders, and village heads. Table 1 shows the list of settlements along with their respective population numbers.

Table 1. List of settlement areas and number of populations.

No.	Settlement name	No. of populations
1.	RPS Kuala Betis	2780
2.	RPS Balar	978
3.	Pos Brooke	3000
4.	Pos Hendrop	767
5.	Pos Blau	553
6.	RPS Tuel	904
Total		8,982

Note: RPS = Rancangan Penempatan Semula.
Source: Gua Musang district office, 2029.

The sample size was determined by using the method introduced by Krejcie and Morgan (1970). The sample size was calculated using the following formula:

$$S = \chi^2 NP\,(1-P)/d^2\,(n-1) + \chi^2\,P(1-P)$$

Where: S represent the necessary sample size, χ^2 denotes the chi-square value from the table for 1 degree of freedom at the specified confidence level, N represents the size of the population, P represents the population proportion (.5), d = the degree of accuracy expressed as a proportion (.05).

The confidence level was set at 95% with a degree of freedom of 1, and the chi-square value (χ^2) was determined to be 3.841. The population size (N) is 8,982, the population proportion (P) is 0.5, and the degree of accuracy, stated as a proportion (e), is 0.05. Thus, the calculation is as follows.

$$S = \frac{3.841*8982*0.5*(1-0.5)}{((0.05)^2*(8982-1)) + 3.841*0.5(1-0.5)}$$

$$S = \frac{8624.9655}{22.4525 + 0.96025}$$

$$S = 368.387 \approx 370$$

The value of S, for a total population (N) of 8,982, is approximately 370, specifically denoted as 368.387. In this study, a comprehensive interview was conducted with a sample of 550 household heads, adhering to the recommended criteria for a robust sample size.

Two sections were developed for the questionnaires. Section A outlines the household's demography and socioeconomic status, while Section B addresses forest change issues, including causes, impacts, and responses. Section B is further divided into several subsections based on previously identified themes. Specifically, the 'Cause' section is further subdivided into multiple sub-subsections, encompassing changes in land use, local socioeconomic and population characteristics, accessibility, policy and management, and ecological effects generated by humans.

Furthermore, within the 'Impact' segment, we further categorize impacts into two sections: negative and positive impacts. In Section 'A,' the questions primarily comprise structural inquiries aimed at gathering demographic and socioeconomic information from respondents. These questions encompass details such as age, gender, marital status, race, religion, family size, level of education, social activity, and income. On the other hand, in Section 'B,' we gauge respondents' attitudes toward forest change using eight statements rated on a five-point Likert scale. These statements collectively address the issue of illegal forest encroachment. The data gathered from the questionnaires in this study was analysed analysis using Statistical Package for the Social Sciences (SPSS) version 23.

3. RESULTS AND DISCUSSION

3.1 Demographic Profile

The demographic profile of all participants in this study encompasses variables such as age, gender, marital status, race, religion, education, occupation, and monthly income. A summary of the survey findings regarding respondents' demographic profiles is presented in Table 2.

The study involved 550 respondents, revealing crucial insights into their demographic profiles. Among these respondents, distinct age distributions were observed, with a majority (50.90%) falling between 26 and 30 years old, while smaller percentages were distributed across other age brackets. The age group of 26 to 30 appeared integral in familial and community support, often engaged in full-time work. Regarding gender, 55.45% of the participants were male, dominating household headship. Notably, a limited number of female household heads, specifically single mothers, were identified. Marital status varied, with 55.63% married, showing a notable preference for intracultural marriage, particularly within the Temiar community.

Table 2. Demographic profile of the respondents.

Demographic profile		Frequency	Percentage
Age			
	19 to 25 years old	120	21.82%
	26 to 30 years old	280	50.90%
	31 to 39 years old	65	11.81%
	40 to 49 years old	78	14.18%
	50 years old and above	7	1.27%
Gender			
	Male	305	55.45%
	Female	245	44.55%
Marital status			
	Single	238	43.27%
	Married	306	55.63%
	Divorced	6	1.09%
Race			
	Indigenous	480	87.27%
	Chinese	11	2.18%
	Indian	5	0.91%
	Malay	54	9.82%
Religion			
	Islam	508	92.36%
	Christian	12	2.18%
	Buddha	11	2.00%
	Hindu	5	0.91%
	Others	14	2.54%
Education level			
	No formal education	27	4.90%
	Primary education	116	21.10%
	Secondary school	400	72.72%
	College/University	7	1.27%
Occupational sector			
	Government	15	2.73%
	Private	265	48.19%
	Self-employed	270	49.10%
Monthly income			
	RM1500 and below	538	97.81 %
	RM1501 to RM2999	8	1.45%
	RM3000 to above	4	0.74%

Ethnic identification revealed 87.27% as Orang Asli, with other ethnicities such as Malay, Chinese, and Indian represented in smaller percentages. Religious affiliation primarily comprised Muslims (92.36%), while efforts to integrate Islamic teachings among indigenous communities continue alongside cultural preservation. Education levels indicated a majority (72.72%) completing secondary schooling, while limited access to higher education due to financial constraints was evident. Employment distribution showcased 48.19% in the private sector, 49.10% self-employed, and 2.73% in government jobs. The monthly income of most respondents (97.81%) was Ringgit Malaysia (RM)1500 or lower, primarily from sectors like agriculture and logging, with a few entrepreneurial ventures

exceeding this income bracket. Demographic profiles illustrate a complex socio-economic landscape, encompassing age dynamics, gender roles, cultural preferences, educational limitations, diverse employment sectors, and income disparities among respondents in the study area.

3.2. Factors of Land Use and Land Cover Change (LULC)

Table 3 shows a respondent's perception of the factor causing land use and land cover change (LULC) in the study area. A total of eight statements were formulated for this particular sub-section to assess the respondents' perception of this issue.

Table 3. Respondent perception on factors of LULC change.

No.	Statement	1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
B1	Forest coverage of Lojing highlands area is changing	0	0	0	245 44.55%	305 55.45%
B2	Forest change is due to human activities	0	0	40 7.27%	370 67.27%	140 25.45%
B3	Biodiversity is reducing	0	0	42 7.64%	450 81.82%	58 10.55%
B4	Habitats and species reducing	0	0	14 2.55%	53 9.64%	483 87.81%
B5	Income from forest reducing	0	0	32 5.82%	220 40.0%	298 54.18%
B6	Forest production reducing	0	0	24 4.36%	96 17.45%	430 78.18%
B7	Environment changing due to the forest damage	0	0	58 10.54%	375 68.18%	117 21.27%
B8	New infrastructure developed replacing forest	0	0	10 1.82%	130 23.64%	410 74.55%

Based on the data in Table 3, the first statement (B1), 245 respondents (44.55%) agreed, while 305 respondents (55.45%) strongly agreed that the forest coverage in the Lojing Highlands area is changing. Local perspectives assert significant transformations in the region since the early 1980s, aligning with governmental development objectives. Efforts have been made to enhance the area by providing amenities and services. For the second statement (B2), 370 respondents (67.27%) agreed, 140 (25.45%) strongly agreed, and 40 (7.27%) were neutral regarding human activities causing forest changes. Participants largely acknowledged human impacts on forest attributes, including biodiversity decline, deforestation, and climate change.

The third statement (B3) showed 450 respondents (81.82%) agreeing, 58 (10.55%) strongly agreeing, and 42 (7.64%) being neutral about biodiversity reduction. Respondents highlighted ecological concerns with implications for climate change, noting increased rainfall and its effects. The fourth statement found 53 respondents (9.64%) in agreement, 483 (87.81%) strongly agreeing, and 14 (2.25%) neutral regarding habitat and species reduction. Respondents attributed habitat loss to anthropogenic actions, impacting species populations and biodiversity.

Regarding the fifth statement (B5), 220 respondents (40.00%) agreed, 298 (54.18%) strongly agreed, and 11 (2.25%) were neutral about reducing income from the forest. Declines in forest resources and associated income were linked to human activities like deforestation. For the sixth statement (B6), 96 respondents (17.45%) agreed, and 430 (78.18%) strongly agreed on reducing forest production. This decline in non-timber forest products was attributed to agro-tourism prioritization and large-scale agriculture, impacting medicinal plants and other resources.

Addressing the seventh statement (B7), 375 respondents (68.18%) agreed, 117 (21.27%) strongly agreed, and 58 (10.54%) were neutral about environmental changes due to forest damage. Responders acknowledged climate change's influence on forest ecosystems, affecting biodiversity and natural patterns. Analyzing the eighth statement (B8) found

130 respondents (23.64%) in agreement, 410 (74.55%) strongly agreeing, and 10 (1.82%) being neutral about new infrastructure replacing forests. Infrastructure projects were seen as potentially impacting forest ecology, necessitating careful planning to mitigate adverse effects.

The mean score of respondent perception on factors of land use land cover change (LULC) is shown in Table 4. There were eight items of statements used for this analysis, and the result analysis shows that the mean score for these eight items of statements is from 3.893 to 4.369. From this range of mean scores, it was found that the average mean score is 4.252, which indicates the level of respondents' perceptions of land use change is at a high level.

The indigenous community's efforts to assimilate into mainstream society often entangle them in enduring challenges, jeopardizing their livelihoods. These challenges, inclusive of exploitation and developmental inadequacies, persist unresolved. Moreover, they confront new hurdles like climate change and the alteration of their traditional practices, posing threats to their cultural identity and long-term survival. These issues create uncertainty in solving problems within the community, notably in the costs incurred by their assimilation into the prevailing societal norms.

Table 4. Mean score of respondent perception on factors of LULC change.

No.	Item of statements	Mean score	Rank	Indication
B1	Forest coverage of the Lojing highlands area is changing	4.364	2	High
B2	Forest change is due to human activities	4.327	3	High
B3	Biodiversity is reducing	4.295	5	High
B4	Habitats and species reducing	4.301	4	High
B5	Income from forest reducing	4.232	6	High
B6	Forest production reducing	4.369	1	High
B7	Environment changing due to forest damage	4.201	7	High
B8	New infrastructure developed replacing forest	3.893	8	Average
Total mean score		4.252		High

Despite potential negative implications, active participation within the societal structure can yield positive outcomes for the Indigenous community. For instance, the Orang Kuala subgroup has achieved remarkable economic empowerment, significantly enhancing their quality of life (Zal, 2013). Their role as suppliers of essential resources derived from nature to external populations has notably boosted the financial well-being of the Temiar community. However, the Temiar community faces adverse repercussions. The heightened demand for resources like logs, rubber, and palm oil has led to detrimental consequences, resulting in livelihood loss and significant threats due to depleting forest resources. In the Lojing Highlands, Indigenous populations have observed a decline in forest product harvests, impacting their income. The decline and disappearance of these resources are partially linked to pursuits in agro-tourism and eco-tourism, government policies, and illegal encroachments into forestry areas driven by human greed.

3.3. The Anthropogenic Causes of Land Use Land Cover Change (LULC)

Advancing development stands as a central goal for nations worldwide, aiming to elevate people's overall quality of life. Governments actively drive industrial growth, commercial farming, and various industries to broaden economic prospects and fulfil these aims. Consequently, specific regions have been earmarked to support high-impact economic activities and foster commercial activities. There were fourteen items of statements were prepared for this sub-section in order to gain respondents' perceptions on this matter (Table 5).

Within the land-use factors, the analysis reflected diverse viewpoints from participants. Urban development garnered responses from 262 individuals (47.64%) in agreement, 145 (26.36%) remaining neutral, 124 (22.55%) strongly agreeing, and 19 (3.45%) disagreeing. Concerning agriculture expansion, there were 295 (53.64%) agreements, 132 (24.00%) neutral responses, and 153 (27.82%) strong agreements. Furthermore, 385 respondents (70.00%) acknowledged agriculture as a significant factor, with 65 (11.82%) neutral responses and 100 (18.18%) expressing strong agreement.

Table 5. The anthropogenic causes of land use land cover change (LULC).

No.	Factors/Cause		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Land use factors	Urban developments	0	19 3.45%	145 26.36%	262 47.64%	124 22.55%
2		Agriculture expansion	0	0	132 24.00%	295 53.64%	153 27.82%
3		Agriculture	0	0	65 11.82%	385 70.00%	100 18.18%
4	Population & socio-economic factors	Population pressure (Increase of population size and density)	0	43 7.82%	120 21.82%	215 39.09%	172 31.27%
5		Increase of migrant people	0	76 13.82%	56 10.18%	232 42.18%	186 33.82%
6		Higher income from non-forest source	0	0	124 22.55%	176 32.00%	250 45.45%
7		Overharvesting of forest products	0	0	200 36.36%	148 26.91%	202 36.73%
8		Poverty rate	0	50 9.09%	150 27.27%	232 42.18%	118 21.45%
9		Education level	0	0	95 17.27%	296 53.82%	159 28.91%
10		Farm size expansion	0	0	44 8.00%	320 58.18%	186 33.8%
11	Accessibility factors	Accessibility/ Distance to the market and road	0	0	29 5.27%	296 53.82%	225 40.91%
12	Policy & management factors	National and state legal policy	0	0	180 32.73%	268 48.73%	102 18.55%
13	Human-induced ecological factors	Land erosion	0	0	167 30.36%	196 35.64%	187 34.00%
14		Water and oil pollution	0	0	65 11.82%	320 58.18%	165 30.00%

Lojing area was designated as a small colony in 2010 aimed to preserve its identity as an agro-tourism and eco-tourism hub. A land allocation of 11,967.472 hectares by the Land and Mines Department was designated for developmental purposes to various governmental and private entities. The evaluation of population and socio-economic factors encompassed multiple causes. For instance, reactions to population pressure varied: 215 (39.09%) were in agreement, 120 (21.82%) were neutral, 172 (31.27%) strongly agreed, and 43 (7.82%) disagreed. Regarding increased migration, responses included 232 (42.18%) in agreement, 56 (10.18%) neutral, and 186 (33.82%) strongly agreeing.

Accessibility emerged as a significant factor, with 296 (53.82%) agreements, 225 (40.91%) strong agreements, and 29 (5.27%) neutral responses. This factor, shaped by transportation and urbanisation, holds substantial influence over land-use changes. Policy and management factors, the fourth cause, engaged 196 (35.64%) agreements, 187 (34.00%) strong agreements, and 167 (30.36%) neutral responses. Zoning laws, land-use planning, and conservation programmes substantially drive alterations in land use.

Human-induced ecological factors, the fifth cause, highlighted concerns around land erosion (196 agreed, 187 strongly agreed, 167 neutral) and water and oil pollution (320 agreed, 165 strongly agreed, 65 neutral). These factors, resulting from human activities, exert significant impacts on land use. The land-use changes result from various factors encompassing population dynamics, economic growth, accessibility, policy implementations, and human-

induced ecological factors. Overpopulation, pollution, fossil fuel combustion, and deforestation notably impact land productivity and its suitability for diverse uses.

Table 6, shows a mean score of 4.4025 which indicates that accessibility issues have emerged as the primary anthropogenic driver of land use change. The necessity to establish access, such as a road network, in the Lojing Highlands region was driven by the imperative to meet local economic demands. This included facilitating connectivity between various post communities within the area and establishing a link between the neighbouring regions of Cameron Highlands and Gua Musang in Kelantan. In this study, the average value for policy and management components was 4.3711. This value is related to the suitability of land utilization for optimal economic advancement while avoiding detrimental environmental consequences. The ecological impacts of soil erosion and river pollution attributed to human activities had been primarily driven by unregulated infrastructure expansion, extensive cultivation of crops, and inadequate enforcement measures.

Table 6. Mean score about anthropogenic causes of land use land cover change (LULC).

No.	Factors		Mean score	Indication
1	Land use factors	Urban developments	4.3820	High
2		Agriculture expansion	4.3820	High
3		Agriculture	4.3912	High
4	Population & socio-economic factors	Population pressure (Increase of population size and density)	3.8994	Average
5		Increase of migrant people	3.7610	Average
6		Higher-income from non-forest source	3.8616	Average
7		Overharvesting of forest products	3.8616	Average
8		Poverty rate	3.7925	Average
9		Education level	3.8616	Average
10		Farm size expansion	3.8931	Average
11	Accessibility factors	Accessibility/Distance to the market and road	4.4025	High
12	Policy & management factors	National and state legal policy	4.3711	High
13	Human-induced ecological factors	Land erosion	4.3711	High
14		Water and oil pollution	4.3711	High
Average mean score			4.1022	High

The mean score highlights agriculture as a significant driver of land change in highland regions. The implementation of a program aimed at fostering agricultural growth and promoting mass tourism has led to environmental challenges, exemplified by the situation in Cameron Highlands, adjacent to Lojing Highlands. Over the past three decades, Cameron Highlands' land cover has significantly changed due to extensive construction and land removal activities. Upland regions, prone to landslides and soil erosion, notably contribute to water pollution issues in interconnected river systems, particularly through sedimentation and siltation processes. Agricultural operations stand out as the primary source of nitrogen runoff and phosphorus discharge compared to residential, urban, and vacant areas. It's crucial to recognize that landscape alterations, including peatland drainage, land flooding for rice cultivation, and deforestation during land clearance, are pivotal factors contributing to environmental degradation associated with land use changes.

3.4. Correlation Analysis of LULC and Factor Items

The Pearson correlation coefficients offered insights into the relationships between the LULC and various influencing factors. The findings, as outlined in Table 7, unveiled a noteworthy pattern—a positive correlation existing between all variables examined and the observed forest change within the study area. This suggests that as these influencing factors change, they tend to correspond with alterations in the forest landscape.

The correlation analysis highlighted five variables that displayed notable associations with forest change. Among these were accessibility factors, presenting a particularly strong correlation coefficient of 0.609. This indicates a robust relationship between the ease of access and the changes observed in the forested areas. Similarly, the development of agriculture (r=0.591), policy and management decisions (r=0.584), human-induced factors (r=0.484), and ecological considerations (r=0.484) exhibited significant positive correlations with forest change.

The significance of these relationships was further emphasized through the analysis of P-values, which ascertain the statistical significance of these correlations. Notably, the P-values for the identified variables—accessibility factors (0.005), policy and management (0.004), agriculture (0.002), human-induced factors (0.003), and ecological factors (0.002)—all fell below the 0.01 threshold. This underscores a strong and statistically significant relationship between these variables and forest change, indicating that these factors play a crucial role in influencing the observed alterations in forested areas at a significance level of 0.01. These relationships are vital as they help in understanding the drivers behind forest change. These findings suggest that aspects such as accessibility, agricultural development, policy decisions, human-induced actions, and ecological dynamics significantly contribute to the shifts observed in the study area's forest landscape. Such insights are pivotal for formulating effective strategies and policies aimed at managing and conserving forests while considering the multifaceted impact of these influencing factors.

Table 7. Correlation of LULC and factor (variables).

Variables	Coefficient of correlation	P value
Accessibility factors	0.609**	0.005
Policy and management	0.584**	0.004
Agriculture	0.591**	0.002
Human-induced	0.296**	0.003
Ecology factors	0.484**	0.002

Note: **. Correlation is significant at the 0.01 level (2-tailed).

3.5. Perceptions of both Negative and Positive Impacts of Forest Change on the Community

There were ten statements were developed for the subsection focusing on perceptions of negative impacts, while five statements were created to assess positive perceptions. Table 8 displays respondents' feedback regarding negative impacts, while Table 9 pertains to positive impacts.

Table 8. Negative impacts of forest change on the community.

No.	Statement	1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
D1	Biodiversity is threatened	0	0	0	458 83.27%	92 16.72%
D2	Species and habitats reducing	0	0	31 5.64%	389 70.72%	130 23.64%
D3	Number of trees reducing	0	0	77 14.00%	356 64.73%	117 21.27%
D4	Income from forest reducing	0	0	120 21.82%	310 56.36%	120 21.82%
D5	Forest production reducing	0	0	125 22.73%	299 54.36%	126 22.91%
D6	Frequency of flood and damage changing	0	0	0	312 56.73%	238 43.27%
D7	Forest damage increasing and land changing	0	0	20 3.64%	402 73.09%	128 23.27%
D8	Solid waste detected	0	0	100 18.18%	369 67.09%	81 14.72%
D9	Risk of local livelihood (Forest dependent) increasing	0	0	65 11.82%	416 75.64%	69 12.55%
D10	Increase migration of people	0	0	67 12.18%	445 80.91%	38 6.91%

Table 9. Positive impacts of forest cover change on the community.

No.	Statement	1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
E1	Source of income increasing	0	0	0	435 79.09%	115 20.91%
E2	Income increasing (From other sources by creating new job opportunities)	0	0	100 18.18%	287 52.18%	163 29.64%
E3	Overall quality of living standard increasing	0	0	50 9.09%	320 58.18%	180 32.73%
E4	Communication system improved	0	0	115 20.91%	305 55.45%	130 23.64%
E5	New infrastructure developed for useful purposes replacing forest	0	0	65 11.82%	410 74.55%	75 13.64%

3.5.1. Negative Impacts

The data analysis indicates alarming trends across multiple statements. In the first statement (D1), a substantial majority, 83.27%, agreed, and 16.72% strongly agreed that biodiversity is under threat. Similar concerns were evident in the subsequent statements, where respondents expressed agreement and strong agreement on issues such as the reduction of species and habitats (D2), the decrease in tree numbers (D3), the decline in forest-derived income (D4), reduced forest production (D5), and changes in flood frequency and damage (D6). The seventh statement (D7) raised concerns about escalating forest damage and changing land, with 73.09% agreement and 23.27% strong agreement. The detection of solid waste in the study area (D8) also garnered attention, with 67.09% strongly agreeing. Statement nine (D9) highlighted the increasing risk to local livelihoods, with 75.64% agreement and 12.55% strong agreement, while the tenth statement (D10) emphasized the negative impact of growing migration on the ecosystem and livelihood, with 80.91% agreement and 6.91% strong agreement.

The results point out the critical threats posed to biodiversity by human-induced factors, including overcrowding, pollution, fossil fuel combustion, deforestation, and climate change. Highland regions are particularly vulnerable, facing significant risks from climate change, habitat loss, and excessive exploitation. The impact of climate change on temperature and precipitation patterns affects species distribution, while habitat loss disrupts essential qualities necessary for habitats. Over-exploitation of resources further contributes to biodiversity depletion. The complex interplay of factors, including accessibility, population growth, economic development, technology, and regulations, influences both biodiversity and land usage patterns.

3.5.2. Positive Impacts

Forests play a pivotal role in providing varied economic and social benefits, contributing significantly to employment, forest product processing, trading, and investments. Income generated from forests includes diverse products such as fuel, construction materials, medicinal items, and sustenance. In the analysis of the initial statement (E1), 79.09% of 435 respondents agreed, while 20.91% strongly agreed on the rise in income sources. The subsequent statement (E2) revealed that 52.18% of 287 respondents agreed, 29.64% strongly agreed, and 18.18% remained neutral, indicating an increase in income through new job creation from alternative sources. Statement three (E3) analysis highlighted that 58.18% of 320 respondents agreed, 32.73% strongly agreed, and 9.09% remained neutral concerning improvements in overall living standards. Similarly, statement four (E4) showed that approximately 55.45% of 305 respondents agreed, 23.64% strongly agreed, and 20.91% remained neutral regarding enhancements in the communication system. Significant is the observation in the analysis of the fifth statement (E5), where 74.55% of 410 respondents agreed, 13.64% strongly agreed, and 11.82% remained neutral, indicating the development of new infrastructure replacing forest areas for useful purposes.

4. CONCLUSION

The forests in Lojing, Kelantan, are characterized by a diverse range of species, serving as vital assets for local communities by providing sustenance, economic opportunities, and access to medicinal plants, among other advantages. The continued reliance on these forest resources is rooted in their economic importance and the cultural heritage transmitted across generations. However, individuals encounter difficulties in broadening their income avenues due to limited skills and capabilities. Human-induced activities resulting in land use and land cover change (LULC) significantly impact the local ecosystem by transforming the natural state of forests for alternative land uses. The study identified various key causes of deforestation, including factors like accessibility, land use, government policies, human activities, ecology, and population-related factors. On a positive note, respondents perceive deforestation as an emerging income source, leading to augmented earnings through new employment opportunities, improved communication systems, an elevated overall quality of life, and the development of infrastructure, replacing forests sign of progress in the region. This growth has yielded favourable outcomes for the Temiar community, presenting an additional source of revenue. To ensure the continuity of common life, there is a need for an improved focus on implementing sustainable practices that balance conservation and economic advancement. However, certain infrastructure projects, such as roads, health facilities, communication networks, and clean water sources, require completion. Notably, the most vulnerable, including landless and small-scale farmers, heavily rely on income derived from forest products. The Temiar ethnic group in the Pos Lojing Highlands settlement area has acquired additional income from various forest products, encompassing fuel, food, construction materials, medicinal items, and more. During crises, some resort to selling forest goods, and income-generating activities involve foraging, fruit harvesting, and other practices. The utilization of forest resources significantly contributes to additional income for several households in the Lojing Highlands, supporting economic growth in the region. Despite the negative impacts, land use and land cover change (LULC) have brought positive transformations to the study area. Infrastructure development has improved the overall quality of life for the population, particularly the Temiar community. It creates new job opportunities, spanning agriculture, logging, construction, and self-employment, provides diversified income sources, lessening dependency solely on the sale of forest products.

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Institutional Review Board Statement: The Ethical Committee of the Universiti Putra Malaysia, Malaysia has granted approval for this study on 16 August 2021 (Ref. No. REC/08/2021 (PG/FH/225)).
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
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