Health Literacy in a Protected Area: Stakeholder mapping and system barriers

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Abstract

This study investigates the structural and relational determinants of health literacy in Pahang National Park, Malaysia. Using Net-Map and Social Network Analysis (SNA), we mapped stakeholder relationships among 16 actors involved in health promotion. The network showed moderate cohesion (density = 0.47), with key roles played by clinics, JAKOA, and schools. Thematic analysis revealed barriers in education, infrastructure, poverty, and restrictive policies. Findings highlight the need for cross-sectoral collaboration, school-based interventions, and inclusive policy reforms to improve health literacy in protected communities. Results offer a systems-based framework for advancing health equity in ecologically constrained settings.

Keywords: health literacy, protected areas, social network analysis, stakeholder mapping, Pahang National Park

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1.0 Introduction

Health literacy is a foundational determinant of individual and community health, influencing the ability to access, comprehend, and apply health information to make informed health-related decisions (Sørensen et al., 2012). It is pivotal in shaping vulnerable populations' health behaviors, service utilization, and outcomes. In recent years, global public health discourse has increasingly emphasized health literacy as both a human right and a strategic priority to reduce health disparities. The World Health Organization (WHO) advocates for context-specific strategies that integrate health literacy into national policies, especially in settings where socioeconomic and infrastructural barriers hinder access to health services.

Protected areas are designated for ecological conservation where populations often face a double burden: poverty and marginalization on the one hand and regulatory constraints on the other (Zhang et al., 2020). These areas frequently include rural and Indigenous communities with limited access to healthcare, formal education, and health communication infrastructures (Nutbeam & Lloyd, 2021). In Southeast Asia, particularly Malaysia, such structural challenges are exacerbated by geographically isolated terrains, cultural-linguistic diversity, and rigid conservation policies (Chin, 2024).

Pahang National Park (PNP), one of Malaysia's largest and most ecologically significant national parks, is home to Indigenous populations and other rural groups. Despite the richness of its biodiversity, the communities residing within and around PNP experience socioeconomic disadvantages, infrastructural underdevelopment, and restricted access to modern health services (Ahmad et al., 2024). A national survey reported that a substantial proportion of Malaysian adults, particularly those in rural and low-income brackets, have inadequate health literacy, directly contributing to poorer health outcomes and greater health inequities (Jaafar et al., 2021).

Addressing these challenges requires understanding individual knowledge deficits and mapping the broader systemic and relational dynamics that shape access to health information. The Net-Map methodology offers an innovative approach by visualizing relationships, power hierarchies, and communication flows among stakeholders involved in health literacy efforts (Borgatti et al., 2024). Combined with Social Network Analysis (SNA), this method provides a deeper understanding of how stakeholder interactions facilitate or hinder the spread of health information within complex environments like protected areas.

This study applies the Net-Map tool and SNA techniques to identify and map the key stakeholders involved in promoting health literacy in PNP, analyze the structure and cohesion of the stakeholder network using SNA, explore perceived barriers to health literacy from the stakeholder perspective, and propose multi-sectoral strategies to enhance health literacy and health equity in protected communities. Through these objectives, the study offers empirical insights and policy recommendations for improving health literacy in marginalized populations living within protected areas, where public health and environmental conservation must be balanced with human development.

2.0 Literature Review

2.1 Health Literacy as a Social Determinant of Health

Health literacy has evolved from focusing on individual skills, such as reading health pamphlets, to a broader concept embedded in social contexts and systems (Nutbeam & Lloyd, 2021). It is now widely recognized as a key social determinant of health (SDH), influencing the ability of individuals and communities to make informed health decisions, engage with healthcare systems, and adopt preventive behaviors (Sørensen et al., 2012). Low health literacy is linked to increased hospitalization rates, poor self-care, lower uptake of preventive services, and higher healthcare costs (Nutbeam & Lloyd, 2021).

In marginalized populations, including Indigenous groups and rural communities, health literacy deficits are compounded by systemic issues such as poverty, poor infrastructure, and educational inequalities (Smylie et al., 2021). These structural determinants limit both the accessibility of health information and the capacity to act upon it. Hence, improving health literacy requires more than individual-level education; it demands systemic, culturally sensitive, and community-engaged approaches.

2.2 Health Literacy in Protected and Rural Areas

Globally, communities living in protected areas often face unique challenges due to the conservation and biodiversity policy of the protected areas. The challenges include strict environmental regulations that limit development, inadequate health infrastructure, and limited integration into national health systems (Pailaha, 2023). Studies from Canada, Australia, and Indonesia consistently show that Indigenous and rural populations in such regions are at higher risk of health illiteracy due to geographic isolation, cultural mismatches in health communication, and a preference for traditional medicine (Smylie et al., 2021).

In Southeast Asia, targeted interventions in the Philippines and Thailand have demonstrated the potential of community-based health literacy models, including digital tools and empowering community health workers (Kosowicz et al., 2023). While such models improve access and engagement, challenges remain in sustaining outreach, especially where digital divides persist.

In the Malaysian context, rural communities, including the Indigenous people, frequently experience a combination of educational disadvantages, income insecurity, and restricted healthcare access. In protected areas like PNP, these problems are exacerbated by conservation policies that restrict infrastructure expansion (Rahim et al., 2022), such as permanent settlements, road connectivity, and telecommunication services. Chin (2024) argues that the environmental health risks experienced by these communities often stem not from the environment but from systemic neglect and exclusion from health and development programs.

2.3 Stakeholder Engagement and Health System Coordination

Improving health literacy in underserved settings also depends on effective stakeholder coordination. Fragmented service delivery, where government agencies, NGOs, and healthcare providers work in silos, often undermines public health efforts (Chang et al.,

2021). Without a shared communication and strategy alignment platform, interventions risk duplicating or excluding key community actors, ultimately limiting their impact.

Understanding stakeholder roles and power dynamics is essential. Social Network Analysis (SNA) helps map these relationships by identifying key actors and communication gaps. The Net-Map method enhances this by involving stakeholders in mapping influence, information flow, and engagement gaps (Borgatti et al., 2024).

2.4 Gaps in Literature and Research Justification

Although international studies have explored stakeholder coordination in health promotion, limited research has been done on applying network-based methodologies to health literacy in protected communities, especially in Malaysia. Most existing studies focus on individual-level determinants or broad national health literacy scores, with few examining the role of inter-institutional collaboration in shaping access to health information. This study addresses that gap by applying the Net-Map method and SNA to PNP, capturing both structural and relational dimensions of health literacy promotion. This research contributes to the growing call for system-based approaches in tackling health inequities in ecologically and socially marginalized contexts by identifying how power, influence, and collaboration are distributed across stakeholders.

3.0 Methodology

3.1 Research Design

This study employed a qualitative case study approach to explore complex phenomena within their real-life context, specifically, the stakeholder dynamics and barriers surrounding health literacy in protected communities. The approach was selected to provide an in-depth understanding of stakeholder roles, interactions, and perceptions that shape health literacy efforts in PNP, a socio-ecologically sensitive site in Malaysia.

To capture both relational and thematic data, two complementary methods were used: (1) the Net-Map methodology, a participatory tool that combines stakeholder mapping, social network analysis (SNA), and influence visualization, and (2) thematic analysis of focus group discussions (FGDs) and in-depth interviews with identified stakeholders.

This dual-method design allowed for identifying key actors, mapping communication flows, and deeper insight into the perceived barriers and strategies for enhancing health literacy.

3.2 Participant Selection and Sampling Strategy

A purposive and snowball sampling strategy was employed, beginning with stakeholder nominations from local community members who identified individuals perceived as influential in health-related matters. These initially nominated stakeholders were then invited to recommend further other relevant actors involved in health promotion, policymaking, or service delivery within the PNP region, including those from local health

offices, community leadership, conservation agencies, and NGOs. Sixteen stakeholders were ultimately identified and recruited, representing a diverse mix of institutions:

- Government agencies (e.g., District Health Office, District Education Office, The Department of Orang Asli Development (JAKOA)
- Community leaders (Tok Batin, Penghulu, village heads)
- Service providers (health clinics, schools)
- Civil society organizations and NGOs
- Policy influencers (e.g., state legislative representatives)

Inclusion criteria included active engagement in health-related activities or governance in the PNP area, availability for in-depth participation, and consent to data collection and mapping exercises.

3.3 Data Collection Methods

Data was collected between January 2025 and February 2025 using Focus Group Discussions (FGDs) and semi-structured in-depth interviews.

3.3.1 Focus Group Discussions (FGDs)

Three FGDs were conducted with groups of 4–6 participants to stimulate interaction and allow stakeholders to build upon each other's insights. These sessions involved guided questions on:

- Stakeholder identification and roles
- Existing health literacy initiatives and gaps
- Challenges in community engagement
- Recommendations for improvement

Participants collectively engaged in the Net-Map exercise, where they:

1. Identified actors involved in health literacy
2. Mapped relational ties (information, resource flow, collaboration)
3. Assigned influence levels using "influence towers."
4. Discussed strengths, weaknesses, and missing connections in the network

Each Net-Map was photographed and digitally transcribed for subsequent SNA using UCINET software.

3.3.2 In-depth Interviews

Ten interviews were conducted to gather nuanced individual perspectives that may not surface in group settings. These interviews focused on:

- Perceived health literacy barriers in the community
- Institutional limitations in outreach
- Local socio-cultural and policy challenges

Interviews and FGDs were conducted in Bahasa Malaysia, audio-recorded with consent, and later transcribed and translated for analysis.

3.4 Data Analysis

A two-tiered analysis strategy was used to explore stakeholder structures and thematic patterns.

3.4.1 Social Network Analysis (SNA)

SNA was applied to assess the structure of the health literacy stakeholder network using the following metrics:

- Density: The proportion of actual ties to possible ties, indicating overall network cohesiveness.
- Degree Centrality: Number of direct connections a stakeholder has (in-degree and out-degree), reflecting their communication role.
- Betweenness Centrality: A measure of brokerage power on how often a stakeholder serves as a bridge between others.
- Closeness Centrality: The extent to which an actor can efficiently reach others in the network.

These measures provided insight into the integration, influence, and potential bottlenecks within the stakeholder ecosystem. SNA was conducted using UCINET and visualized through NetDraw.

3.4.2 Thematic Analysis

Transcripts from interviews and FGDs were analyzed using Byrne's (2022) six-phase framework:

1. Familiarization with data
2. Generating initial codes
3. Searching for themes
4. Reviewing themes
5. Defining and naming themes
6. Producing the report

The themes were developed inductively and later grouped under four main barrier categories: education, infrastructure, finance, and policy. Sub-themes such as language barriers, poverty status, and regulatory constraints were also identified.

The study employed analyst triangulation, audit trails, and member checking with selected participants to enhance trustworthiness.

4.0 Findings

This section presents the key findings from the Social Network Analysis (SNA) and thematic analysis of stakeholder perspectives on health literacy in the PNP. The findings are grouped into two main subsections: (1) stakeholder network structure, and (2) perceived barriers to health literacy and suggested strategies.

4.1 Stakeholder Network Structure in Health Literacy

The Social Network Analysis (SNA) revealed a moderately cohesive network of 16 stakeholders involved in health literacy initiatives in PNP. The network included government agencies (e.g., District Health Office, JAKOA), local community leaders (e.g., Tok Batin, Penghulu), schools, NGOs, and other institutional actors such as the District Education Office and Department of Wildlife and National Parks (PERHILITAN).

4.1.1 Network Density and Connectivity

Table 1 reveals the summary of the SNA data. Network density was calculated at 0.47, representing that 47% of all possible ties between the 16 nodes were present. While this is an acceptable rate of interaction and communication, it also shows that more than half of the possible relationships are absent. This moderate cohesiveness reflects that while some cooperation occurs, there is room for increased integration-particularly with the peripheral players.

The network had an average degree of 6.625, which meant that, on average, each stakeholder was directly connected to approximately 6–7 others. This is quite a high level of interaction, though not optimal for frequent information exchange.

Table 1. Summary of SNA data

Network Indices	Value
Density	0.47
Number of nodes	16
Number of ties	106
Standard deviation	0.5
Average degree	6.625

4.1.2 Central and Peripheral Actors

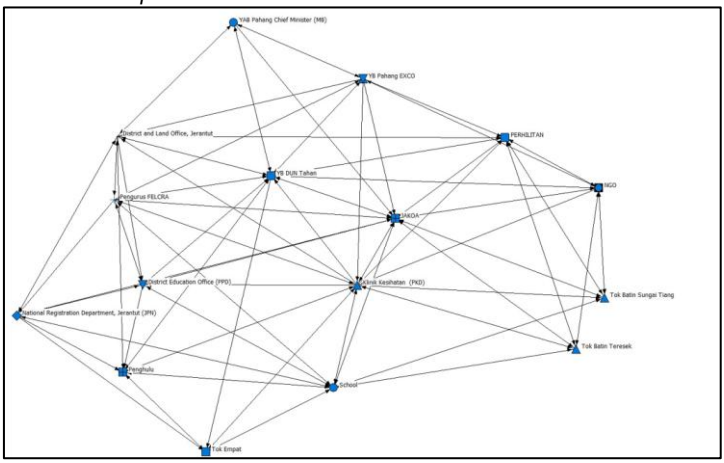

Fig.1 Social Network of Stakeholders of Health Literacy in TNP.

Fig. 1 reveals a dense web of connections among a set of nodes labeled within TNP. There are 16 nodes, each representing distinct entities such as offices, positions, or organizations, that are intricately linked, as evidenced by the numerous edges that denote the relationships between the stakeholders.

Table 2 shows the result of the individual network of each stakeholder in the SNA.

Stakeholder	Out-Degree	In-degree	Closeness	Betweenness
YB DUN Tahan	9	10	20	27.85
JAKOA	9	12	18	24.50
Klinik Kesihatan (PKD)	11	9	21	23.25
School	9	9	21	16.75
Penghulu	5	7	23	5.38
Tok Empat	3	5	25	0.67
Tok Batin Sungai Tiang	5	5	25	1.84
Tok Batin Teresek	5	5	25	1.84
NGO	7	5	26	5.76
PERHILITAN	5	8	22	5.88
Pengurus FELCRA	8	6	24	7.53
District and Land Office, Jerantut	7	7	23	10.63
YAB Pahang Chief Minister (MB)	4	3	31	0.61
National Registration Department, Jerantut (JPN)	6	5	25	2.80
District Education Office (PPD)	6	6	24	2.33
YB Pahang EXCO	7	4	28	3.39

The findings show that the main leading central actors included:

- Klinik Kesihatan (District Health Office) – Highest out-degree (11), indicating proactive outreach.
- JAKOA – Highest in-degree (12), reflecting high receptiveness or trust by others.
- YB DUN Tahan – Highest betweenness centrality (27.85), functioning as a crucial bridge in the network.
- Schools – High closeness and balanced degree of centrality, suggesting strong potential as connectors to the youth community.

Peripheral stakeholders such as the Chief Minister's Office (MB) and Malaysia National Registration Department (JPN) had low degrees and minimal betweenness, highlighting weak integration into the health information network.

4.1.3 Implications of Network Structure

The network structure relies on a few key actors for disseminating health-related information and coordinating outreach. This can lead to vulnerabilities like communication bottlenecks or uneven regional access. Although not currently maximized, schools show

potential as strategic intermediaries due to their proximity to the community and educational infrastructure**.**

4.2 Perceived Barriers and Strategies for Health Literacy

Thematic analysis of FGDs and interviews identified four overarching barriers affecting health literacy in PNP communities: educational limitations, infrastructural deficits, economic constraints, and restrictive policy environments.

4.2.1 Educational Barriers

Many residents demonstrated low levels of health awareness and a limited understanding of preventive healthcare. Communication challenges, including low literacy and language mismatches, were prominent among Indigenous groups. Cultural norms and fear of medical institutions also deter proactive health-seeking behaviors.

"Some villagers are afraid to visit clinics, especially the elderly. I have to use their dialect and even draw pictures to explain how to take medicine," – *Stakeholder 1, community health worker*.

Proposed Strategies:

- Health education seminars and screening campaigns
- Visual and multilingual outreach materials
- First-aid and CPR training to build local health capacity

4.2.2 Infrastructure Barriers

Stakeholders described challenges in both physical and digital infrastructure. Many villages lacked road access, public transportation, reliable internet, or healthcare facilities. Clean water supply remained a concern in several areas.

"In Hulu Tembeling, the internet is poor, and the roads are bad. Some areas still rely on hill water," – *Stakeholder 5, NGO representative*.

Proposed Strategies:

- Infrastructure upgrades (roads, water, internet)
- Mobile health clinics or telehealth hubs
- Recruitment and training of more local health staff

4.2.3 Financial Constraints

Poverty was a persistent issue, limiting access to healthcare services and reducing the community's ability to prioritize health over daily survival needs. Many respondents reported unstable employment and low household incomes.

"It is hard for most of us to earn RM500 monthly. Health is a secondary concern when food is the priority," – Stakeholder 7- local leader.

Proposed Strategies:

- Vocational and small enterprise development for youth
- Government subsidies or health insurance coverage
- Health services bundled with economic incentives

4.2.4 Policy Limitations in Protected Areas

Strict conservation policies limit permanent settlements, infrastructure expansion, and access to utilities in PNP. While critical for environmental sustainability, these policies often come at the expense of community health and development.

"Only solar power and hill water are allowed. Permanent facilities are restricted," – *Stakeholder 8, park officer*.

Proposed Strategies:

- Eco-friendly policy revisions allowing green infrastructure
- Multi-stakeholder forums balancing conservation and public health
- Inclusion of Indigenous voices in policy dialogues

5.0 Discussion

This study explored how stakeholder dynamics and structural barriers shape health literacy in the protected area of PNP, Malaysia. Using the Net-Map methodology and Social Network Analysis (SNA) alongside thematic analysis revealed critical gaps and opportunities in the multi-sectoral response to health inequities. The findings confirm that health literacy in such ecologically constrained communities is deeply influenced by broader social determinants of health (SDH), network fragmentation, and policy design.

5.1 Stakeholder Dynamics and Network Implications

The SNA results demonstrate a moderately connected stakeholder network, with a density of 0.47. This suggests that while some collaboration exists among health actors in PNP, a significant portion of the network remains underutilized. High betweenness centrality scores for political representatives and government clinics indicate dependency on a small subset of actors to mediate information and resource flow. This reliance raises concerns about system resilience, especially in crises or policy shifts (Borgatti et al., 2024).

Interestingly, schools emerged as structurally well-positioned actors with balanced centrality scores, yet they remain underleveraged in practice. As Komolafe et al. (2020) and Tomokawa et al. (2020) highlight, schools can function as trusted, stable nodes for disseminating health messages, especially among youth and families. Empowering teachers and integrating health literacy into the school curriculum could, therefore, serve as a high-impact, low-cost intervention.

Peripheral actors, including state-level policymakers and civil registry departments, exhibited weak ties to the health information ecosystem. This disconnection reflects vertical gaps in governance and a lack of integration between policy design and ground-level

implementation. Without mechanisms for shared accountability and regular dialogue, such disconnects hinder the development of community-tailored health initiatives.

5.2 Barriers as Expressions of Structural Inequity

The thematic findings reinforce that health literacy challenges in PNP are not merely due to individual knowledge gaps but are rooted in persistent structural inequalities. The four thematic barriers, i.e., education, infrastructure, finance, and policy, were found to strongly correspond with international evidence in rural and Indigenous health (Nutbeam & Lloyd, 2021; Smylie et al., 2021). Compounding by linguistic diversity and cultural norms, educational gaps have limited the reach of conventional health promotion strategies. Education programs that use visual, oral, and local dialects could enhance people's understanding of health information and trust. Moreover, mobile clinics, health volunteers, and village-based training are immediate and practical ways to bring health services to the community. The infrastructural deficits faced by PNP, particularly in transport, digital access, and healthcare facilities, are also seen in other protected and underserved areas globally (Pailaha, 2023). Mobile health technologies and renewable energy-powered facilities have shown success in similar contexts (Kosowicz et al., 2023) and may offer feasible alternatives for PNP.

Financial hardship among PNP residents also directly affects health-seeking behavior. In settings where income is unstable or informal, preventive care is often seen as a luxury. Integrating economic development initiatives with health promotion, such as vocational training for youth or microgrants, is tied to health participation. These could enhance both economic and health resilience.

Policy constraints specific to protected areas present the most complex barrier. While conservation goals are critical, overly rigid restrictions on infrastructure and settlement disrupt community development. As Rahim et al. (2022) noted, sustainable development models must balance ecological preservation and social inclusion. Policies encouraging eco-friendly infrastructure, community-managed clinics, and participatory planning can help reconcile these dual imperatives.

5.3 The Value of Systems Thinking and Participatory Tools

This study illustrates the utility of combining Net-Map with SNA and thematic analysis to inform systems-based public health strategies. Rather than treating stakeholders as static entities, this approach surfaces dynamic relationships, influence flows, and opportunities for synergy or reform. The participatory aspect of Net-Map also empowers local actors to define their realities and co-develop solutions. This is an important shift from top-down planning to community-led resilience building.

As health literacy becomes increasingly recognized as a national development priority, especially in line with Malaysia's SDG commitments and public health blueprints, stakeholder alignment is essential. A systems lens helps to identify leverage points for reform, reduce redundancy, and ensure that health literacy programs are contextually grounded, socially inclusive, and ecologically sustainable.

6.0 Conclusion and Policy Recommendations

This study examined the structural and relational barriers to health literacy in the protected area of PNP, Malaysia, using an integrated methodological approach comprising Net-Map, Social Network Analysis (SNA), and thematic analysis. Findings revealed that low health literacy among marginalized communities in PNP is not simply a product of individual knowledge gaps but the result of systemic inequities linked to education, infrastructure, poverty, and conservation policy constraints.

The SNA results indicated moderate network cohesion, with key government and community actors playing central roles in information dissemination. However, the presence of peripheral and underutilized stakeholders, such as schools and civil institutions, suggests that coordination and integration remain limited. Thematic insights further highlighted the compounding effect of economic hardship, infrastructural isolation, language barriers, and restrictive environmental policies on community health behaviors. This study offers a novel, systems-based perspective on health literacy promotion in ecologically sensitive and underserved regions by mapping stakeholder relationships and analyzing their perceived barriers and strategies. It underscores the necessity for cross-sectoral collaboration, participatory planning, and policy reform to respect conservation priorities and community development needs.

Several key policies and practice recommendations to enhance health literacy include integrating health into the school curriculum. School is the best hub for integrating relevant topics such as hygiene, nutrition, first aid, and digital health. Improving physical and digital infrastructure is also crucial. It can be done by upgrading eco-friendly infrastructure, expanding mobile clinics, setting up solar-powered telehealth stations, and ensuring mobile internet access for digital health efforts.

Article Contribution to Related Field of Study

This study contributes to the public health and environmental policy literature by operationalizing a stakeholder-centric, network-based approach to understanding and improving health literacy. It demonstrates how social network tools can generate actionable insights in complex, underserved settings when paired with community-based participatory methods. The findings are particularly relevant for health planners, educators, and conservation authorities seeking integrated solutions prioritizing ecological sustainability and human well-being.

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