

DEVELOPING A THEORETICAL FRAMEWORK FOR ASSESSING USER EXPERIENCE ON HIKING TRAILS IN SRI LANKA

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Abstract: This paper presents the process of developing a theoretical framework to assess user experience on nature-based hiking trails, with a focus on Sri Lanka's third peneplain landscapes. The study adopts a literature review approach to structure and refining parameters that influence hiking experiences, considering both physical and visual dimensions of the landscape. Research on nature trails and user experience was systematically reviewed and synthesized to identify assessment variables related to the physical satisfaction and visual satisfaction of hikers through a manual review of the literature. Models such as the Trail Problem Assessment Method (TPAM), Nature-Based Recreation Experience Model, Kaplan and Kaplan's Environmental Preference Theory, and Maslow's hierarchy of needs informed the selection of parameters. The framework integrates physical conditions (e.g., mud, erosion, unofficial trails, litter) with visual and experiential qualities (e.g., scenic values, nature-oriented details, ephemeral qualities, presence of other people). The resulting framework provides a structured basis for evaluating hiking trails and addressing research gaps in tropical contexts like Sri Lanka, where empirical studies on trail-based user experience remain limited. The article highlights how the literature review process led to the development of a theoretically grounded and contextually adaptable assessment model.

Keywords: *User satisfaction, Nature trails, Theoretical framework, Visual parameters, Physical parameters*

1. Introduction

Mountain tourism is a growing global phenomenon, offering opportunities for recreation, ecological conservation, and economic development. Hiking has become one of the most demanded activities worldwide due to its diverse recreational, ecological, and cultural values (Pathirana, 2024). Activities range from casual family walks to extreme mountain treks, and these journeys provide benefits such as physical health, psychological restoration, and enhanced cultural awareness. In many countries, hiking has evolved from a leisure pursuit to a structured form of nature-based tourism, generating employment opportunities, conserving ecosystems, and promoting sustainable development.

Globally, countries with mountainous regions such as Switzerland, Nepal, and Canada have long leveraged hiking as a tool for economic growth, environmental stewardship, and cultural promotion. In South Asia, including Sri Lanka, hiking-based tourism is increasingly positioned as a driver of regional economic recovery and diversification (Saintz et al., 2023). Sri Lanka, recognized as a biodiversity hotspot, possesses unique geographic characteristics such as peneplains, mountain ranges, and tropical ecosystems. These landscapes not only provide ecological functions but also determine the types of recreational opportunities available to users. Central to this is the concept of peneplain. Sri Lanka's three peneplains have been studied for their geomorphological significance (Rangwala & Miller, 2012), but their recreational implications remain underexplored. The third peneplain, with its rugged terrain, biodiversity, and accessibility, demonstrates significantly higher visitation compared to the first and second peneplains.

This variation raises the research problem: why are trails in the identified peneplain more popular than those in other peneplains, and how do physical and visual parameters influence hiker perception and satisfaction?

Despite the global rise of hiking tourism, Sri Lanka lacks established models to assess user experiences on nature trails. While international studies have explored trail conditions, visual qualities, and user experience dimensions, tropical contexts remain underrepresented. Much of the existing literature originates from temperate regions, where seasonal changes, cultural dynamics, and landscape structures differ greatly from tropical realities. Directly applying these models to Sri Lanka risks overlooking unique experiential qualities such as monsoon-driven ephemeral changes, dense forest enclosures, or cultural traditions tied to mountains. Developing a Sri Lankan framework for trail assessment can reveal overlooked factors influencing hiker satisfaction, identify new tourism potentials, and inform landscape design and management. The need is not only academic but also practical: without structured evaluation tools, the tourism sector may fail to capture emerging opportunities while compromising ecological integrity. Trail degradation, unmanaged visitor impacts, and poor design could reduce satisfaction and harm Sri Lanka's reputation as a nature tourism destination.

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The primary aim is to develop a theoretical framework for assessing user experiences on Sri Lankan hiking trails. The objectives are as follows:

- To review global and regional literature on trail conditions, visual experiences, and user perceptions.
- To identify physical and visual parameters influencing hiking experiences.
- To structure these parameters into a theoretical framework adaptable for assessing user experiences in tropical landscapes.

2. Literature Review

2.1. PHYSICAL EXPERIENCE

Nature trails form the backbone of hiking experiences, serving as pathways that connect people with protected areas, biodiversity, and cultural landscapes. They simultaneously act as recreational resources and ecological buffers, balancing human use with ecosystem protection (Maria Raya et al., 2018; Davies, 2018). Effective trail design is therefore crucial, influencing both ecological sustainability and user satisfaction.

Physical conditions strongly affect hiking experiences. Mud, erosion, exposed roots, and storm damage can reduce accessibility and safety, leading to dissatisfaction (Antoušková et al., 2014; Lee et al., 2019). Conversely, well-maintained trails encourage positive experiences. The Trail Problem Assessment Method (TPAM) has been widely applied to monitor and measure such conditions (Moore et al., 2012). By focusing on parameters observable by users, TPAM demonstrates how physical settings shape perception without requiring advanced technical tools. Trail conditions are not static but evolve under the influence of natural processes and human use. For example, poor drainage leads to standing water, which not only erodes soil but also creates discomfort for hikers. Similarly, unofficial trails (parallel or diverging) emerge as users seek shortcuts, disrupting ecosystems while altering navigation experiences. These physical attributes directly tie into landscape perception, affecting how trails are valued. Human influences add another dimension. Studies in Europe and North America show that designed interventions such as boardwalks, benches, and signage can enhance accessibility and safety (Gundersen & Vistad, 2016). Yet they may also detract from natural immersion, highlighting the delicate balance between management and authenticity. Trails near urban contexts are further complicated experiences, as users may be distracted by noise or visual intrusions (Milman & Zehrer, 2018). Precedence studies illustrate these dynamics. The GR20 in Corsica is renowned for its challenging conditions, drawing adventure-oriented hikers who seek resilience and accomplishment. By contrast, El Yunque in Puerto Rico emphasizes accessibility, attracting large numbers of visitors by offering dramatic rainforest experiences with relatively easier conditions. Together, these cases highlight how physical trail conditions mediate demand and satisfaction.

2.2. VISUAL EXPERIENCE

Visual experience is often the most memorable aspect of hiking, guiding route selection and shaping lasting impressions. Research consistently identifies scenic values, vistas, panoramas, and diverse terrains as critical determinants of satisfaction (Hull & Stewart, 1995; Dorwart et al., 2009). Hikers seek both climax views, such as mountain peaks, and smaller visual stimuli, such as streams or moss-covered rocks, which punctuate their journey with variety. Landscape features enrich visual experience. Vegetation diversity, water elements, and topographic variations provide cues that sustain attention and curiosity (Chhetri & Arrowsmith, 2002; Zhang et al., 2019). Studies show that even minor details, such as mushrooms, wildflowers, or tree canopies, can elevate satisfaction by creating connections between hikers and the living environment. These small-scale observations underscore the importance of considering micro-level landscape details in trail design.

Ephemeral qualities add dynamism to hiking. Weather conditions, shifting light, and seasonal variations can radically transform landscapes (Brassley, 1998). In Sri Lanka, monsoon rains, mist, and sudden shifts in sunlight are common, producing sensory-rich experiences. Such changes often enhance a sense of mystery and unpredictability, making each hike unique. Yet, few frameworks capture these temporal elements, leaving a gap in existing models. The presence of others is another dimension. For some, encountering fellow hikers fosters community, safety, and shared enjoyment; for others, it diminishes solitude and immersion (Dorwart et al., 2009). These social interactions form part of visual experience because they alter how hikers perceive and respond to landscapes. Kaplan & Kaplan's Environmental Preference Theory (1989) provides a cognitive framework to interpret visual experiences. Its four qualities—coherence, legibility, complexity, and mystery—explain how landscapes guide orientation, curiosity, and emotional responses. For instance, a trail with clear coherence fosters comfort, while one high in complexity sustains interest. Mystery, created by hidden curves or dense vegetation, invites exploration. Applying this theory to hiking trails enables structured evaluation of visual parameters.

2.3. USER EXPERIENCE

User experience goes beyond physical and visual factors, encompassing psychological and emotional responses. Maslow's hierarchy of needs (1943) situates hiking as satisfying a spectrum of human motivations, from basic safety to self-actualization. For many, hiking delivers restoration, challenge, and fulfillment, addressing higher-order needs like self-esteem and belonging (Pomfret, 2006).

Experiences are also shaped by personal attributes. Studies show differences in perception by gender, age, education, and hiking experience (Antoušková et al., 2014; Chhetri & Arrowsmith, 2002). Novice hikers may prefer trails with safety and accessibility, while experienced hikers value challenge and complexity. These variations emphasize the need for flexible frameworks that accommodate diverse user groups. Place attachment theory (Scannell & Gifford, 2010) emphasizes the emotional bonds between users and landscapes, explaining why some trails foster loyalty and stewardship. Strong attachments encourage repeat visits, conservation behavior, and cultural narratives tied to landscapes. User experience can be assessed using innovative methods. The Experience Sampling Method (Hull & Stewart, 1995) captures real-time emotions; Visitor Employed Photography (Dorwart et al., 2009) documents meaningful visual encounters; and cognitive mapping exercises highlight spatial memory and perception. These approaches underscore the importance of integrating subjective responses into assessment models.

2.4. HIKING AS OUTDOOR RECREATION

Hiking is considered a low-level adventure activity but provides profound benefits. It connects users with nature, enhances physical health, and contributes to cultural identity (Molokáč et al., 2022). Nature trails are not merely pathways but cultural and ecological assets, shaping how societies interact with their landscapes ("Environmental Perception and Learning Experience in Nature Trail of National Park Visitors," 2021).

In Sri Lanka, hiking is growing rapidly due to its biodiversity and geographic uniqueness (Pathirana, 2024). The third peneplain is particularly popular, including iconic destinations such as the Knuckles Range, Horton Plains, and Adam's Peak. Visitor statistics show significantly higher use of these landscapes compared to the first and second peneplains, confirming the importance of landscape features in shaping demand (Forest Department, 2024). Despite this potential, systematic assessment of trail experiences remains absent. Without frameworks, trail development risks focusing solely on accessibility or promotion, neglecting the nuanced experiential qualities that sustain long-term tourism appeal. This creates both an academic and practical gap that this research seeks to address.

2.5. RESEARCH GAP

Most existing frameworks originate from North America, Europe, and Australia. Few studies address tropical landscapes, where climatic variability, biodiversity, and cultural practices produce unique hiking experiences. This gap highlights the need for frameworks tailored to Sri Lanka, capable of integrating physical, visual, and psychological dimensions. By addressing this gap, the research contributes both to global scholarship and local practice, offering tools for tourism development, conservation, and landscape design.

3. Research Methodology

Based on the research problem, first phase of this study involved a manual literature review aim to identify parameters that influence nature trail experiences among hikers. Literature based assessment framework developed through the study to categorization of the parameters. Categorization of the two main parameters mentioned below,

- Physical experience
- Visual experience

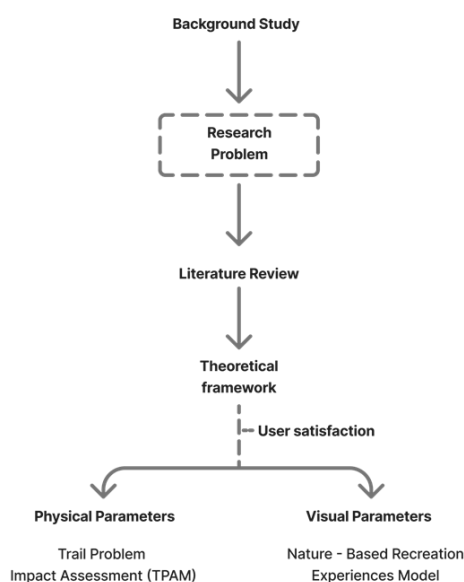


Figure 1: Research method starts with research problem to identify and develop a theoretical framework

Nature trail assessment models and research papers assessed to identify what parameters are most and least assessed. Previous research papers are reviewed under different environmental zones (Asia, Europe, tropical) with extremely different contexts. Parameters and assessment models used in previous research were identified through the literature review to identify sub parameters. Seasonal changes and differences, governing issues and nature trail management aspects, domestic landscape diversity of trail environments, lacked assessment parameters in both Sri Lankan and abroad trail environments, covering overall trail satisfactory parameters; methods used to filter sub parameters and categorization of framework. Detailed sub-parameters were integrated into an assessment framework model including domestic specific contextual trail characters which is introducing to the Sri Lankan context, which has been lacking in prior research after reviewing of global assessment models.

4. Building the theoretical framework

4.1. FRAMEWORK DEVELOPMENT

The framework integrates insights from multiple models and theories. TPAM informed the selection of physical parameters, while the Nature-Based Recreation Experience Model (Dorwart et al., 2009) contributed to the visual and social dimensions. Kaplan and Kaplan's theory (1989) structured cognitive aspects of visual experience, and Maslow's hierarchy of needs (1943) contextualized user motivations and satisfaction. Together, these perspectives provide a robust theoretical base for integrating diverse parameters. By synthesizing these models, the framework captures both objective and subjective elements of hiking. It recognizes that trail conditions affect satisfaction not only directly (e.g., erosion causing discomfort) but also indirectly (e.g., erosion adding mystery). Likewise, visual qualities may offset physical challenges, and personal attributes mediate all experiences. This multi-layered approach ensures comprehensive coverage of experiential dimensions.

4.2 REFINED FRAMEWORK

The integrated parameters result in a multi-layered framework connecting physical conditions, visual qualities, and user experience. This structure ensures a comprehensive evaluation of hiking trails, reflecting both objective environmental characteristics and subjective user perceptions. For example, physical parameters such as storm damage influence safety and perception, while visual parameters like scenic views elevate satisfaction despite challenges. User attributes mediate these experiences, creating diverse outcomes among hikers. Therefore, the framework is adaptable and inclusive, suitable for assessing and revealing new potential nature trails in Sri Lanka's landscapes. This theoretical framework is specifically tailored for the Sri Lankan context, which differs from Western contexts characterized by more facilitated nature trail systems, four major seasonal changes, and different hiker attitudes and anthropology.

Table 1: Framework with assessment parameters

Variables	Physical experience	Visual experience	User experience
Previous models used	-Trail Problem Assessment Method (TPAM)	-Nature-based recreation experiences model	-
Parameters	-Mud on trail -Standing water on trail -Trail erosion -Exposed tree roots on trail -Excessive trail Width -Unofficial trails (parallel) -Unofficial trails (diverging) -Running water on trail -Litter on or beside trail -Vandalism on or beside trail -Dog waste on or beside trail -Bike impacts -Damaged trees -Storm damage	-Scenic values -Nature – oriented details -Ephemeral qualities -Presence of other people	-User satisfaction according to landscape experience and personal attributes
Theoretical base	-Landscape preference – Conceptual framework -Kaplan & Kaplan's preference matrix (1989)	-Grounded theory	-Maslow's hierarchy of needs

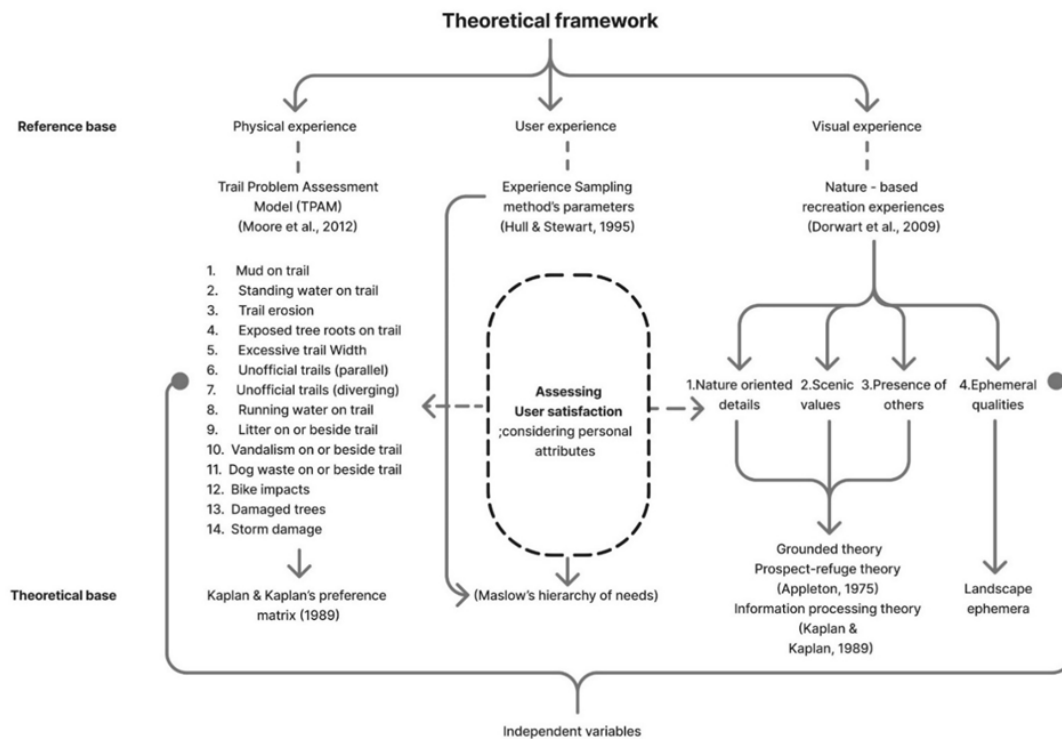


Figure 2: Dependency of the parameters

4.3. REFINED FRAMEWORK WITH INTEGRATION OF SUB-PARAMETERS OF THE PARAMETERS

The framework integrates insights from multiple models and theories. TPAM informed the selection of physical parameters by identifying and measuring observable trail problems. Meanwhile, the Nature-Based Recreation Experience Model (Dorwart et al., 2009) contributed to understanding visual and social dimensions of hiking experiences. Kaplan and Kaplan's Environmental Preference Theory (1989) structured the cognitive aspects of visual experience, focusing on qualities such as coherence, legibility, complexity, and mystery. Maslow's hierarchy of needs (1943) provided context for user motivations and satisfactions, linking hiking experiences to broader psychological needs. Together, these perspectives offer a robust theoretical foundation for integrating diverse parameters in the assessment of nature trail experiences.

4.3.1 Physical Experience

Table 2: Selected physical parameters and sub parameters for the assessment

Physical parameter	Sub parameters
1. Mud on trail	a. No mud at all b. Mud on trail, but appeared only visually c. Mud on trail, sensed by the legs d. Mud on trail, took intervention to cross it e. Completely mud on trail, can't cross
2. Standing water on trail	a. No standing water appeared at all b. Standing water, sensed by the legs c. Standing water on trail, took intervention to cross it d. Standing water on the trail, can't cross
3. Eroded trail conditions	a. No trail erosion appeared at all b. Trail erosion can appear beside the trail, not disturbing the journey c. Trail erosion disturbed journey
4. Exposed tree roots	a. No exposed roots appeared at all b. Exposed roots appeared visually only c. Had to jump by largely exposed roots to cross d. Exposed roots completely blocked the journey
5. Excessive trail width	a. No excessive trail width appeared at all b. Trail width varied throughout the journey
6. Desired (unplanned path created by repeated pedestrian or animal traffic) trails (diverging/separating)	a. Desired trails did not appear at all b. Desired trails make the way wrong c. Desired trails guided correct way d. Desired pathways guided to new viewpoints

7. Desired (unplanned path created by repeated pedestrian or animal traffic) trails - (parallel)	a. Parallel trails did not appear at all
	b. Desired trails made the way confused
	c. Desired trails diverted hiking into it
	d. Desired pathways guided to new viewpoints
8. Running water on the trail	a. Running water did not appear at all
	b. Running water visually appeared on the side of the trail
	c. Running water sensed by the legs
	d. Running water completely blocked the journey
9. Litter on or beside the trail	a. No litter presence at all
	b. Litter appeared, but not highly focused
	c. Litter completely disturbed the way
10. Vandalism (action involving destruction of or damage to public or private property) on or beside the trail	a. No vandalism found along the trail
	b. Vandalism/way-findings showed the way correctly
	c. Vandalism had focused more than environment
11. Animal waste on or beside the trail	a. No animal waste appeared at all
	b. Animal waste appeared on trail, but not disturbed
	c. Animal waste appeared and disturbed the journey
	d. Animal waste increases the sense of nature
12. Bike impacts on the trail	a. Bike impacts did not appear at all
	b. Bike impacts damaged trail condition
13. Damaged trees on the trail	a. No damaged trees appeared at all
	b. Damaged trees act as a landmark
	c. Damaged trees blocked the way
14. Storm (physical harm or destruction caused to the environment) damage on the trail	a. No storm damage appeared at all
	b. Storm water sensed by the legs
	c. Storm water caused mud on the trail
	d. Storm water barriered the way

4.3.2 Visual Experience

Table 3: Selected visual parameters and sub parameters for the assessment

1. Nature oriented details	2. Scenic values	3. Presence of other people	4. Ephemeral changes/changes of landscape
a. Ferns	a. Sudden openings	a. Hikers (climb down)	a. Sunrise
b. Moss covered roots	b. Overlooking points	b. Hikers (climbing up)	b. Sunset
c. Mold on rock	c. Distance views	c. Group of hikers	c. Changes of clouds
d. Flowers & insects	d. Long view of the trail	d. Solo hikers	d. Changes of sounds
e. Leaf types	e. Mountain views	e. Friend groups	e. Sudden rain
f. Caves	f. Vistas	f. Family groups	f. Sudden sunny
g. Mushrooms	g. Canopy of trees	g. Couples	g. Sudden wind
h. Uprooted vegetation	h. Views from shade	h. Friendly hikers	h. Sudden mist
i. Rocks	i. Views through sunlight	i. Un-friendly hikers	i. Lush green and drought weather
j. Grass types	j. Views through covered area	j. Hikers shared information	j. Seasonal changes
k. Snake holes	k. Sky views	k. Camping hikers	k. Foliage
l. Different trees	l. 360 views	l. One day hikers	
m. Types of branches	m. 180 views	m. Hikers needed help	
	n. 120 Views	n. Hikers helped	
	o. 90 Views	o. Good behaviours	
		p. Bad behaviours	

5. Discussion

Major parameters under physical and visual (refer table 2 and table 3) are detailed under contextual characteristics of nature trails in Sri Lanka/ tropical contexts. Study concluded theoretical framework with mostly assessed parameters in global scenario, sub parameters which are contextual with tropical trail characteristics, user satisfaction or user experience that can be covered both physically and visually which mostly covers overall experience of the user, and mostly every possible way that can be each parameter can occurred in a nature trail (ex; mud on trail can be occurred with different aspects; refer table 2) . Mentioned (refer table 2 and table 3) sub parameters are not isolated but mutually reinforcing. For example, erosion may reduce accessibility but simultaneously create a sense of mystery, appealing to adventurous users. Similarly, ephemeral

changes such as mist may obscure views but enhance atmospheric qualities. Thus, the framework balances both negative and positive aspects of parameters, reflecting the complexity of hiking experiences. But these parameters are acting independently to keep the model simple, not complex.

By situating the framework within Sri Lanka's tropical landscapes, it captures experiential elements absent from Western models. It provides a holistic basis for empirical application, guiding both research and practice. Trail managers can use the framework to monitor trail conditions, identify strengths, improve user satisfaction, and explore potential nature trails.

6. Conclusion

This paper demonstrates how selected research papers helped selection of parameters, how contextual characteristics of landscape matter in user experience, and what types of general parameters can cover overall user satisfaction on nature trails, the hierarchy of each parameter that can be affected to the specific user categories in specific landscapes. Research problem driven questions enhanced need for the development of a theoretical framework for assessing user experiences on hiking trails. By integrating physical, visual, and user-centered parameters, the framework addresses a critical research gap in tropical landscapes such as Sri Lanka. While existing models primarily originate in Western, European, specific landscapes with elevations, landforms, land characteristics, trail management conditions, weather conditions. Adapted framework captures the unique characteristics of Sri Lankan hiking environments.

The contribution of this framework is twofold: theoretically, it synthesizes diverse models into a **coherent structure adaptable to tropical contexts**; practically, it provides a basis for **evaluating trails** and **guiding tourism development**. Physical and visual parameters act as independent parameters which reduces the complexity of this model. Management aspects did not discuss because, most commonly nature trails are not managed by government or private parties in Sri Lanka. Future research can apply this framework empirically to case studies, refine parameters through user feedback, and extend its application to other tropical landscapes. As identifies, **nature trails and outdoor recreation tourism have demand in the future**. Considering the foot traffic nature trails have huge potential when identifying, assessing, and **re-shaping for the field of tourism, economy, and landscape architecture**. Preference models can contribute **identifying new potential, uplift nature trail experience to both nature and user**. As a basic study, this framework also has **implications for landscape architecture** and policy. By aligning trail design with user perceptions, it ensures both satisfaction and sustainability. Ultimately, the framework strengthens the role of Sri Lanka's landscapes in supporting recreation, identity, and sustainable economic growth.

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